A SUPPLY CHAIN COORDINATION FRAMEWORK FOR MALARIA TREATMENT THERAPIES IN GENERAL HOSPITALS IN UGANDA

by

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A supply chain coordination framework for malaria treatment therapies in general hospitals in Uganda

I declare that this dissertation (title above) is my work and that all the sources that I have used or quoted have been indicated and acknowledged using complete references.

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OLUKA PROSS NAGITTA **DATE**

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This dissertation is dedicated to my family more especially my husband, Nicholas Oluka, my children; Andrew, Priscilla and Claire and my niece Martha.

ABSTRACT

Building supply chain coordination frameworks is a popular practice in the private sector in many developed countries. Despite this fact, in developing countries such as Uganda, the public health sector has hardly adopted this practice. Although the existing frameworks offer a good platform for measuring and improving the understanding of concepts underlying coordination dimensions at the micro-environment, they have limited capacity to analyse coordination interactions within the health sector, especially in developing countries like Uganda.

Using the business management environment framework, this study explored the critical supply chain coordination dimensions, logistics activities dimensions and the management environment (market and macro) dimensions affecting the availability of Artemisinin-based Combination Therapies for malaria (ACTs). The overall main research goal of this thesis was to develop a supply chain coordination framework for malaria treatment therapies (ACTs) in general hospitals in Uganda. To understand the coordination dimensions of ACTs, the study adopted an exploratory sequential mixed research design, which involved a mixture of qualitative and quantitative approaches. For the qualitative phase, four focus group discussions were held. From the results, an instrument was developed and later validated using the quantitative approach. Specifically, Exploratory Factor Analysis (EFA) with a maximum likelihood extraction method followed by Confirmatory Factor Analysis (CFA) were used to analyse quantitative data. Considering the volume of the dimensions, Analytical Process Hierarchy (AHP) was carried out to rank the dimensions in order of priority.

Analysis of the factor correlation matrix shows no common variance among the components; therefore, the principal components were distinct from one another and there was no discriminant validity. The CFA results showed that the standardised parameter estimates of the initial measurement models were all significant ($p<.05$). CFA and APH outputs were somehow different simply because each technique has its own purpose and principles. It was indicated that the correlation between critical supply chain coordination dimensions and level of ACTs availability is moderately higher, followed by logistics, macro and market environments.

By better understanding the supply coordination dimensions effects on ACTs in Uganda, the research provides important direction to African governments and international donor agencies in their efforts to make malaria treatment therapies available, especially to the rural poor and avert death. The findings serve as a platform to argue for revisiting coordination dimensions in

view of conditions that include a resurgent market and macro-environment in developing countries. The insight raises implications for extending coordination frameworks that are geographically focused, and specific to ACTs. It may influence policy direction in this regard and thus contribute to the body of knowledge.

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LIST OF ABBREVIATIONS

ACTs	Artemisinin-based Combination Therapies
CMS	Central Medical Stores
DHO	District Health Officer
DLS	District Level Stores
DMO	District Medical Officer
DTMC	Drug Therapeutic Management Committee
EMHSLU	Essential Medicines and Health Supplies List of Uganda
EOQ	Economic Order Quantities
EDL	Essential Drugs List
FGDs	Focus Group Discussions
FY	Financial Year
GH	General Hospital
HC	Health Centre
HMB	Hospital Management Board
HMIS	Health Management Information System
HSSIP	Health Sector Strategic Investment Plan
HSSP	Health Sector Strategic Plan
LMD	Last Mile Delivery
LMIS	Logistics Management Information System
MoFPED	Ministry of Finance, Planning and Economic Development
MoH	Ministry of Health
MADM	Multiple Attribute Decision Making
NCST	National Council of Science and Technology
NDA	National Drugs Authority
NGO	Non-Governmental Organizations
NMS	National Medical Stores
OAG	Office of Auditor General
PMI	Presidential Malaria Initiative
RDT	Rapid Diagnostic Test
RMS	Regional Medical Stores
RRH	Regional Referral Hospital
SAS	Statistical Analysis System

SCM	Supply Chain Management
SCMU	Supply Chain Management Unit
SEM	Structural Equation Modeling
SMS	Short Message Service
SPSS	Statistical Package for Social Scientists
SOP	Standard Operating Policies
SRIHDC	Senate Research and Innovation Higher Degrees committee
SOP	Standard Operating Policies
UCG	Uganda Clinical Guidelines
UHC	Universal Health Coverage
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WHO	World Health Organization

CHAPTER ONE

ORIENTATION AND OVERVIEW OF THE STUDY

1.1 Introduction

Artemisinin Based Combination Therapies (ACTs) are currently believed to be among the best efficient drugs for treating malaria cases in the developing world (Spisak, Morgan, Eichler, Serumaga & Wang, 2016:165; World Health Organisation, [WHO] 2013:1; Afriyie, Amponsah, Antwi, Nyoagbe, & Bugyei, 2015:409; Watsierah & Ouma, 2014:1). Most countries with high incidences of malaria have instituted National Malaria Treatment Policies specifying which drugs are suitable for particular cases of malaria, but more importantly, to ensure that drugs are readily available for treatment and use in hospitals (Shretta & Yadav, 2012:1; Mutabingwa, 2005:307). Shockingly, in most Ugandan general hospitals scarcity of many essential drugs including ACTs, is continuing to persist despite efforts by the Government to build and maintain stocks (Jahre, Dumoulin, Greenhalgh, Hudspeth, Limlim & Spindler, 2012: 61-62; Budget Monitoring & Accountability Unit [BMAU] 2015, 1-4; Kassama, Collins, Liowa & Rasool, 2015:253, Kohler, Pavigani, Micheal, Ovtcharenko, Murru & Hill, 2012:1; Frost, Hiller, Islam, Printz, Mwencha & Whitehouse, 2011: 2; Nsungwa-Sabiiti Peterson, Pariyo, Ogwal-Okeng, Petzold, & Tomson, 2007:1200). Consequently, the situation appears to be flouting the logical supplication of WHO: 'to treat malaria cases within the required 24 hours' (Watsierah & Ouma, 2014:7; Ministry of Health [MoH] Report, 2014-2015:7), to the common patients (Wangu & Osuga, 2014). So far, several scholars have delved into the causes of stock-outs and have zeroed on a common cause of inadequacy in supply chain coordination (Leung, *et al.,* 2016:1; Yadav, 2015: 146-147).

A well-coordinated medicine supply chain ensures that inputs (medicines and medical supplies) are available at the right time and the right place for particular tasks to be performed. Furthermore, there is a world-wide recognition that strong supply chains are essential for positive health outcomes (Brown, Atif, Hasselberg, Steele, Wright, & Babar, 2014: 1). Arshinder, Kanda & Deshmukh, (2009:40) recommend coordinating the supply chain so as to ensure that all activities are systematically glued together for the achievement of a joint supply chain goal. Organisations that fail to coordinate their supply chains face challenges of minimal capacity utilisation, a superfluous inventory, escalated costs, stumpy customer satisfaction, and irresponsive order fulfilment (Arshinder *et al*., 2009:41 & Simatupang *et al*., 2002:289).

Whereas the present supply chain frameworks have offered a podium for determining and refining conceptual appreciation of the underlying dimensions on supply chain coordination at the micro-environment, they have inadequately focused on coordination of the macro-issues. Yet, the limited micro dimensions offer little appreciation of coordination in the distribution of drugs (Nagitta & Mkansi, 2015:25). Therefore, as supply chains evolve and change in size, shape and configuration, there is an urgent need to configure and appreciate how best they can be coordinated, controlled and managed (MacCarthy, Blome, Olhager, Srai & Zhao, 2016).

In sub-Saharan Africa, there are persistent uncertainties regarding the exact number of people who die from malaria episodes because of stock-out of medicines owing to scanty verifiable statistical information (Snow, 2014:2). Even so, WHO and the United Nations Children's Fund (Unicef) Report (2015:20) claim that inadequate stocks of malaria drugs are one of the factors responsible for death on children in sub-Saharan Africa. The same report indicates that by 2015 only 13% of children with malaria were projected to have received ACTs since these drugs had been recommended by WHO in 2000. This connoted a desperate need for accelerated supply chain coordination at the micro, market and macro environments in providing ACTs in endemic countries to alleviate the *status quo*.

Furthermore, empirical substantiations of supply and distribution of ACTs in developing countries appear to be challenging, shaped by multifarious interdependencies among the crucial players: government, donors, patients, interest groups, and private organisations, among others (Ongolo-Zogo, & Bonono, 2010:237; Chuma, Okungu & Molyneux, 2010:10; Wild & Cammack, 2013:2). Nevertheless, the interplay of coordination dimensions and logistics are known to have remained perennially wanting, as Vledder, Friedman, Sjöblom, Brown, and Yadav (2015: 4) and Yadav (2015: 143) assert that hardly any studies on public health have so far investigated supply chain coordination of medicines at the point of service delivery. Moreover, the existing supply chain coordination frameworks are not suited for the actuality in developing countries (Nagitta & Mkansi, 2015: 25). In addition, Kuhlmann, Rangnitt and von Knorring (2016:58) contend that the problem could partly be explained by managers' reliance on intuition rather than being informed by the applicability of management frameworks. For this reason, the identification of requisite factors to enable more proficient coordination remained imperative as a quest for improving responsiveness, flexibility, operational efficiency, and enhancement of service delivery (Mehralian, Zarenezhad & Ghatari, 2015:75) and Dan (2015:1), respectively.

SCM significantly plays a leading role in firm's performance and has, therefore, attracted serious research attention over the last decade. Proper supply chain management goes a long way in eliminating problems such as; information flow; low customer service issues, bullwhip effects, as well as long production and delivery lead-times (Jacobs, Berry, Whybark, & Vollmann, 2011: 197; Svensson, 2015). While initial supply chain actors sought to achieve cost reductions or increase profits at the expense of their supply chain partners, current orientation is creating competitive supply chain as a whole through collaboration or coordination (Soroor, *et al*., 2009; Jain, *et al.,* 2015:11). Jain *et al.,* (2010: 15) report that SCM literature in reality, is still very fragmented. Furthermore, Vactor (2011: 246) underscores that supply chain management in the public sector has been under-researched, especially in the context of developing countries.

Interestingly, even the studies by various scholars that have been striving to document causes of the ACTs stock-outs in Uganda (Nanyunja, Oryem, Kato, Kaggwa, Katureebe & Saweka, 2011:12; BMAU; 2015, 1-4; *ACT Watch* Group & PACE / Uganda, 2013:28; Shretta & Yadav, 2012:3) have been averred to be at variance—at least with inconsequential solutions to the predicament (Leung, Chen, Yadav, & Gallien, 2016:1; Yadav, 2015: 146). This quagmire substantially gave way to the empirical investigations and consequent resolutions in the current study on the proficiency of ACTs supply chain coordination in Uganda.

1.2 Contextualisation of the problem

To date malaria is ranked as one of the leading causes of morbidity and mortality in developing countries (Afriyie, *et al.,* 2015:409; Rusk, Highfield, Wilkerson, Harrell, Obala, & Amick, 2016; Damien, Aguemon, Abdoulaye, Bocossa, Ogouyemi-Hounto, Remoue & Le Hesran 2018), despite the recent surge in both national and international interest in reducing the malaria burden and the willingness to tackle the disease. Earlier report by the World Health Organisation (WHO) (2011; 2015) further alludes that malaria is still a huge health burden in Africa, particularly in Uganda where malaria accounts for up to 50% of the country's morbidity and mortality especially among children under five years and expectant or pregnant mothers (Ministry of Health [MoH] Report Financial year, 2014/2015:2). The Uganda National Malaria Control Strategic Plan (2011:6) postulates that malaria is highly endemic in 95% of the country, covering approximately 90% of the population. The remaining 5% of the country consists of unstable and epidemic-prone transmission areas in the highlands of the south- and mid-west, along with the eastern border with Kenya, and the north-eastern border with South Sudan. *ACTwatch* (2013:28) further reports that in Uganda an estimated 30-50% of outpatient visits at health facilities are due to malaria, while 15-20% of all hospital admissions and 9-14% of all hospital deaths are attributed to malaria. The percentage could be bigger because a significant percentage of deaths occur at home and are, therefore, not reported by the facility-based health management information System. World Health Organisation Report (2013:42) expresses difficulty in tracking the level to which patients with confirmed malaria received ACTs. In terms of outpatients, malaria accounts for 25–40% of the outpatient visits to health facilities (MoH Report, 2014-2015:7). Similary, the Second National Health Development Plan (2015:28) reports that in spite of the significant investments in malaria control, the malaria burden remained high. The major cause of outpatient and in-patient attendances in Uganda accounted for 13.7% of children under five years.

Furthermore, a gloomy picture is reported with an estimated 26.8% of hospital-based under-five deaths, caused by malaria (MoH, FY 2016/2017:4). Whereas extant literature does not reveal the number of deaths because of the unavailability of ACTs, it is noteworthy that availability of medicine in health facilities is substantial to quality health care. In the same direction, it is also regrettable that empirical interventions to improve ACTs availability in Uganda to reduce eventual mortality rates have also not yet succeeded, as the applied frameworks are perceived to be notably inept (Uganda Bureau of Statistics [UBOS], 2015:95). The UBOS statistics from household self-rating indicated that availability of drugs, generally declined from 26% in 2008 to 22% in 2015 (UBOS, 2015:95).

The situation is not any better in many African countries despite the availability of many interventions focused on preventive and therapeutic approaches. In order to reduce the burden, a policy shift was recommended in 2006 to use ACT as the most affordable effective option to treat uncomplicated malaria in many sub-Saharan countries, where widespread malarial parasite resistances to medicines are recorded to be rife (Watsierah & Ouma, 2014:7; Matowe & Adeyi, 2010:3). Treating malaria promptly with ACT antidotes affected persons and deters the disease progressing to more severe forms and death. In many countries, ACT use remains low partly due to cost of ACTs posing a barrier to their use (Deye *et al.*, 2016). Therefore, availability of malaria treatment pills is a crucial element of universal health coverage. However, achieving it presents a major challenge, especially in low-income countries (Khuluza, & Heide, 2017:1).

Earlier studies point out that despite such empirical deficiencies, there is no frameworks that has been conclusive with more relevant determinants to improve ACTs availability. Poor management of interdependent multifaceted relationships between personnel in health facilities and health information to support service delivery has further complicated this problem (Tumwine, Kutyabami, Odoi & Kalyango, 2010: 557; Shretta & Yadav, 2012:3). Hence the recommendations for more rigorous empirical research, seeking to address the problem of inadequacy of ACTs in developing countries (Watsierah & Ouma, 2014:7). Unfortunately, as Patouillard, Hanson and Goodman (2010:12) argue, there are limited nationally representative studies on anti-malarial supply and distribution chains of ACTs in sub-Sahara Africa. For example, the studies carried out in the healthcare sector in Uganda, particularly in Karamoja (Jahre, *et al.,* 2012:54), have offered a minimal understanding of the coordination framework to impact the supply and distribution of drugs in the country (Nagitta & Mkansi, 2015:25). By this very fact, the connotative inference remains reducing the incidence of unavailability through improved coordination as an urgent and necessary imperative if the Universal Health Coverage (UHC) is to be achieved in the foreseeable future (Talisuna, Noor, Okui & Snow, 2015: 2).

1.2.1 Conceptualization of the study variables

This section provides definition of variables as applied in the study.

General concept of supply chain and supply chain management

Different scholars define the term supply chain differently depending on the context, industry or sector (Ambe & Badenhorst-Weiss, 2011). From the manufacturing sector, Verma and Boyer (2010:19) define a supply chain as a network of business organisations or supply chain partners, that work together to convert and move goods from the raw material stage to the end user. From the public sector view point, a supply chain consists of all chain partners that directly or indirectly fulfil a customer request (Migiro & Ambe, 2008; Ambe & Badenhorst-Weiss, 2011). Related to healthcare, supply chain denotes the flow of information, supplies, and finances involved in the acquisition and movement of goods and services, from the supplier to the end user (De Vries & Huijsman 2011:161; Aronsson, Abrahamsson &Spens, 2011).

Another author describes the healthcare supply and distribution chain as upstream, midstream, and downstream. The upstream chain consists of biotech firms, pharmaceutical agents or manufacturers, and medical device firms. The midstream of the healthcare supply chain is composed of central medical stores, insurance companies, and other financiers of the system. The downstream is made up of health facilities (hospitals) where actual delivery of the health service takes place (Sinha & Kohnke, 2009:200).Typically, hospital supply chain includes the internal chain (patient care units, hospital warehouse, patients, among others.) while the external chain consists of distributors, vendors, and manufacturers (Rivard-Royer *et al*. cited in Laundry & Beaulieu, 2013:468). The rationale is to enhance medical outcomes and simultaneously reduce costs. This, therefore, means that there is a high level of the interdependence between units or processes, signifying coordination that allows quick response and flexibility as a necessary prerequisite that integrates operations to achieve the mutual goal of the supply chain as a whole (Aronsson, Abrahamsson & Spens, 2011:176). Effective management of the chain must take into account coordinating all the different actors without compromising customer satisfaction, while still keeping costs down (Fawcett, Wallin, Allred, Fawcett, & Magnan, 2011; Jain, *et al.,* 2015:13; Xie & Breen, 2012:41 ;).

Generally, the concept of SCM entails the management of resources across and within firms with the aim of maintaining the business operations profitably. Resources can be materials, information, people and other organisational assets such as equipment (Sehgal, 2009). The phenomenon is equally important in health care organisations if they are to achieve the organisation's set goals (Al-Saa'da, Taleb, Al Abdallat, Al-Mahasneh, Nimer, & Al-Weshah, 2013: 42). Compellingly, in the private sector, SCM is a well-developed scientific discipline (Samuel, Gonapa, Chaudhary & Mishra, 2010) compared to the public sector (Yadav, 2015: 142). Hugos (2011: 4) defines supply chain management as the coordination of location, production, inventory, and transportation activities among supply chain partners to achieve the best mix of efficiency and responsiveness for the market being served. On the contrary, Pienaar and Vogt (2012:8) define supply chain management as a philosophy that involves managing all attendant activities related to planning, sourcing, procurement, conversion, and delivering products to the end users.

Supply chain coordination: Various scholars define supply-chain coordination accordingly. According to Singh (2013:82), supply chain coordination can be viewed as an act of properly combining a number of objects (objectives, actions and decisions, information, knowledge, funds) for the achievement of the chain goal. For the purpose of this study, it meant management of interdependent activities that account for the flow of products, resources, and information to achieve better supply and distribution of goods and services to end users (Malone & Crowston, 1994:87; Akhtar, Marr & Garnevska, 2012:85).

ACTs: Mainly described as Artemisinin-based Combination Therapies, are efficacious drugs for control and treatment of uncomplicated malaria (WHO 2013:1; Afriyie, *et al.,* 2015:409; Watsierah & Ouma, 2014:1).

Non-availability: (hereafter referred to as "stock-outs or inadequacy) means the situation of having less stock of ACTs in the medical facility than required for patients as stipulated by the national guidelines (Budget Monitoring and Accountability Unit [BMAU], 2015:1).

Supply chain management: This involves managing all activities pertaining to the flow of resources from the supplier to the end-users (patients), through the integration of both internal and external systems (Van Weele, 2010:255; Burt, Petcavage & Pinkerton, 2010:529).

Healthcare supply chain: Schneller and Smeltzer (2006:30) define healthcare supply chain as the flow of finances, supplies and information from the supplier to the end user. Healthcare supply chain in this case intended to enhance clinical outcomes, while simultaneously controlling unavailability. The healthcare supply and distribution chain are accordingly divided into upstream, midstream, and downstream levels. In this study, general (district) hospitals are the first referral points after the lower health centres and are in the downstream chain where actual delivery of the health service takes place (Sinha & Kohnke, 2009:200; Ford & Scanlon, 2007:192-193). General hospitals are presumed to deliver to a much poorer populace at the district level.

Availability: From marketing discipline, availability is construed to describe the ability to meet customer demand with the desired item in terms of quantities and quality (Bowersox, Closs & Cooper, 2002:73-76). Ideally, availability is measured by order fill rate, stock-out frequency and orders shipped (Zinn, Mentzer & Croxton, 2002:22). Another authority refers the term to mean the probability that an item is available within the required time; measured in terms of met delivery timeliness, ease of transfers and redistribution (Ministry of Health & Social Welfare of Liberia Report, 2010: 7). In this study, availability refers to the physical presence of the medicine at the service delivery point (Matowe & Adeyi, 2010:1); in good quality and in the right quantities to treat ailments and diseases; timely delivery of drugs, stock-out frequency and improved stock levels (Abwola, 2014: 10).

Coordination: Coordination is defined as a way of dealing with dependencies among activities characterised by dimensions towards mutually agreed goals (Malone & Crowston, 1994:87). Despite the differences in defining the term, certain things must nevertheless be present such as people working together to accomplish interdependent tasks and a specific goal. In this study, the definition was applied while involving the following constructs:

- *Information sharing:* It is used in reference to the extent to which critical and proprietary information is communicated to one's supply chain partner. This is in accordance to Flynn, Huo and Zhao (2010:60); and Singh (2011:634). It invokes the aspects of accuracy, timeliness, adequacy, and credibility of exchanged information.
- *Top Management commitment:* Refers to the willingness to devote energy and resources to ensure availability of products. This conceptualisation was preferred from Viinamäki (2004: 120) and Boella van der Torre (2006: 4).
- *Mutual Understanding*: This was construed as the level of confidence, dependability and honesty among supply chain partners. It also described that no party exploits the other party but instead trust each other (Arshinder *et al.,* 2009:785; Katsikeas, Skarmeas, & Bello, 2009:132).
- *Responsiveness:* Represented the rate at which supply chain members respond to customer requirements (Singh, 2011:625; Holweg, 2005:605).
- *Organisational factors:* Referred to, among others, organisational structures (decentralised or centralised) and culture (Singh, 2011:633; Li, Rao, Ragu-Nathan & Ragu-Nathan, 2005:633).
- *Collaborative decision-making:* This entailed joint planning or forecasting of demand trust, regular meetings and flow of information between supply chain members (Singh, 2011:623).

1.2.2 Supply chain coordination dimensions

In reviewing the literature, several supply chain coordination frameworks emerge from different authors, which are incongruent with the surveyed empirical case investigation of the distribution of ACTs in developing countries carried out by Nagitta and Mkansi (2015:36). In this context, the supply chain coordination dimensions developed by different scholars (Singh, 2011; Shukla Garg & Agarwal., 2013; Arshinder *et al*., 2009; Phong-arjarn & Jeenanunta, 2011; Ballou, Gilbert & Mukherjee 2000; Gittell, 2011; Malone & Crowston, 1994; Thompson, 1997; Van de Ven *et al.,* 1976; Fugate, Sahin & Mentzer, 2006; Simatupang & Sridharan, 2005) appear to opine for different dimensions, from either the manufacturing or retail sectors. Hence, evidence from a survey of empirical cases relating to the supply and distribution of ACTs in developing countries reveals a link and interplay of market and macro dimensions in the distribution of ACTs (Nagitta & Mkansi, 2015). It is this mismatch between theory and practice that led to a research gap in that it was difficult to avert stock-outs if the existing frameworks are to be utilised to improve the availability of ACTs, without first amending the framework to be in line with empirical case evidence observed.

The purpose of this study, therefore, was to explore the key coordination dimensions within the hospital, market and macro environments in order to develop the coordination framework that is much suited to make ACTs available in Uganda. Therefore, this study extends earlier findings by exploring the dimensions, links, and nature of interplay of market and macro environment in the supply and distribution of ACTs, but from a perspective of general hospitals in Uganda.

1.2.3 Key logistics in the medicine supply chain

The medicine supply chain in a typical hospital has five basic functions, namely, forecasting, quantification, procurement, storage, and dispensing/distribution (Iqbal, Geer, & Dar, 2017:80; Kamuzora, 2014:3). These activities ought to be interdependent to ensure that good quality ACTs are promptly available at the service delivery points (USAID | DELIVER PROJECT, Task Order 1. 2010: 5).

Forecasting: In Uganda, this involves estimating future medicine requirements in a particular financial year. The activity is based on the essential medicine list (EML) developed by National Drug Authority (NDA) and communicated to all hospitals and National Medical Stores (NMS). The selection takes into account the product storage requirements, safety, costs, efficacy, and shelf life (MoH, Report FY 2012/2013:6).

Quantification: The activities that relate to the estimation of the quantities of drugs needed i.e. estimating the quantities of ACTs consumed, are done in relation to forecasting patients' needs, considering also the costs of products, documentation, staffing skills, and workloads during service delivery (USAID | DELIVER PROJECT, Task Order 1, 2011:6).

Procurement: These activities relate to the acquisition of supplies through purchase, donation or manufacture. It generally follows prescribed regulations and procedures issued by Public Procurement and Disposal of Public Assets Authority (PPDA) and the NDA. This involves coordinating different stakeholders who budget, develop work plans and communicate with NMS for deliveries of medicines, among others.

Storage and distribution: Activities related to the holding and movement of materials. It involves arranging space for storage of supplies or inventories, facilities and other equipment for appropriate handling of ACTs. Storage and dispensing may affect access and shelf life of the distributed medicines.

Dispensing: These are activities that encourage the dispensing of medications appropriate to clinical needs in doses that meet patient requirements.

1.2.4 Management environment factors affecting supply chain coordination

According to Child (1972:3), the management environment while composed of three environments (micro, macro and market), is complex. Kinra & Kotzab (2008:290; Nieman & Bennett (2002:29); Fahey & Narayanan (1986:49) also allude to this. This conceptualisation suggests that numerous variables emanating from any of the environments, or sometimes a combination thereof may influence how supply chain coordination is made more effective or at times, not (Kinra & Kotzab, 2008:283). Saltman and Duran (2016:34), Saltman, Durán and Dubois (2011:5) point out that public hospitals can be described from three dependent but interconnected levels: (1) the micro-level (hospital level management focusing on day-to-day operations); (2) the meso-level (institutional level decision-making functions) and (3) the macro-level (health system within which the health facility operates - consisting of national/regional or supranational policy-making functions with reference to finance, structure and organisation of hospitals). However, the scholars argue that the three levels seem unclear although at both the micro and meso-levels, policy and management decisions become inevitably tangled as part of institutional governance.

Notwithstanding the foregoing, the micro-environmental factors are internal to the organisations and therefore they were covered under internal dimensions highlighted by Singh (2011:633). Whereas Singh's framework provides a foundation on the dimensions, there appears to be no 'development' of the interview process; the topic guide did not evolve to explore emerging themes in greater depth during the course of the interview study. In that sense, the methods used by Singh, Arshinder and colleagues were more like the pre-determined, theory-based approach described in the studies, unlike the emergent themes analysis that this study employed. In addition, it is not clear when their identified level of saturation was reached. In contrast to this approach, this study employed a set of principles proposed by Francis, Johnston, Robertson, Glidewell, Entwistle, Eccles, and Grimshaw (2010: 1234) so as to establish the right sample size to support the conclusion. Of interest is an understanding of key critical dimensions posed by the market and macro-environment that were studied, but from the perspective of general hospitals. The market environment is composed of role players (customers, suppliers, competitors, among others).

Lastly, the macro-environment includes political, economic, technological, and legal factors, which form the central focus of this study (Nagitta & Mkansi, 2015:25). This study analysed the effect of market and macro-environmental factors on supply chain coordination of ACTs in general hospitals in Uganda. It was anticipated that the market management factors directly influence the supply of ACTs, while the macro factors indirectly influence the supply chain coordination of ACTs in general hospitals in Uganda. This study extended earlier findings of Nagitta and Mkansi (2015); exploring the dimensions, logistics activities and nature of interplay of market and macro-environment in the supply and distribution of ACTs.

1.3 Problem Statement

In Uganda, public hospitals form an integral part of the health system, from which malaria affected patients obtain treatment. ACTs are the most efficacious drugs for control and treatment of uncomplicated malaria in the developing world (Spisak, *et al*., 2016:165; Shretta & Yadav, 2012:1). However, in most hospitals and particularly in Uganda, most drugs are rarely available for treatment and dispensing to patients (Wangu & Osuga, 2014; Kohler, *et al*., 2012:1). Whereas various scholars have documented the causes of stock-outs of medicines (Leung, *et al.,* 2016:1; Yadav, 2015: 146-147), a common cause appears to be the lack of supply chain coordination.

Building supply chain coordination frameworks is a popular practice in the private sector in many developed countries, developing countries public health sector has hardly adopted this practice (Yadav, 2015). Although the existing frameworks offer a good platform for measuring and improving understanding of concepts underlying coordination dimensions at the micro-environment, they have limited capacity to analyse coordination interactions within the health sector, especially in developing countries like Uganda (Nagitta & Mkansi, 2015:25). Better still, whereas Uganda developed a National Medicine Policy in 2015, the plan lacks clear general guidelines on how to coordinate the supply and distribution of medicines.

For instance, while Section 4 of the National Medical Stores Act (1993) requires the corporation to procure, store and distribute medicines and medical supplies for the national and public benefit, the review of the account statements for health facilities maintained at NMS revealed that items worth Uganda Shillings 3,590,576,764 (equivalent to United States dollars $ 944,989) remained un-distributed to six hundred forty nine (649) health facilities at the end of the year. Items worth Uganda Shillings 3, 278,163,534 ($ 862,675) were for ninety eight (98) health facilities that had balances of at least UGX.2, 000,000 each at NMS. The inconsistency was partly attributed to delayed and uncoordinated submission of procurement plans by the Health facilities and non-alignment of facility orders to the procurement plans. Lack of medical supplies at the facilities results into stock-outs and treatment disruptions (Auditor Generals' Report, June 2017). Furthermore, in the study carried out in Uganda by Bruno, *et al.,* (2015) it was by found out that ACTs had the highest percentage stock-out. Since ACTs are used in the treatment of malaria, the stock-outs of this drug could have a severe impact on the health of the population. The scholars further assert that interventions which have been put in place to strengthen most health systems usually ignore the interconnections between system components. Due to this phenomenon, populations' access to medicines is usually addressed through fragmented, mostly vertical approaches that majorly focus on supply, unrelated to the wider issue of access to health services and interventions (Bigdeli, Jacobs, Tomson, Laing, Ghaffar, *et al.*, 2013). Hence the need to develop a coordination framework specific to Uganda's general hospitals with the hope of addressing the issue of non-availability of ACTs.

Several authors have suggested factors contributing to the low availability of medicines and health products at public health facilities (Leung, Cen, Yadav, & Gallien, 2016:1; Kraiselburd & Yadav, 2012:1; Nanyunja, Oryem, Kato, Kaggwa, Katureebe & Saweka, 2011:12).

However, the failure to systematically diagnose and understand why and how supply chains coordination leads to underperformance has led to ad hoc projects that address only the surface symptoms of the underlying structural causes (Yadav, 2015:146). The poor or no coordination may have terrible consequences such as inventory disparities, low capacity utilisation, poor customer service, high inventory costs, slow order fulfilment response, undesirable quality, and dissatisfied customers (Eltantawy, Paulraj, Giunipero, Naslund & Thute, 2015:895; Masten & Kim, 2015:13: Zissis, Ioannou & Burnetas, 2015: 21; Christopher, Harrison, & van Hoek, 2016:61).

Notwithstanding the great coordination platform laid by proponents of coordination frameworks, the studies offer a boundary condition that is limited to micro dimensions. The limited micro dimensions offer little understanding of coordination in the distribution of drugs, especially in developing countries, where medical drug distribution is shaped by macro and market influences. Ignoring market and macro dimensions in assessing coordination creates loopholes; closing these could improve drug availability, reduce stock outs and even combat the malaria death rates reported by previous studies (WHO Report, 2013; ACTwatch, 2013; Tumwine *et al*., 2010). This study, therefore, aimed at extending the coordination frameworks by offering case evidence that clearly provided an insight into supply-chain management in the medical industry in Africa. Specifically, the study sought to incorporate the market and macro perspective into the coordination framework for ACTs. To consolidate the argument, the study supplies an analysis of coordination frameworks and classifies each framework by comparing it with the management environment. Drawing from published case studies about distribution of ACTS, the study clearly addresses the question of how market and macro dimensions influence the distribution of ACTs drugs in Africa. It is from this case evidence that the study pinpoints the market and macro environment implications in developing countries. Incorporating the market and macro environment augments the assessment of existing coordination frameworks.

Against this background, this called for the need to develop a framework likely to work in this setting (general hospitals) to improve availability of malaria treatment pills commonly known as ACTs in Uganda using the business management environment framework. This study, therefore, explores and tests the critical supply chain coordination dimensions, logistics activities dimensions and the management environment (Market and Macro) dimensions affecting the availability of ACTs for malaria. In practice, the developed framework may be used as a decision-making tool helping general hospitals better understand their contextual environment and gain the ability to focus on the critical coordination dimensions to improve their supply and distribution of ACTs in a sustainable manner.

1.4 Research Objectives

The main aim of this study was to develop a supply chain coordination framework for malaria treatment therapies (ACTs) in General hospitals in Uganda.

1.4.1 Research objectives

In order to achieve the main objective, the following secondary objectives are used:

i. Examine how the critical supply chain coordination dimensions affect ACTs in the general hospitals in Uganda.
ii. Assess how logistics activities dimensions affect supply chain coordination of ACTs in general hospitals in Uganda.
iii. Critically analyse the management environment dimensions that affect supply chain coordination of ACTS in general hospitals of Uganda.
iv. To determine the most critical supply chain coordination that emerges from objective i, ii, and iii.

1.4.2 Research questions

The main research question that defines the study is: What is the appropriate supply chain coordination framework for malaria treatment therapies (ACTs) in general hospitals in Uganda?

The secondary research questions include the following:

i. How do the critical supply chain coordination dimensions affect the availability of ACTs in general hospitals of Uganda?
ii. How do the logistics activities dimensions affect supply chain coordination of malaria of ACTs in general hospitals of Uganda?
iii. How do the management environment dimensions affect supply chain coordination of ACTs in general hospitals of Uganda?
iv. What are the most critical supply chain coordination that emerges from object i, ii, and iii?

1.5 Significance of the study

The study may provide a critical contribution to benefit policy makers, scholars and health sector managers with handy solutions to the obtaining problems connected with supply chain coordination of ACTs.

1.5.1 Practical relevance

Currently, governments are under pressure to optimally operate, albeit with limited resources. Examining critical coordination dimensions, logistics dimensions and the management environmental factors affecting ACTs in the heath sector may assist in finding a better solution to address the problem of stock-outs, therefore averting consequential deaths. The outcome of this study may be used as a decision-making tool, helping hospitals to gain a better understanding of their contextual environment. Moreover, hospitals may gain the ability to focus on the critical areas to improve their supply chain in a sustainable manner.

1.5.2 Theoretical relevance

Extant research has, however, focused on single effects (micro-environment) and paid little attention to the interactions among health supply chain system building blocks and interventions at the market and macro-management environments. In addition, while many studies on supply chain coordination in the retail and manufacturing sectors exist, the literature addressing how hospitals can achieve supply chain coordination is limited, especially in developing countries and most specifically about medicines chains. Most scholars have investigated the factors causing stock-out from the micro perspective, disregarding the market and macro-environment factors. Owing to the increasing importance of availing medicines in a timely and flexible manner, it is vital to conduct more research in this field from the holistic perspective. This study, by investigating the critical coordination dimensions, logistics dimensions and management environment factors, may help in filling the gaps that exist in the literature. The understanding of supply chain coordination in the health sector in developing countries is at the development stage. Specifically, the study may provide a body of knowledge to strengthen overall management of the health sector.

1.5.3 Methodological relevance

This study used a mixed methods research design. In this study, an expert group approach instead of literature alone was explored. The exploration of key dimensions from expert focus groups contributed towards understanding the exploratory sequential mixed methods better.

Most importantly, the study made a contribution in developing an instrument that could be used for future studies.

The limitations experienced were;

- The novelty of the subject in the health sector and the lack of data in this area is a challenge. Studies that have developed previous models determined critical dimensions from literature (Arshinder, Kanda & Deshmukh, 2011:71; Akhtar, *et al*., 2012:85.).
- Other studies point to expert groups as alternative methods of determining critical dimensions (Mehralian *et al.,* 2015:83; Singh, 2011:619). In some of these studies, the number of the units of analysis used was too small, making it difficult to find significant relationships from the data, as statistical tests normally require a larger sample size to ensure a representative distribution of the population and to be considered representative of groups of people to whom results would be generalized or transferred.

1.5.4 Contribution of the study

This study makes three contributions in the health care supply chain as explained below;

- **Theoretcal contribution:**

The study makes a noteworthy contribution to the body of knowledge and understanding of the healthcare supply chain field in developing countries. Ignoring market and macro dimensions in assessing coordination creates loopholes; closing these could improve drug availability, reduce stock outs and even combat the malaria death rates reported by previous studies (WHO Report, 2013; ACTwatch, 2013; Tumwine *et al*., 2010). Specifically, this study contributes towards extending the coordination frameworks by offering case evidence that clearly provides an insight into supply-chain management in the medical industry in Africa. Specifically, the study incorporates the market and macro perspective into the coordination framework for ACTs. To consolidate the argument, the study supplies an analysis of coordination frameworks and classifies each framework by comparing it with the management environment. Drawing from published case studies about distribution of ACTS, the study clearly addresses the question of how market and macro dimensions influence the distribution of ACTs drugs in Uganda. It is from this case evidence that the study pinpoints the market and macro environment implications in developing countries. Incorporating the market and macro environment augments the assessment of existing coordination frameworks. The extensions contribute to both the body of knowledge and supply-chain practices in the medical industry.

- **Concepual contribution**

As regards knowledge contribution, the study provides a conceptual extension of the framework to assist with better assessment of medicine supply chain coordination. In practice, as mentioned above, this may reduce medicine stock-outs, improve drug availability, and might lead to possible combat of the malaria death rate through better supply chain management in the medical sector. As such, this work contributes to the foundational knowledge of medicine supply chains. These challenges must be addressed by scholars, policy makers, and practitioners alike if pharmaceutical supply chains are to be developed and improved in emerging regions.

- **Methodological contribution**

The study makes a contribution in the form of a validated research tool-questionnair which can beused in another developing world context.

1.6 Scope of the study

The field of study is the supply chain coordination. On the other hand, the industry of study is the health sector. The study focused on supply chain coordination dimensions, logistics dimensions (forecasting and quantification, budgeting and planning, procurement and storage, and distribution or dispensing activities), and the management environment factors (market and macro environments) that account for variations in the availability of ACTs.

1.7 Brief preview of research methodology

The section briefly discusses the research design and strategies adopted, population and section of samples and explains how data was collected and analysed.

- ***Research design***: The mixed methods research design was adopted. Specifically, exploratory sequential design with a quantitative priority (Creswell & Plano Clarke, 2011:86). The study adopted a mixed methods approach because neither qualitative nor quantitative approach was deemed adequate to answer the research questions fully (Creswell, 2014:31; Tashakkori & Teddlie, 2010:8). Specifically, an exploratory sequential mixed research design was adopted for the study.

- ***Phase one—qualitative approach: Case study strategy***: Out of the 45 general hospitals, four hospitals were purposively selected from the Northern and Eastern regions because it has the highest malaria burden (Uganda Bureau of Statistics [UBOS] & ICF International, 2015:50). The target population were members of the Drug Therapeutic Management Committee [DTMC]. Eight DTMC members were selected on the basis of experience and availability (Copper & Schindler, 2011:147) per hospital.

- ***Exploratory data collection techniques*****:** Focus group discussions (FGDs) were used to collect data in each of the four selected hospitals. During each FGD, two trained research assistants were used. The FGDs lasted between 90 minutes to two hours as supported by Kothari & Garg (2014); Copper & Schindler (2011).

- ***Procedure for qualitative data collection*****:** Semi-structured questions were asked to probe for detailed explanations up to the point of theoretical saturation (Guest, Bunce & Johnson, 2006: 65). Permission to tape-record the sessions was also sought.

- ***Data analysis from multiple cases:*** Qualitative data analysis took a three-phase approach including data reduction; data display; conclusions; and verification (Creswell & Plano Clark, 2007:148; Miles & Huberman, 1994:72). Computer-aided qualitative data analysis software program known as Nvivo was used to analyse qualitative data. This phase concluded with the development of a survey instrument.

- ***Phase two—quantitative approach: Survey strategy:*** Survey strategy was used to answer the; "*who, what, where, how much and how many questions*" (Saunders, Lewis & Thornhill, 2009: 149). In order to test the relationships between the variables, the following hypotheses were generated:

Table 1: Null and alternative hypotheses

Hypothesis	**Null**	**Alternative**
Hypothesis 1	$H0_1$: There is no significant correlation between the critical supply chain coordination dimensions and ACTs availability in District general hospitals in Uganda.	$H0_1$: There is a significant positive correlation between the critical supply chain coordination dimensions and ACTs availability in District general hospitals in Uganda.

Hypothesis 2	$H0_2$: There is no signification correlation between logistics activities dimensions and ACTs availability in District general hospitals in Uganda.	$H0_2$There is a significant correlation between logistics activities dimensions and ACTs availability in District general hospitals in Uganda.
Hypothesis 3	$H0_{3a1}$: There is no significant correlation between the market management dimensions and ACTs' availability in District general hospitals in Uganda.	$H0_{3a2}$: There is a significant correlation between the market management dimensions and ACTs' availability in District general hospitals in Uganda.
	$H0_{3b1}$: There is no significant correlation between the macro management environment dimensions and ACTs' availability in District general hospitals in Uganda.	$H0_{3b1}$: There is significant correlation between the macro management environment dimensions and ACTs' availability in District general hospitals in Uganda.

- ***Population and sample under survey strategy:*** There are four classifications of hospitals in Uganda. The first category is a national referral hospitals, followed by regional referral hospitals, then general hospitals and lastly the health centres. This study focused mainly on general hospitals with a population size of 45 hospitals. Out of the 45 general hospitals, 40 were randomly selected based on Krejcie and Morgan Table (Appendix 2). The table has all the provisions required to arrive at the required sample size (Krejcie & Morgan, 1970:608).

- ***Survey data collection technique:*** In phase two of the study, a self-administered structured questionnaire was used. A five-point Likert scale questionnaire was designed to enable respondents score the items: 5-stronly agree; 4-agree; 3-neutral; 4-disagree; and 1-stronlgly disagree.

- ***Data analysis under survey strategy:*** Statistical Packages for Social Sciences (SPSS) and AMOS were used to explore and test the relationship between variables. Specifically, Exploratory Factor Analysis (EFA) to determine the best factor structure to represent the supply chain coordination was employed in this study. This was subsequently complemented with a confirmatory assessment to test the hypotheses (Table 1) using AMOS software (V 21). Finally, Multiple Attribute Decision-making (MADM) algorithm, specifically, Analytical Hierarchy Process (AHP) was performed so as to prioritise, test and refine the general conceptual model for supply chain coordination of malaria treatment pills in general hospitals in Uganda.

1.8 Outline of chapters

Finally, the research outline that was followed is depicted in Figure 1.

Chapter 1: This chapter helps the reader to understand the topic being studied and justifies why the topic was studied. The study begins with the introduction of the study. To put the study into practical context, the problem is contextualised. The focus of the study is included to inform the reader the specific aspects with which the study is concerned. This is followed by a brief explanation of the main study constructs, the problem statement, and the significance of the study. The chapter outline is illustrated in Figure 1.

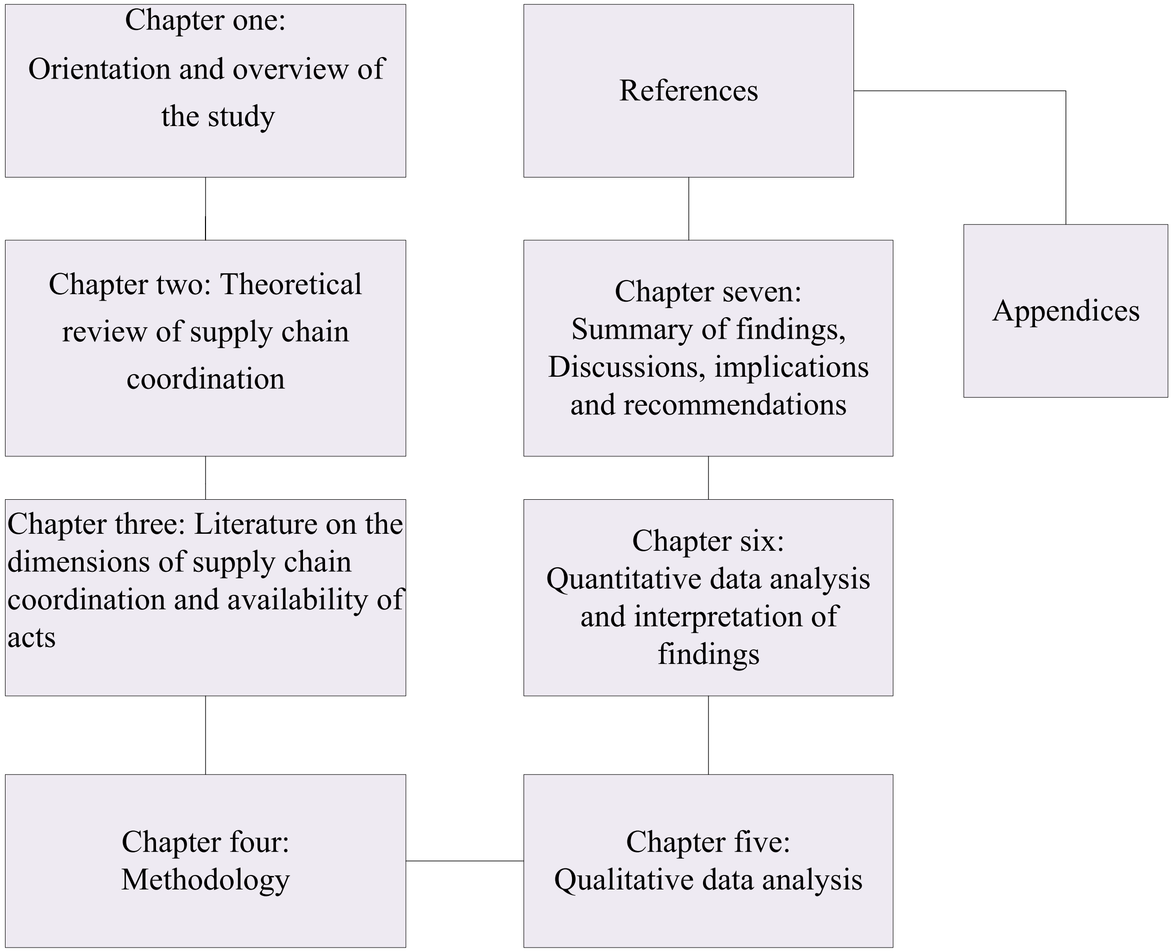


Figure 1: The summary of the outline of the dissertation in the next sections

Chapter 2: This chapter presents the theoretical orientation of supply chain coordination. In this regard the supply chain concept in the health sector is explained from the global perspective to the Ugandan context. Finally, the theoretical orientation supply chain coordination is accordingly discussed to ground the study.

Chapter 3: In this chapter, the conceptualisation of the supply chain coordination frameworks, after a review of literature on available frameworks is is made.

Chapter 4: This chapter entails a detailed description of the methodology. Specifically, it describes the justification for the epistemological stance that was adopted for the study, research design (Mixed methods) and research strategies (four multiple case studies and a survey). This is followed by the justifications, how data were collected and analysed, and ethical considerations. Lastly, conclusions are presented.

Chapter 5: The chapter presents results from the exploratory studies (the in-depth case studies) giving practical insights into the critical coordination dimensions, logistics activities and management environment (market and macro) factors that support the development of the current level of variables under the study. This phase concludes with the development of a questionnaire that was used in the quantitative phase.

Chapter 6: Under this chapter, the knowledge gathered in the previous chapter is used to carry out a survey to validate and test the hypotheses posed. Application of the relevant methodological options in the various survey processes with a high level of rigour to ensure valid results is made. Specifically, this chapter presents the findings of the survey results. The findings are arrived at by testing the correlation between the variables by first using an EFA followed by CFA. Furthermore, in order to prioritise the key supply chain coordination dimensions, analytic hierarchy process (AHP) approach was used. The technique provided a framework to cope with multiple criteria situations involving intuitive, rational, quantitative, and qualitative aspects. AHP provided a practical approach in identifying the most influential criteria that make ACTs available in general hospitals in Uganda.

Chapter 7: In the last chapter, a summary of findings and discussion of the findings are made. Thereafter, implications and a coordination framework are presented. Finally, the chapter ends with the presentation of the limitations encountered in the study and suggestions for future research are also made.

1.9 Summary

This chapter was designed to introduce the study background, the research problem, primary and specific objectives, research questions, the relevancy of this thesis, and definition of key terms. The background to the problem, namely the supply chain coordination and availability conceptualization was discussed. With these foundations in place, the next chapter reviews extant literature on the theoretical review of supply chain management.

CHAPTER TWO

THEORETICAL REVIEW OF SUPPLY CHAIN COORDINATION

2.1 Introduction

This chapter presents the theoretical orientation of supply chain coordination. In this regard the theoretical orientation of supply chain coordination is accordingly discussed to ground the study. Furthermore, the supply chain concept in the health sector is explained from the global perspective to the Ugandan context and the emerging challenges.

2.2 Theoretical review

The issue of coordination has been topical in various fields of management and organisational effectiveness and efficiency. For example, the earlier scholars have been attempting to put up models and various theoretical frameworks to enhance the supply - chain coordination of their time, some of the elements of these have stood the test of time. Nevertheless, time has been controverting some of the intentions – prompting more empirical actions from contemporary researchers and scholars to delve into further pragmatic scrutiny; for greater responsiveness and relevance. This study was supported by the Coordination Theory, according to Malone and Crowston (1994). The theory conjectures that for greater effectiveness and efficiency, an organisation ought to continually identify and assign tasks, with their respective interdependencies (coordination dimensions) - connoting that coordinating the supply - chain is a critical element that must ensure that all activities in the supply –chain should be systematically glued together, for superior performance. Malone and Crowston hinged their theory on the efforts of earlier theorists in the dominion of supply-chain coordination – as highlighted, hereinafter.

This chapter reviews some of the efforts of the earlier empiricists, including Fredrick W. Taylor (1914); Thompson (1967:15); Stover (1970:70); Van de Van, Delbecq & Koenig, (1976:332); Mintzberg (1989:101); Malone and Crowston (1994); and Crowston and Osborn (1998:8). The empirical trajectory is further punctuated by the contemporary development of refined theoretical frameworks to match with respective contemporary times, e.g. Ballou *et al* (2000); Lambert and Cooper (2000); Meca & Patnayakuni, Rai & Seth (2006: 13); Rai, Patnayakuni, & Seth (2006); Timmer (2008); Arshinder, *et al* (2008); Okhuysen & Bechky

(2009); Akhtar, *et al.,* (2012); Ramanathan & Gunasekaran (2014); Labiad, Beidouri & Bouksou (2014); Labiad, *et al.,* (2014:618); and Soosay & Hyland (2015).

In 1914 Fredrick W. Taylor, had emphasised standardisation of manufacturing processes for effective coordination and performance of work tasks. According to Okhuysen & Becky (2009: 465) Taylor's assertion ensured that the inputs were available at the right time and the right place for particular tasks to be performed through dimensions such as scheduling and coordination. Taylor's contribution on structural importance to enhance coordination of tasks was underscored by Henri Fayol, who stressed unity of command using the top-down approach with a focus onto organisational structural coordination as an essential component of coordinated management. Whereas Fayol's ideas focused on design of relationships between positions in organisations, Taylor's idea provided for coordinated activity through designing of work processes.

In 1967, Thompson reiterated the importance of organisational structure in augmenting coordination performance (1967:18). His study led to the coining the concept of "mutual adjustment" to cater for unplanned contingencies and to the wide spread use of coordination theory in a variety of disciplines to design structured tasks for performance. His other scholarly efforts in various studies on coordination theory advocated for the use of plans based on pre-established schedules, routines, and rules (Thompson, 1967:56).

In 1970, Stover pushed further the efforts of Thompson (1967). According to Stover (1970:70), scheduling or timetabling in the rail sector as a coordination dimension significantly led to enhanced performance. Although the findings from this study hyped the rationale for planned processes and structures, it was not articulate on how incidental changes would be managed because of shocks in the environment, causing failures to account for the eventualities in performance of tasks. His approach gave rise to dimensions or incidental requisites such as interpersonal communication and feedback, proposed by Van de Van, Delbecq & Koenig, (1976:332).

Coordination was later identified with regulatory guidelines as requisites used to manage task-related processes, in order to achieve organisational objectives (Mintzberg, 1989: 101). For Mintzberg (1989), the dimensions of coordination, once effectively managed, were deemed fundamental to hold the organisation accountable, via the formalised actions. For that matter, their use would be substantially determined by the task to be performed, purpose and context.

Mintzberg proposed six coordination dimensions that ought to be deemed necessary for adequate supply and distribution of a specific commodity. The first was standardisation of skills and knowledge, followed by standardisation of norms in which standards on behaviour of organisational staff are set to enable personnel to relate and work with each other. The, standardisation of work processes which are specified to the people performing interrelated tasks and standardisation of coordination of outputs by specifying the results of different work units or subunits (performance targets are defined and known by staff). Also, mutual adjustment where coordination is through simple processes of informal communication and lastly, direct supervision where the manager instructs subordinates with interrelated activities regarding what to do at a particular point in time.

Later on, Malone and Crowston (1994) found out that coordination is a concern across departments, which help to determine task interdependence based on structures. These include structural or formal (centralisation or decentralisation, standardisation, and control of behaviour) and informal dimensions (informal communication, personal contacts, and socialisation (Reger & Gerybadze, 2009:7). Nevertheless, the definitive conceptualisation put forward by Malone and Crowston (1994) appeared too optimistic as the scholars considered the coordination modes according to process realignment. They did not highlight the question of combining different dimensions of coordination in large organisations. Coordinating complex environments may require a diversity of outputs (products, services, markets); specialised inputs with strong interdependencies; and managing unanticipated change and goal setting (Huiskonen & Pirttilak, 2002:178).

However, in 1998 Crowston and Osborn (1998:8) linked the relative desirability of dimensions to the use of new information systems, such as computer systems that make it easier to find existing solutions to a problem in a database or within the business processes. According to Crowston and Osborn (1998: 42), such a system is therefore likely to reduce duplication and coordination costs with business processes. This contention was upheld and improved by contemporary researchers, such as Scott and Davis (2007:29), who highlighted the fundamentality of employee behaviour towards information sharing, stated rules that result into harmonisation of desired cooperation, responsiveness, mutual understanding and joint decision making to resolve problems. These orientations resulted in the advocacy of structures, roles and organisational rules as modelled by Okhuysen & Bechky (2009:467), to enhance organisational coordination.

2.3 Coordination theory and medicine supply chain

Medicines are strategic products in any health system and, therefore their supply chain coordination ought to be given top priority (Jaberidoost, Nikfar, Abdollahiasl, & Dinarvand, 2013). Medicine supply chains are complex and different from the manufacturing chains, because they usually have large and extended pipelines requiring high levels of product availability with high uncertainty in supply and demand (Cho & Zhao, 2017; 2018; McKone-Sweet, Hamilton, & Willis, 2005). Hence, the need to investigate and acknowledge operations in the health care sector so as to enhance decision - support frameworks, remains ultimate (Uthayakumar & Priyan, 2013). Regrettably, as nations continue to search for better health supply chains, relevance is often proved to remain rather scanty; presenting wanton challenges, such as: (1) absence of demand information, (2) lack of coordination, (3) inventory management (4) human resource dependency, (5) stock out (6) order management, (7) warehouse management, (8) expiration, (9) shipment visibility, and (10) temperature control (Privett & Gonsalvez, 2014). These issues are addressed by and contained in the coordination theory, hence its relevance to the current study. In the subsequent sub-sections the global and Ugandan medicine supply and distribution chains, are respectively reviewed.

2.3.1 Global medicine supply and distribution chain

From the global perspective, Yadav (2015:145) published a general model for the distribution of essential medicines in developing countries, to harmonise their coordination. Figure 2 summarises this model.

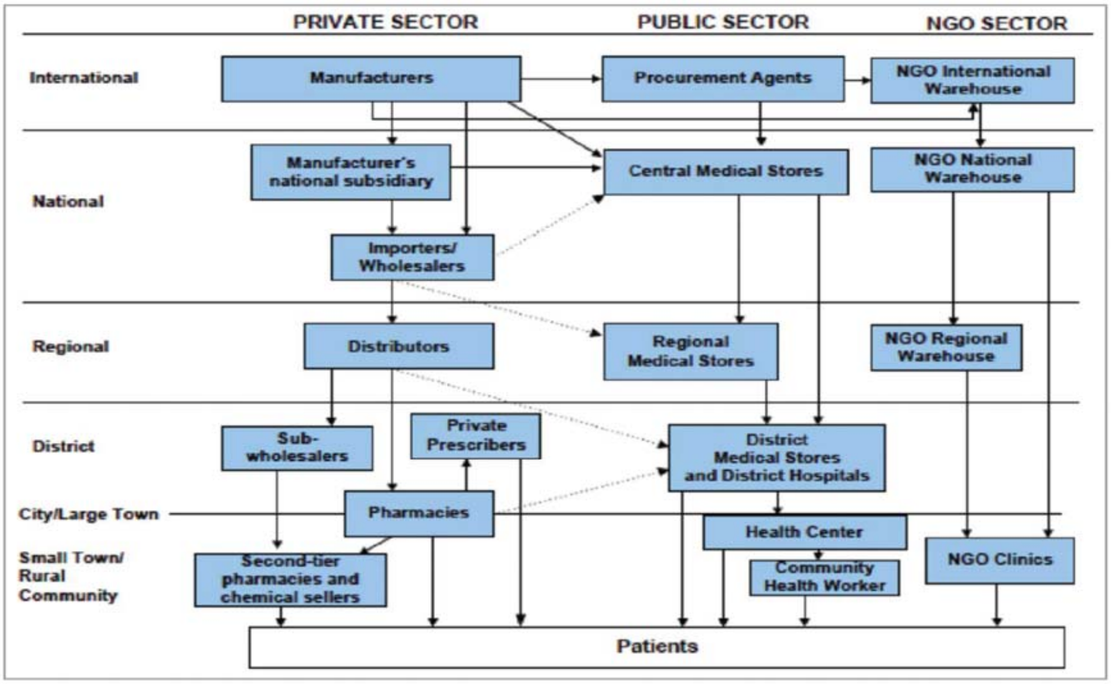


Figure 2: International medicine supply chain

Source: World Health Organisation cited, in Yadav (2015:145)

Figure 2 presents a multi-tiered distribution system from the manufacturer to the central stores, then to the regional and district stores, and finally to the health facility. Although the framework provides an overview of how drugs may move through distribution channels in the private, government and non-governmental organisations (NGOs), it does not adequately provide a detailed description of how to manage the interdependencies among and within the health facilities – a slight deviation from the coordination theory. The problem is escalated because of little appreciation of the discipline, thereby affecting service delivery (Ambe & Badenhorst-Weiss, 2011; Pule 2014: 137).

2.3.2 Structure of the healthcare supply chain management in Uganda

In Uganda, the healthcare supply chains are made up of a series of actors with different roles and responsibilities, spread over a large variety of locations. If one of the actors fails to fulfill its role, the whole chain is disturbed. Therefore, all actors need to be accurately identified, accredited and coordinated (Baez-Camargo & Kamujuni, 2011).Table 2 summarises the organisation of the health system (referral level, facility nature, service quantity and nature of service provision).

Table 2: The hierarchy and capacity of the health sector in Uganda

S/No.	Referral level	Nature of facility	Number of persons served	Nature of services provided
1	Community level	Village health committees	1,000 people	Provide free Primary Health Care (PHC)and outpatients interventions
2	Parish level	Health Centre III	20,000 people	Provide free PHC services (all above plus in-patients and laboratory
3	County level	Health Centre IV	100,000 people	Provide free PHC (all above plus emergency surgery and blood transfusion)
4	District level	District health Services Centre and general hospitals & laboratories	500,000 people	Provide free PHC and 2nd care services (user fees charged in private wings of the hospital)
5	Regional level	Regional referral hospitals and laboratories	2,000,000 people	Provides free tertiary care (user fees charged in private wings of the hospitals)
6	National level	National referral hospitals and National Reference Laboratories	30,000,000 people	Free specialised care (user fees charged in private wings of the hospitals)
7	World Health Organisation and other partners.	Ministry of Health Headquarters	-	Other sectors and post health services

Source: Adopted from Uganda National Malaria Control Strategic Plan (2011:4)

According to *Uganda National Malaria Control Strategic Plan (2011:4),* the health services delivery is structured around a referral system as shown in Table 2. The starting point in the system at the local level is the Health Centre One (HC1), which consists of village health teams (VHTs). The VHTs link health facilities with the community. The next levels of referral are HC II, III, and IV, located at the parish, sub-county and county respectively. Once the Health Centres (HCs) are unable to handle the medical situation, the patients are referred to the general hospitals, also referred to as the district hospitals. The last levels are the regional referral hospitals and the national referral hospitals respectively (USAID, 2015:11; MoH Reports 2010-2015:5). In terms of reporting, the medicines supply chain in Uganda is organised as a pyramid, with the Ministry of Health (MoH) at the top (MoH, FY 2014/2015: 2). However, a scholar reports that lack of a clear referral system and clear gatekeeper role in Uganda's health system at times leads to abuse by stakeholders (Mukasa, 2012).

2.3.3 Emerging challenges in coordinating the healthcare supply chain and research gap

Uganda's health system in the 1960s was one of the best in the region with well-equipped and staffed hospitals and a set of connected health units. However, the period from 1970 to1985 was marred with political turmoil, wrecking the health care system (Mukasa, 2012). From 1986 to date, the sector has witnessed an unprecedented increase in number of districts, to which critiques have referred to as a political patronage (Conroy-Krutz & Logan, 2011). Notwithstanding the political squabbling on the escalating number of districts, there is a risk of fragmenting the health supply system, making it even harder to coordinate the resources as well as medicines. Despite considerable progress that has been made to deliver medicines to health centers, internal coordination and supply chain management are still substantial challenges (MoH, Report 2013/14:103).

Admittedly, whereas supply and distribution frameworks of medicines (based on demand and pull system) have rigorously been developed in Uganda, this appears not to be working satisfactorily (USAID Task Oder 1, 2010:3; Pule, 2014:138). For instance, there are occasional delays in the delivery of essential medicines to the health facilities (Auditor General's Report, 2016: 31). On his part, Yadav (2015: 142) concludes that the reason is attributed to failure to embrace the discipline in many developing countries. However, Nagitta & Mkansi (2015:26), attribute the problem to failure to manage the linkages within the hospital (micro), the market and macro-environments. From the findings of studies carried out in developing countries, although differ, they point out a common recurrence of lack of supply chain coordination (see Table 3).

Table 3: Coordination problems

References	Focus of Investigation	Findings
Leung, *et al.,* (2016:1)	The impact of inventory management on stock-outs in Zambia.	Lack of coordination for funding, between institutions, interventions, and public and private actors at global, national, and local levels.
Yadav (2015: 146-147)	Diagnosis of the Root Causes Health Product Supply Chains in several developing countries: and an Agenda for Reform	Lack of coordination in terms of supply chain planning, lead time, incentives, skills and designs
Vledder, *et al,* (2015: 4)	Factors impacting supply chain coordination leading to stock-outs in developing countries	Lack of coordination causing a malfunctioning supply chain for essential medicines causes non availability.
Kraiselburd & Yadav (2012:1)	Supply Chains and Global Health in low income countries	Coordination problems across multiple stakeholders with widely divergent objectives.
Nanyunja, *et al*. (2011:12)	Expiry of medicines in supply outlets in Uganda	Lack of coordination between public medicine wholesalers and their clients to harmonize procurement and consumption as well as with vertical programs to prevent duplicate procurement
BMAU; 2015, 1-4	Root causes of continuous stock-outs of medical supplies in Uganda:	Lack of coordination with National Medical Stores, prioritisation and forecasting, planning, data management and monitoring systems when tracking amounts of drugs ordered,
Asamoah, Abor & Opare, 2011:790	Examining the pharmaceutical supply chain for artemisinin-based combination therapies in Ghana.	Lack of coordination of information flow leading to delays and disruptions in the supply chain system
Jahre *et al*., 2012: 67	Improving health in developing countries: reducing complexity of drug supply chains	Lack of coordination between distribution points and stakeholders.
Nakyanzi, Kintu, Oria & Kamba, 2010: 154	Expiry of medicines in supply outlets in Uganda	Lack of coordination between public medicine wholesalers, vertical programmes and clients to harmonize procurement and consumption.

Although the impact of unavailability of ACTs may not have been quantified in all the cases illustrated in Table 3 above, there is considerable anecdotal evidence to show that unavailability of drugs is a result of coordination. The recurrence and observation of coordination issues raised by the scholars listed in Table 3 prompted the quest to explore and examine the coordination of ACTs in developing countries. Moreover, many African countries are faced with the service delivery in their health because the poorly developed uncoordinated supply chain practices that would enable them exploit their potential with regard to timely delivery, improved quality, cost and responsiveness (Smith Madon, Anifalaje, Malecela, & Michael, 2008).

While available literature provides only minimal efforts to classify the attendant supply chain coordination dimensions, Labiad, Beidouri & Bouksou (2014: 617) have attempted to classify three coordination approaches. These guided the examination of how the three management environments influence supply chain coordination in each general hospital:

i) Coordination of departmental activities within an organisation; for instance, between logistics and finance, logistics and production, and logistics and marketing (Arshinder, *et al*.; 2008:316; Labiad, *et al.,* 2014:618). This view considers more collaborative working and joint planning, including joint product development, mutual exchange of information and integrated information systems, and cross-coordination at several levels in the firm's supply chain (Meca & Timmer, 2008:1; Ramanathan & Gunasekaran, 2014:252; Soosay & Hyland, 2015:613).
ii) External coordination between legitimate but separate companies (Labiad, *et al.,* 2014:618; Akhtar, *et al*., 2012:91-92). This is perhaps the most researched issue among the three forms of SC coordination. The idea behind this kind of coordination is the use of information technology as a basis for exploiting the linkages in the supply network. It involves other players, often with varied product offerings (Ballou *et al*., 2000: 613; Patnayakuni, Rai & Seth, 2006: 13; Rai, Patnayakuni, & Seth, 2006:225).
iii) Intra-functional coordination management of interdependent activities within the logistics function of an organisation. The study by Lambert and Cooper (2000: 65) has been at the forefront of this form of coordination, suggesting a shift towards integrated supply chains.

Since hospital SCM includes the internal and external chains, the reviewed work falls short in identifying critical coordination dimensions, logistical activities, and environmental factors that affect the availability of ACTs.

2.4 Summary

In the preceding chapter, a theoretical review on supply chain management coordination, via global and local initiatives revealed gaps. These necessitated further rationalisation and empirical scrutiny, which this study sought to address.

CHAPTER THREE

LITERATURE ON THE DIMENSIONS OF SUPPLY CHAIN COORDINATION AND AVAILABILITY OF ACTs

3.1 Introduction

This chapter presents the conceptualisation of the supply chain coordination frameworks, after a review of literature on available frameworks: Lotfi et al (2013) coordination framework that employed simulations; Phong-arjarn & Jeenanunta coordination framework (2011); Singh Coordination Index (2011) and Gittell (2011). Rational Coordination framework that had used the Network Approach. Other frameworks reviewed, included the Supply Chain Coordination Index (Arshinder, Kanda & Deshmukh, 2009); Xu & Beamon (2006) Framework for Selecting Coordination Mechanism, while applying the Attribute - Based Approach; and the Inter - Firm Coordination Framework of Chen & Yuan (2006). Besides, the frameworks propounded by Simatupang & Sridharan (2005); and Malone & Crowston (1994) and Thompson (1967), were accordingly examined – a summary of all these is highlighted in Table 4 in the chapter. The six elements (forecasting, quantification, procurement, storage, distribution and dispensing) of logistics activities that affect availability of ACTs – as acknowledged by the Liberia Ministry of Health and Social Welfare were also reviewed. The review then examined the interplay between micro, market and macro environmental dimensions in the health supply chain environment (Nagitta & Mkansi (2015) - Table 5). The reviewed studies and frameworks created gaps that eventually underpinned the current study conceptual framework on supply chain coordination & availability of ACTs (figure 5).

3.2 Supply chain coordination frameworks

Some coordination frameworks have been developed and published (Singh, 2011; Chopra & Meindl, 2010; Balcik, *et al*., 2010; Arshinder, Kanda & Deshmukh 2009; Crowston, 1997; Malone & Crowstow, 1994; Galbraith, 1973). These have significantly contributed to the understanding and analysis of different cases, especially in the private sector, *albeit*, with little focus on ACTs (Akhtar, *et al*., 2012; Shukla, *et al*., 2013). Table 4 summarises some of these frameworks:

Table 4: Summary of Analysed Coordination Frameworks

References	Coordination frameworks	Dimensions measured	Discipline	Methodology used	Findings	Micro links	Market links	Macro links
Lotfi *et al.* (2013)	Coordination framework using simulation	Information sharing	SCM	Case studies	Information sharing across different members is found to be essential in managing supply chains effectively under uncertainty.	Firm		None
Shukla, Garg & Agarwal (2013)	Modelling Supply Chain Coordination:	Information technology; joint decision making; Information Sharing and resource sharing	SCM	A case study (Indian automotive parts manufacturing company)	Trading partners is determined as the most important criterion for coordination.	Within firm	Between firms	None
Singh (2011)	Coordination index	6 dimensions of: Top Management commitment Mutuality; Joint decision making and relationships; Information sharing & Responsiveness	SCM	Coordination index using a case study.	Top Management commitment is a major driver for improving the coordination of the six factors. Expert opinions were sought.	firm	Suppliers	none
Phong-arjarn & Jeenanunta (2011)	Coordination framework	Identified four dimensions: Information Sharing (IS), Decision Synchronization (DS), Joint Supply Chain Processes (JP),	SCM	Empirical	The most important factors Top Management's Vision followed by Support and commitment.	Firms	None	None

		and Resource and Skill Sharing (RS).						
Arshinder, K., Kanda, A. and Deshmukh, S.G. 2009	Supply chain coordination index using surrogate measures	Contracts Information technology and Information Sharing& other collaborative initiatives.	SCM	Case studies	There is a need to identify the coordination mechanisms which helps in addressing the uncertainty in supply chains.	Firm	Manufacturers & retailers	
Xu &Beamon (2006)	Framework for selecting coordination mechanism (Attribute based approach)	Resource sharing; Decision style; Level of control Risk or reward sharing	SCM	Case study	Future research should specify what other mechanisms, if appropriate, should be implemented in and determine how the recommended mechanisms should be implemented for a given situation.	firm	None	None
Fugate, Sahin and Mentzer (2006:129-130	Coordination framework	Price coordination Non price coordination Flow coordination	SCM	Empirical case study	1) managers prefer flow coordination mechanisms over price and non-price coordination mechanisms	Firms	Suppliers & customers	None
Chen & Yuan (2006:812)	Inter firm coordination framework in the Aerospace industry	Information sharing, Contract and incentives, Collaboration and trust , collective learning	SCM	Case study	Developed a conceptual framework of coordination in the aerospace industry	Firm	Suppliers & Buyers	None
Simatupang& Sridharan, (2005).	Integrative collaborative frameworks	(1) a collaborative performance system (CPS); (2) Information	SCM	Case studies	Integrated supply chain processes are necessary preconditions for	Retailers	Suppliers, customers	None

		Sharing; (3) decision synchronization; (4) incentive alignment; and (5) Integrated supply chain processes.			coordinated outcomes			
Ballou *et al.* (2000)	Coordination dimensions	intra-functional, inter-functional, and inter-organizational coordination Two main coordination mechanisms were identified; Informal (using power Trust) and formal (performance metrics, sharing of information and allocation of rewards).	SCM	illustrative Case studies	Coordination beyond the immediate function is difficult but offers promise of yet under explored opportunities.	Within functions and between functions	Between firms	None
Malone & Crowston (1994)	Organisational framework	Decision making, communications and development of shared understandings and collective sense making	Organisational design		Focus on dependencies between tasks and not individuals. Focuses attention on cause for a need to coordinate, rather than on the desired outcome of coordination.	Within organisations	None	None
Van de Ven, Delbecq & Koenig	Organisational framework	Impersonal (plans and rules) Personal (vertical	Organisational perspectives	Case study	Identified three modes of coordinating activities.	firm	None	None

(1976)		supervision) Group (formal and informal meetings) & teams			Hypothesized that tasks are worked on jointly and simultaneously. Emphasized group coordination.			
Thompson (1967)	Organisational framework	three generic coordination mechanisms, i.e. standardization or rules,	Organisational design	Case study	Focused on role-based coordination rather than individual ties (groups were the main focus). Thompson notes that dependencies can either be competitive or facilitative.	Within organisations	None	None

Source: Nagitta & Mkansi (2015)

Table 4, it is evident that most of the existing coordination frameworks put little, if any, emphasis on external actors. The major extension to external factors is mainly limited to market factors, and not much on macro factors. The limited emphasis on external factors served as foundation for this study, which related coordination frameworks not only to micro dimensions, but also to market and macro-environment dimensions, especially in developing countries.

For example, in a case study on a selected firm Lotfi, et al (2013), developed a coordination framework while using simulations. For them, they underscored the essentiality of information sharing across the different members in the supply chains. This significantly removed barriers caused by uncertainties. This was a complement to the recent scholars, such as Phong-arjan & Jeenanunta (2011), who had empirically modelled a coordination framework and identified salient dimensions, involving the most crucial factors rotating on the top management's vision, support and organisational commitment. Their coordination framework, like that of Lotfi, et al (2013), had pointed out information sharing as a necessity in decent coordination mechanisms in the supply chain dynamics.

The finding somewhat differed from the literature in which most scholars mentioned trust and information technology as the lead factors in the supply chain coordination. In the review of the literature, the supply chain coordination frameworks emerged to be incongruent with the surveyed empirical case investigations of the distribution of ACTs in developing countries. In this context, the supply chain coordination frameworks developed by previous scholars (Sahran & Zadeh, 2013; Shukla *et al*., 2013; Lotfi, Mukhtar; Phong-arjarn & Jeenanunta, 2011;Gittell, 2011; Singh, 2011; Arshinder *et al*., 2009; Chen & Yuan, 2006; Fugate *et al.,* 2006; Simatupang, 2005), Thompson, 1997; Malone & Crowston, 1994; Van de *et al*., 1976; appeared to opine with the dimensions of the micro-environment. However, Phong-arjan & Jeenanunta (2011), had also underscored in their framework the importance of the elements of decision synchronisation, joint supply chain processes, resource and skill sharing.

This was, nevertheless, rather a magnanimous quest compared to the framework of Singh (2011). The latter, Singh (2011), had proposed a coordination index, involving six dimensions: top management commitment, mutuality, joint decision making, relationships, information sharing and responsiveness. Seeking expert opinions, top management commitment was identified as being crucial to the improvement of supply chain coordination (Table 4). While the scholar used Interpretive Structural Modelling (ISM) methodology, the results were based on five experts' opinion only. Consequently, the framework insinuated the necessity for further validation with empirical data and detailed case studies. Furthermore, Singh (2011: 632) also made attempts to measure coordination with a relatively unique scale. Unfortunately, the tool employed had not been validated, which could have limited the applicability of his findings to hospitals in Uganda. Nonetheless, Singh's (2011) framework was found to be of use to this study in understanding collaborative decision-making, mutual understanding, information sharing, top management commitment, responsiveness, and other organisational factors. In addition, supply chain integration that was initially added to the conceptual paradigm was later dropped after learning from the focus group discussions that hospital systems were not integrated.

Singh was supported by Gittell (2011), who also reiterated the vitality of relationship coordination in his framework which had been modelled using a network approach. Here, shared goals, shared knowledge and mutual respect were identified as requisites in the supply chain coordination framework. However, Gittell's framework highlighted frequent, accurate and communication problem – solving; communication necessity during the supply – chain activities. Other coordination frameworks that were developed before those of Singh (2011) and Gittell (2011) articulated the importance of contracts information technology and information sharing & other collaborative initiatives. For example, Arshinder, Kanda, and Deshmukh (2009) concluded that information technology with adequate sharing of information were essential to cause ideal identification of the coordination mechanisms - helping in addressing the uncertainty in supply chains. Nonetheless, the supply chain framework for selecting coordination mechanisms (Xu & Beamon, 2006), reiterated decision style, level of control and risk or reward sharing above resource sharing. The scholars recommended future research initiatives to specify what other mechanisms, if appropriate, should be implemented. They recommended mechanisms that should be implemented for a given situation, including logistics activities that tend to affect availability of ACTs.

***Logistics dimension framework in general hospitals*:** The findings from a cross sectional survey conducted on 240 respondents in four malaria prone districts in Uganda had indicated that hospitals were mainly affected by "*lack of credible and accessible drug consumption information, poor planning, forecasting and logistics*" (Okiria, Mwirumubi & Mpaata, 2016:1439). Other studies from scholars such as Tumwine, *et al.* (2010:557) had identified that weak inspection and supervision were highly responsible for stock-outs of medical supplies. In fact the study of Baez-Camargo and Kamujuni (2011:12), later also indicated that structural deficiencies without elaborating on the logistics dimensions had also been rife. Strangely, the two studies did little to understand the degree of proficient logistics coordination of ACTs within the general hospitals in Uganda.

According to USAID Deliver Project Task Order (1, 2011:6), management of the drug supply chain should be organised around six basic functions of the medicines management cycle: forecasting, quantification, procurement, distribution, storage, and dispensing (Figure 3).

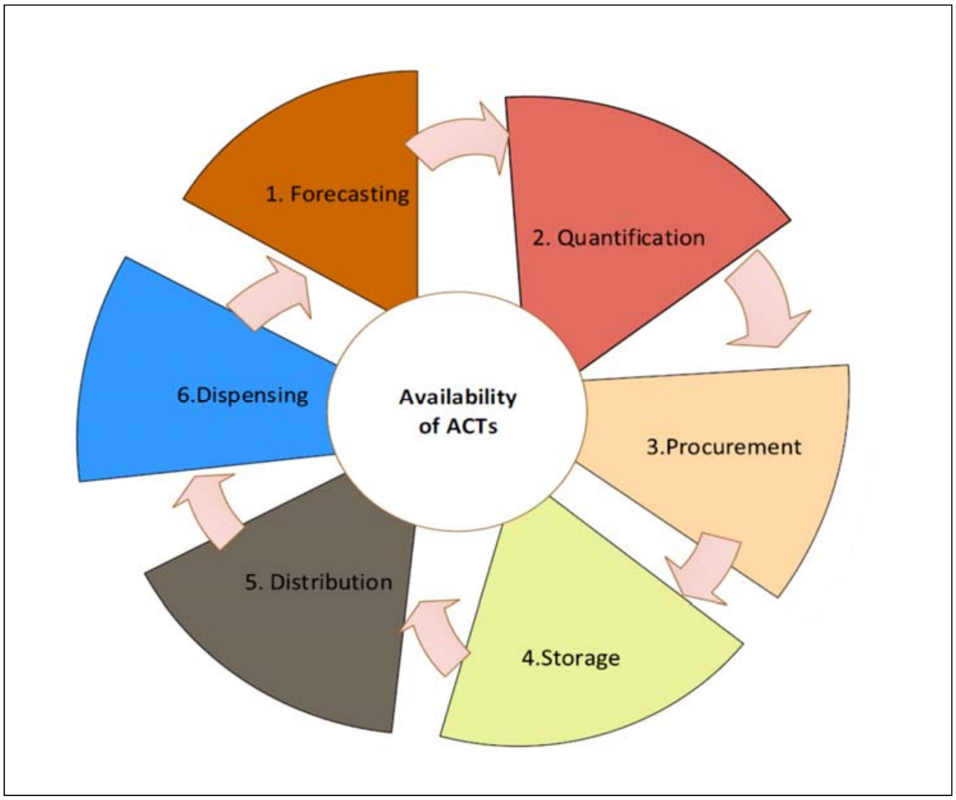


Figure 3: Logistics activities affecting availability of ACTs

Source: Adopted from Ministry of Health and Social Welfare of Liberia

According to figure 3, for an effective medicine supply chain, the above functions ought to be equally important and interdependent to ensure that good quality medicines are promptly available at the service delivery points, especially through use of information technologies (Kamuzora, 2011:4; Bhakoo & Chan, 2011:193). This view was shared later by Iqbal, *et al.*, (2017:81), who asserted that in addition, the success of logistical activities in the medicines supply chain should depend on the ability to consistently meet the demand for standard quality medicines in health facilities, at affordable rates at all levels of the healthcare system.

More so, in another study using factor analysis on a sample of 58 respondents, Shukla *et al.* (2013:64) found out that standardisation of rules, contracts, use of electronic data interchange (EDI), risk and reward sharing, were identified to be key coordination variables. The results of the study were however questioned because of the sample size limitation (Yong and Pearce, 2013:85-86). All the same, it presented the primary enablers of coordination in the SC environments discussed earlier. These studies looked like extensions of the framework developed by Chen and Yuan (2006:812-814), who grounded their efforts in the aerospace industry where they developed a conceptual framework after analysing inter-enterprise coordination in supply chain. The limitation of the study was the failure to empirically demonstrate the interchange of all the coordination dimensions and activities, an issue, which the current research endeavoured to explore.

The key functions that underpinned logistics are presented in Figure 3. An efficacious logistics system provides excellent customer service by fulfilling the seven rights: procuring the right goods, in the right quantity and quality or condition, delivered to the right place, at the right time, for the right cost, and to the right clients or consumers (Abwola, 2014: 2). This implies that if the functions are well managed and coordinated, this may improve service to the customer and lower the waste by making a better connection between demand and supply. Therefore, the health supply chain should strive to integrate its functions of planning and forecasting, quantification, procurement, storage, and distribution. Specifically, this can be done by promoting visibility of information up and down the chain, limiting the number of steps in the process, and encouraging greater coordination and improved predictability of demand among all the levels in the system.

According to Iqbal *et al.,* (2017: 80), many developing countries have been experiencing medicine losses within the logistics cycle (procurement, storage, distribution, and utilisation system), while in some instances, a significant proportion of essential medicines and supplies is alleged to have been misappropriated or diverted. This has so far, called for compulsory judicious management of drug systems (including rational drug management) in order to make optimal use of the drug budget to offer health services of the highest possible standard. Therefore, getting ACTs to patients required that Drug Therapeutic Committees in hospitals coordinate the supply chain activities. In addition, the levels of required ACTs were being based on the challenges (or malaria burden) in the country at a given time. Once the orders were generated by health facilities, they were sent to NMS, which purchased and stored the medicines centrally and finally distributed them to regional stores and local health facilities. For this study, concentration on understanding how the coordination of supply chain logistics activities and their inter-dependencies influenced availability of ACTs in general hospitals in Uganda, was emphasised.

On the other hand, lack of coordination in public hospitals resulted in unavailability of medicines and this has had far-reaching consequences on patients' lives (Kohler *et al.,* 2012:1). Despite the obvious need for drugs to treat patients, information on the prevalence of stock-out has also been predominantly analysed through small survey data sets, and there has been a lack of an integrated framework, addressing the logistics problem (Masters, *et al.,* 2014:1). Therefore, this study aimed at addressing this gap by developing a supply chain coordination framework to expedite the availability of malaria treatment pills, referred to as ACTs.

Market and macro-environment dimensions: To further understand the coordination frameworks used in the supply and distribution of ACTs in the African public sector and from a market and management environment perspective and from a critical realist stance, this study reviewed previous studies that applied coordination frameworks. Accordingly, twenty cases were purposively selected within Africa - linked to the market and macro-environments. The purpose of this was to identify only those studies that dealt with ACT supply and distribution in Africa. Therefore, the focus of this study was to use the coordination theory as a basis for making generative models (i.e. models that suggest interplay between alternative ways in which a process could work using the micro-, market- and macro-environments).

Also reviewed, were published reports and scientific publications from *Malaria Journal*. The journal provides research on several drug-efficacy studies conducted, with examples from Uganda, Tanzania, Kenya, Malawi, Sudan, Ghana and Nigeria, among others in Africa, etc., from 2005 to date (Table 5). These were selected purposely to document how coordination frameworks were influenced by macro factors in developing countries in the supply and distribution of first-line antimalarial drugs for uncomplicated malaria. For experiences on the implementation of the policy, several reports and publications were reviewed to assess whether the level of implementation of the new policy considered the interactions of the micro-, market-and macro-environments.

In order to demonstrate the geographical context of how the market and macro-environment add to the micro dimensions presented in Table 5 above, in the next section, the study presents case studies on supply and distribution of ACTs that highlight the implications arising from market and macro-environment. The literature reviewed under this section took a step in the direction of examining whether there were interactions between micro (critical SCC dimensions) and the other management environments (market and macro-environments) within the supply chain management and general organisational designs. Using content analysis in Table 5, it is clear that many of the existing frameworks have limited capacity to analyse the interactions between different elements of market and macro-environment in the public sector. The analysis also examined the dimension used for measuring coordination. Coordination framework falls into the following seven themes as follows: top management commitment; mutuality; joint decision making and relationships; information sharing, contracts, responsiveness and standardization plans. Unfortunately, there was no coordination framework linked to the macro-environment. Further quotes were extracted from the different articles and reports as indicated in Table 5.

Nagitta and Mkansi (2015:36) affirm that it is important to have a clear understanding of the environment in which a supply chain operates as well as the external forces influencing its level of service delivery. Within a country, the medicine supply chain may operate at different levels: central, regional/district, and service delivery points. In addition, various vertical supply chains may be operating within a country, with many points of intersection and overlap and a diverse set of stakeholders. Therefore, inclusion of factors external to the health facility may complement public sector health-based treatment channels. The foregoing notion is also acknowledged by Nieman and Bennett (2002) and Fahey and Narayanan, (1986) who perceive the market and macro-environments as being instrumental and part of the major management environment. From these environments, businesses may be influenced by several variables emanating from one environment, or sometimes a combination of them all. The micro-environment includes resources (such as capital and labour), business strategies (policies, aims and objectives), and business functions (logistics, marketing and operations). Secondly, from the market environment, there are stakeholders (employees, shareholders) and role players (customers, suppliers, competitors, new entrants, opportunities, and threats). Lastly, in the macro-environment are political, economic, technological, physical, and environmental factors. These were investigated in the current study. From the results, we note that the coordination frameworks for supply and distribution of ACTs demonstrate interplay of all the business management links that describe and analyse the supply and distribution of ACTs. Therefore, it calls for such elements to be taken into account. Table 5 presents the profile of the case studies reviewed.

Table 5: Interplay between the micro, market and macro environment dimensions

Ref	**Case study**	**Quotes from the case**	**Developing country**	**Micro links**	**Market Links**	**Macro links**
Watsierah & Ouma (2014)	cross-sectional survey	Policy actions to address the multiple barriers of access should include broad interventions to revitalize the public health care system.	Western Kenya	Behaviour change communication is recommended during which all outlets staff should be trained in unbiased manner on the current malaria policy to improve drug use in the community.	Considering the role played by private sector in providing treatment for patients in western Kenya, it is important to effectively increase Artemisinin-based combinations in the outlet.	Government needs to implement price policies to protect the most vulnerable groups from exploitation by establishing effective surveillance mechanisms. The prices should also be regulated to ensure uniformity in pricing of the same product in all sector outlets.
RollBack Malaria (RBM) partnership/ United Nations Development Programme, (2013)	Various case studies	Multi-sectoral Action Framework is needed to reduce the malaria burden. The approach stresses creation of synergies through complementarity, effectiveness and sustainability to capitalize as well as emphasizing coordination and managing new and innovative ways.	South Sudan, Kenya, Tanzania	Household surveys, designed to produce data that are comparable over time and across countries.	Private sector, households need to collaborate.	Calls for coordinated action among different development sectors to tackle the disease, which exacts its deadliest toll in sub-Saharan Africa. Coordination among implementing partners such as; national malaria control programs, donors, USAID and Presidents Malaria Initiative (PMI) staff, research institutions, and private sector organisations.
RollBack Malaria (RBM) partnership/ United Nations Development Programme, (2013)	Various case studies	Multi-sectoral Action Framework is needed to reduce the malaria burden. The approach stresses creation of synergies through complementarity, effectiveness and sustainability to capitalize as well as emphasizing coordination and managing new and innovative ways.	South Sudan, Kenya, Tanzania	Household surveys, designed to produce data that are comparable over time and across countries.	Private sector, households need to collaborate.	Calls for coordinated action among different development sectors to tackle the disease, which exacts its deadliest toll in sub-Saharan Africa. Coordination among implementing partners such as; national malaria control programs, donors, USAID and Presidents Malaria Initiative (PMI) staff, research institutions, and private sector organisations.
Yeka, *et al*. (2013)	Country case study	Using public health facilities alone in provision of ACTs, are	Uganda	Public sector health facilities	Medicines for Malaria Venture, has demonstrated that providing	Coordination of malaria is most effective and attainable through the

		not adequate because of inaccessibility. Inclusion of the private sector in healthcare provision will complement public sector and community-based treatment channels.			subsidized ACTs through the private sector can lead to a dramatic improvement in the availability (~70% market share) of effective treatment and the level of uptake.	Interagency Coordination Committee for Malaria (ICCM), with technical working groups (with broad participation from government departments, development partners, civil society and the private sector) for each strategic intervention.
Wild & Cammack (2013)	Country case study	Challenges of chronic shortages of medicines reflect issues of resourcing, at all levels including the health sector in general and with other sectors.	Malawi	Establish drug committees in health facilities to monitor delivery and distribution of medicines, (strengthen bottom-up monitoring mechanisms).	In addition to drug committees in health facilities, involvement of selected community members, to monitor delivery and distribution of medicines, is critical.	Strengthen aspects of policy coherence, coordination, and performance monitoring which would improve the effectiveness of medicine supply and distribution in incremental ways. Developing emergency Drug Procurement Project.
Talisuna *et al*., (2012)	Case studies of Four rural districts	Failure of co-ordination increases burdens on already pressured national institutions.	Uganda	Strengthening the public sector without providing complementary support from the private sector is very unlikely to achieve the WHO Global Malaria Action Plan (GMAP) case management access target that 80% of patients who are supposed to receive treatment within 24 hours of symptom onset.	Retailers, wholesalers. The private sector cannot be ignored, as it is the first point of call for about 60% of Ugandans seeking treatment for fever across all socioeconomic Groups.	Project management team consisting of representatives from the Ministry of Health (MoH), National Drug Authority-NDA and other. Programmes for Accessible Health Communication and Education (PACE), Surgipharm Pharmaceuticals, Malaria Consortium-MC, Ug-MoH, NDA, and the district health officers of the pilot districts.
Shretta and Yadav (2012)	Case studies	A mix of strategies will be required to stabilize the artemisinin and ACT market	Public, public not for Profit and private outlets in Kenya	Individual outlets.	i) Voluntary standards should be created for extractors to ensure appropriate purchasing and sales practices.	i) Better grant management and disbursement at the Global Fund as a part of its new funding model to relieve some of the pressures on the ACTs supply chain, especially with respect to financing delay. ii) Significant investments in country level system strengthening will be required to minimize demand uncertainties at the national level. iii) Streamlining donor processes for fund disbursement and developing better information exchange standards among farmers, extractors, and manufacturers from the agricultural process to sales and purchasing will prevent the bullwhip effect arising from country

						level demand variability to ensure that decision making is not based on inaccurate market signals and ultimately enable a better matching of supply & demand.
Malisa et al., (2011)	Two case studies (Kilombro/Ulanga district	Policy change is both an expensive and difficult process, and many endemic countries are already faced with difficult decisions on how to replace ineffective antimalarial drugs in use with more efficacious, but also more costly alternatives. One of the greatest challenges in this decision-making process is the fear that resistance will develop rapidly to the replacement drug.	Tanzania	Households/families	Increased demand of in both the public and private sector leading to intense collaboration due to drug pressure.	influence of the media, policy makers, and health worker relationship on Parasite population genetic change in Kilombro/Ulanga district is vital.
Asamoah, Abor, & Opare (2011)	Country case study	Networking is necessary because of complex interactions within and between companies in relationships over time.	Ghana	There are basically two main supply channels through which ACT enter the Ghanaian pharmaceutical system. These are the formal (public) and the informal (private) conduits.	Network structure acts as a strategic Alliances that an organisation forms with suppliers, manufacturers and distributors to produce and market a product.	ACT supply network show that, the key actors of World Health Organisation (WHO), Novartis (who plays a key role in the supervision of the farmers), farmer, importer, wholesaler, funders.
USAID / PMI (2011)	Country-wide	Information sharing among donors, the NMCP leadership and staff members will be an important element to consider in Supporting coordination efforts.	Democratic Republic of Congo (DRC)	Training and supervision of health workers trained in malaria.	Collaboration with other donors to make sure that private sector groups are involved in coordination efforts.	Continued support to national and provincial Malaria Task Force Committees for regular meetings and preparation and support technical assistance for coordination and annual review of activities.
Dalrymple (2010).	Several country case studies in developing countries	Malaria is a cross-border affliction of global magnitude, hence the need to control it. Key components are national policies toward adoption and subsidy programs.	Tanzania, Uganda, Kenya among others	Health facilities	Local farmers, extractors, distributors (wholesalers & retailers), Producers, Research & Development, pharmaceutical firms.	Foundations & other donors, government policies, public and private sector.
Ongolo-Zogo & Bonono (2010)	Policy dialogue	WHO recommends putting in place comprehensive Coordination frameworks contextualised to relevant social and community organisations, including the private sector, to	Cameroon	National Committee to Rollback Malaria, recommends home-based management of malaria (HMM) to improve access and reduce delays in	Performance-based contracting for the provision of subsidized ACTs; revising regulations on ACT distribution; Engage private pharmacists in the distribution of subsidized ACTs; ACTs profiling	i) Strengthen the stewardship and regulatory role of the Ministry of Health to ensure the proper registration, regulation, and use of ACTs; ii) resource mobilization to secure the availability of ACTs

		improve access to malaria drugs for vulnerable citizens.		treatment.	(packaging, labelling to limit the illicit drug market; execute specific communication and educational plans aimed at revalorizing the role of and proactively engaging the private pharmacist as public health agent.	nationwide; iii) establishing resources and tools for monitoring and evaluation to ensure universal and equitable access to iv) embedding the HMM strategy within the primary healthcare framework to ensure its sustainability.
USAID/Deliver Project, (2010)	Various case studies	Critical to Set up of in-country logistics management systems to coordinate or collaborate with stakeholders involved in financing, procuring, or distributing commodities.	Zambia & Zimbabwe, Bangladesh, Tanzania & Paraguay	Product selection, quantification & procurement, inventory management at Facility level/procurement units.	Suppliers, distributors (third party logistics), warehouses (central medical stores), programme managers, Service delivery points, government procurement units within health facilities.	Sharing of information with partners at the Central government level (MoH, Provincial Health Offices, Districts, Implementing partners, donors/funding agencies, NGOs, Local regulatory authorities, Medicine planning and selection unit.
Alba *et al*. (2010)	Two case studies	The public health and private retail sector are important complementary sources of treatment in rural Tanzania. Ensuring the availability of ACTs in the private retail sector is important for its successful uptake.	Tanzania	If quality of services is ensured in the private sector the public health impact of ACT can be maximised by making this class of drugs available.	Major gains were made in the private retail sector in terms of availability and accessibility.	It is argued that the delivery of anti-malaria needs to be supplemented by additional distribution mechanisms. This can be achieved through: 1) community case management and 2) strengthening the role of the private retail sector.
Chuma, Okungu & Molyneux, (2010)	Four case studies	Policy actions to address the multiple barriers of access should be designed around access dimensions, and should include broad interventions to revitalize the public health care system.	Kenya	Important to address cultural beliefs (in terms of health workers' age, gender and qualifications which affect provider-patient interaction.	Need to address non-health related interventions such as insecurity and fragility of household incomes can have a significant role in minimizing affordability and access to ACTs.	The government should work closely with health workers, district health management teams and health facility committees to ensure availability.
Africa Fighting Malaria (2007)	Country case study	All stakeholders need to refocus accountability, evidence-based policies with more and better data through capacity building countrywide.	Uganda	Ideas and existing programs all require, increased education and Project supervision at the village level.	Effective and interactive communication routes within the supply chain, specifically between users, manufacturers, purchasers and suppliers are crucial at all stages.	More resources and better coordination at the local level will come with greater engagement from the private sector and faith-based organisations.

Mutabingwa (2005)	Case study	Concerted efforts of multilateral organisations, the local scientific community with involvement of policy-makers progress will be registered on provision of ACTs.	Uganda	Investment in capacity building and strengthening (personnel, resources and infrastructure) of institutions in malaria endemic countries.	Active involvement of scientists from malaria endemic countries in recent International Scientific Forums like the Malaria in Pregnancy Working Group and the Consortium on ACT Implementation is the way to go.	Clear policies on external funding and minimal politics within funding agencies are required. Increased public and private sector partnership are critical if anti-malarials are to be e made available in poor malaria endemic countries.

Source: Nagitta &Mkansi (2015)

From Table 5, it can be observed that several dimensions from a micro link are proposed, few are suggested from the market environment, and none from the macro link. The implication is that the market and macro environments are ignored in many coordination frameworks. Equally, most of the frameworks mentioned above were applied in retail (e.g. Kumar, 2012; Amer, Luong, & Lee, 2010), construction (e.g. Papadopoulos, Zamer, Gayialis, & Tatsiopoulos, 2016; Xue *et al*., 2007:150) and manufacturing sectors (e.g. Georgise, Thoben, & Seifert, 2014; Zhang, Zhao, Voss, & Zhu, 2016) with little or no emphasis on the heath supply chain, market and macro-environments. Previously, coordination dimensions had often been operationalised and evaluated using surrogate (proxy) measures of supply chain profitability. Hence the need to carry out empirical studies to appreciate the impact of implementing a combination of coordination dimensions so as to specify the micro-, market-and macro-factors in managing the interdependencies. This paved the way for analysing the critical supply chain coordination dimension in the hospitals, the attendant logistical activities and management environment (market and macro environments) that enable availability of ACTs in public general hospitals in Uganda (see figure 4). Therefore, it was presumed that if correctly done, supply chain coordination may facilitate the integration of chain activities, resulting in better performance as supported by Shukla, *et al.,* (2013:64).

From the above discussion, it was concluded that there was a need to broaden the theoretical domain of supply chain coordination within the medical field, basing it not only on the micro and market-environments but focusing on a holistic orientation, including the macro-environment and logistics dimensions. Micro and market orientation alone is not sufficient to create superior supply and distribution of ACTs in developing countries, given the dynamics in the larger economy (rooted in national, regional and international contexts). The findings have been schematised in a new framework (Management environment) as shown in Figure 5, with the hope that it will address the interplay of an interdependence among the three management links that describe and analyse the supply and distribution dimensions of ACTs (micro, market and macro environments). Figure 4 illustrates the coordination framework dimensions that underpinned this study for objective 1 and 3 as suggested by (Nagitta & Mkansi, 2015:38). For objective 2 (logistics activities dimensions) are included in the conceptual framework figure 5.

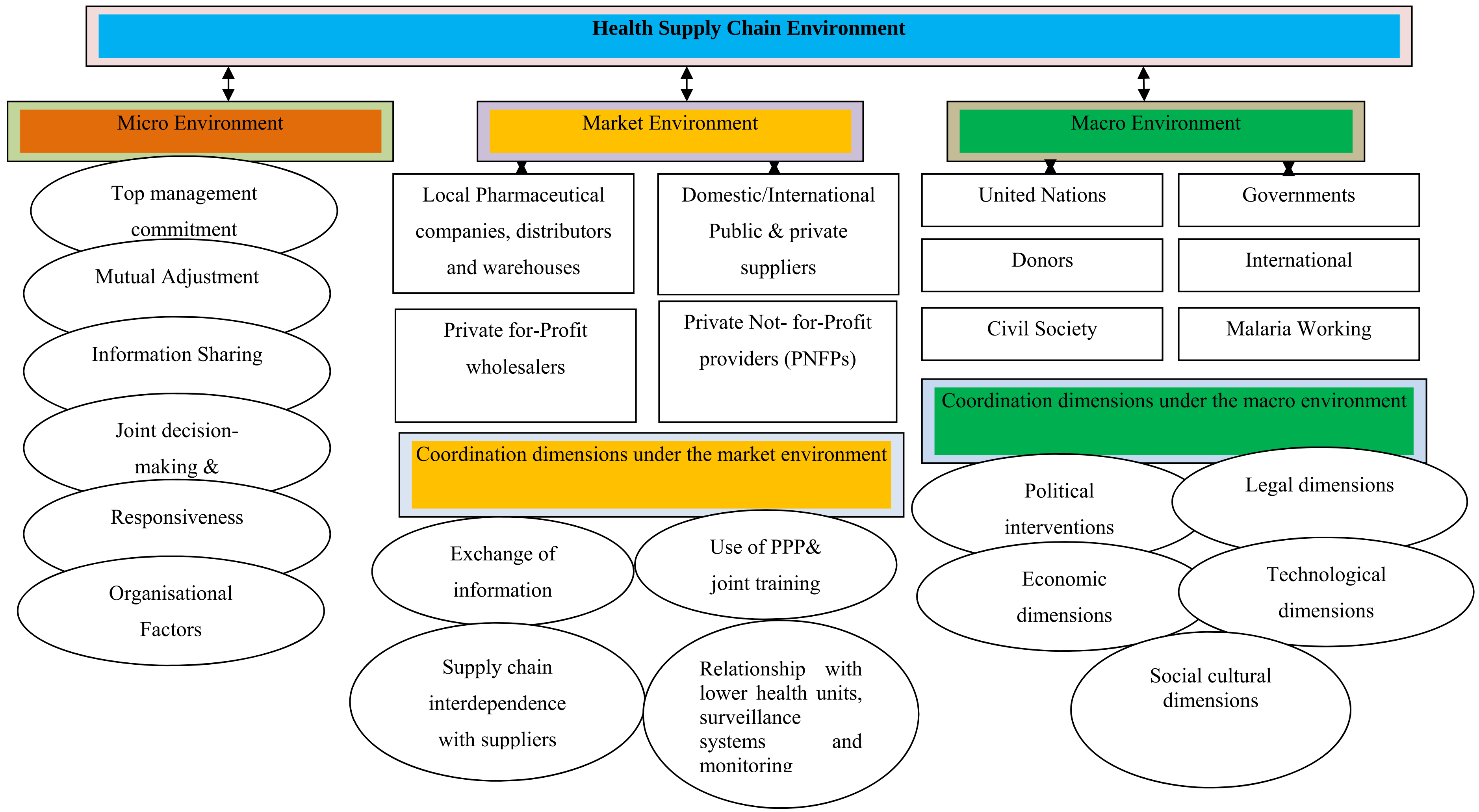


Figure 4: The micro, market and macro dimensions of ACTs market coordination

Source: Nagitta & Mkansi (2015:38)

From the theory and literature review, a health supply chain environment on three levels: micro, marketing and macro environments is depicted in figure 4. Each environment is depicted with its underlying elements, as perceived by Nagitta & Mkansi (2015:38). The current study focussed on micro, market and and macro dynamics of the supply chain coordination in answering objectives 1 and 3. Figure 5 shows the conceptual framework which was developed from the health supply chain environment.

3.2.1 Summary of coordination framework used for the study

This was worked out basing on the developed conceptual framework (Figure 5).

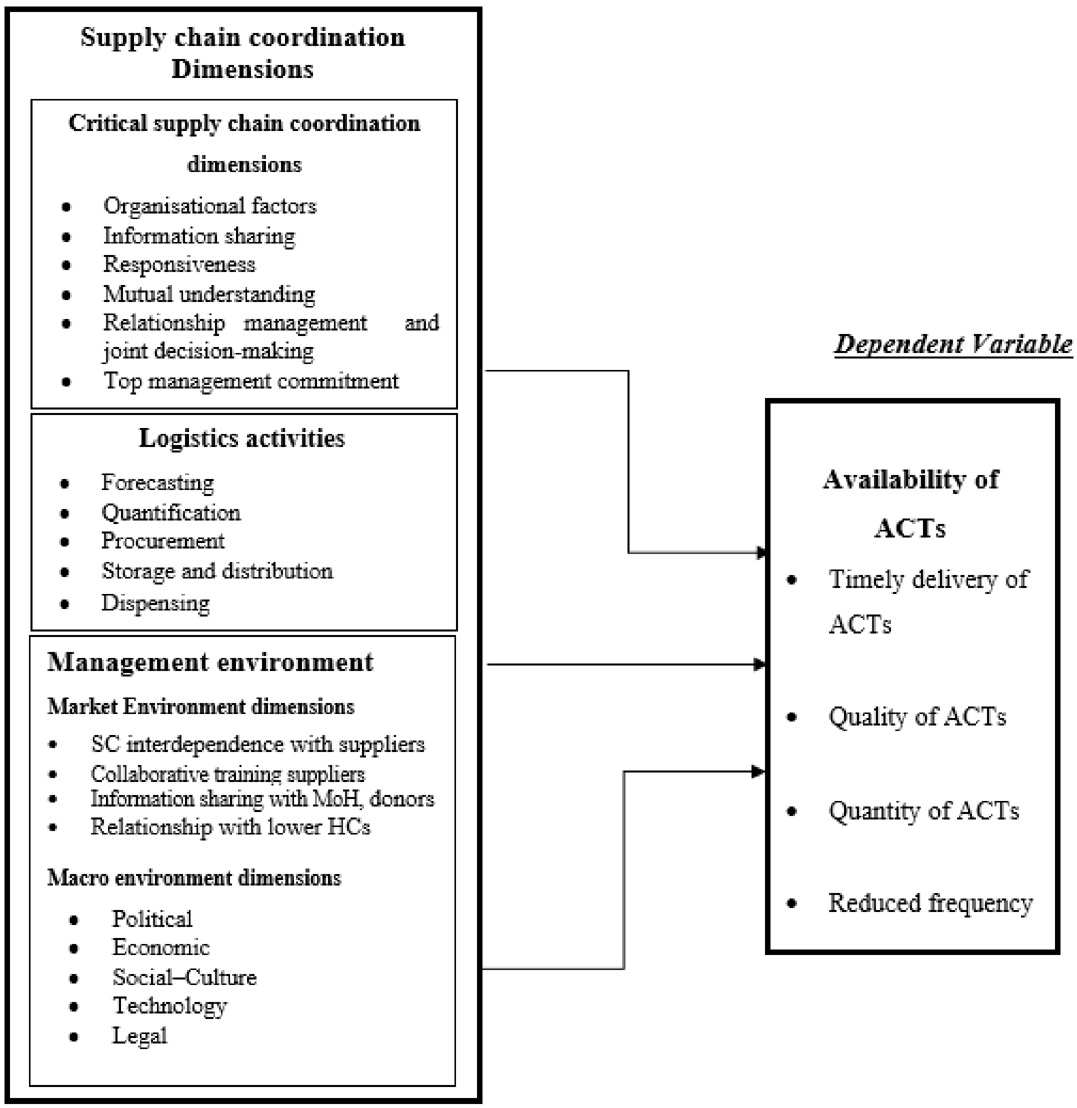


Figure 5: Conceptual Framework on Supply- chain coordination and availability of ACTs

Source: Reviewed literature

The conceptual framework (Figure, 5) depicts supply chain coordination dimensions, as the independent variable the current study. This variable was investigated on the levels of critical supply chain coordination dimensions (micro), logistics activities, and management environment (market and macro). Supply chain coordination dimensions were scrutinized on issues of: organisational factors, information sharing, responsiveness, mutual understanding, relationship management, and joint decision-making and top management commitment. Secondly, logistics activities were examined on forecasting, quantification, procurement, storage and distribution plus dispensing. The last indicator of the independent variable (management environment), according to Figure 5, was investigated on market environment dimensions (supply chain interdependence with suppliers, collaborative training with suppliers, information sharing with Ministry of Health plus donors and relationship with lower health centers), and macro environment dimensions, were assessed up on five levels, namely: political, economic, social–culture and technology and legal. Figure 5, also shows availability of ACTs (the dependent variable of the study). It was scrutinized with the elements of timely delivery of ACTs**,** quality of ACTs**,** quantity of ACTs**,** and reduced frequency of ACT stock-outs.

3.3 Critical supply chain dimension

Critical supply chain coordination, was investigated on six (6) dimensions, as adopted from Singh (2011) – summarised in Table 6.

Table 6: Summary of critical SCCD at the micro (hospital) level

Dimensions	Characteristics/ brief description	Sources
1.Organisation factors (OF)	Organisational structures, hierarchy and bureaucracy and how power flows from top to bottom; decision style.	Ronen, Shlomit & Ben-Asher (2007); Osifo (2012); Anand & Mendelson (1997); Xu and Beamon (2006).
2. Information sharing	Mutual exchange of information on products, processes, schedules and capabilities.	Flynn, *et al*., (2010); Singh, 2011). (Barratt & Oke, (2007); Mikkelsen-Lopez, *et al*., (2013); Gittel (2011). Stanley, *et al*., (2009).
3. Responsiveness	Ability of supply chain members to respond to customer requirements or the ability of an organisations to identify changes in supply and demand, respond swiftly and recover from the volatility in order to sustain a competitive advantage.	Singh (2011); Mehralian, *et al*., (2013); Holweg (2005).
4. Mutual Understanding	Linked to appreciation of organisational goals and building of trust among supply chain members.	Boswell (2006); Arshinder *et al.,* (2009); Kumar, *et al*., (2015); (Katsikeas, *et al*., (2009).
5. Relationship and joint decision making	The opportunity to participate in decision-making, teamwork, and organisational activities.	Matopoulos *et al*., (2007); Barratt & Oliveira (2001); Wagner, *et al*., (2002).
6. Top Management commitment	Mandate to determine the staff to be recruited, investments to be made and defining the organisational structure to accomplish mutual goals.	Hossain and Wu (2009); Singh (2011:623);Sandberg and Abrahamson (2010)

3.3.1 Organisational factors

Organisational factors in the study included organisational structures. According to Ronen, Shlomit & Ben-Asher (2007: 3), these can either be vertical or horizontal. The former are characterised by hierarchy and bureaucracy where power flows from top to bottom; while the latter stresses specialisation and participation. Other organisational structures can be decentralised, flat and flexible because employees are granted more responsibilities for their tasks. The nature of organisational structure determines the coordination dimensions (Osifo, 2012:9). Therefore, if the structure is hierarchical, the coordination is from top to bottom; while a horizontal structure attracts specialised skills requiring flexible dimensions (Ronen, et al., 2007:3). The coordination mode may also take any of the two aspects: how information is shared (information capability); and using authority to make administrative decisions along the supply chain (Anand & Mendelson, 1997:169). The study examined how these dimensions manifest at macro-, market- and micro- level. It also examined these dimensions in supply chain coordination, and how they facilitate information sharing and decision-making among members of the chain to avail malaria treatment pills in general hospitals in Uganda.

3.3.2 Information flow

Information flow was assumed to equate to information sharing – examined with items, including: Verbal communication during CMEs and its influence on ACTs availability; Electronic drug management system and its interactive influence with ACTs availability; Rx-solution and its influence on ACTs availability; information on stock cards and its potential to improve availability of ACTs; sharing of stock status and its influence on availability of ACTs; timely information pinned on notice boards and its ability to improve availability of ACTs, and finally the use of hardcopy reports regarding ACTs and their ability to improve availability of ACTs.

According to Crowston (1997:158) organisations conduct their activities through social networks of employee-actors, who coordinate the flow of products, resources and information using information systems in their work routines. The main objectives of a good logistics management information system (LMIS) includes: improved implementation of an efficient information systems for accurate reporting on what is supplied, consumed and wasted. It should be able to gather data, organise it, analyse and report accurate, timely and appropriate information to decision makers so as to evaluate the how supplies flow, account for products, reducing supply imbalances, and improve efficiency (Chen, 2013: 392; Pinna, Carrus & Marras, 2015:123).

Mutual exchange of information on products, processes, schedules, and capabilities helps supply chain members to develop timely, accurate, and complete delivery plans for the product, therefore improving delivery responsiveness (Flynn, *et al.,* 2010:60; Singh, 2011:634). It also improves accuracy of demand information for products and stock levels in real time and the extent of need (Barratt & Oke, 2007:1217; Mikkelsen-Lopez, Cowley, Kasale, Mbuya, Reid & de Savigny, 2013:2; Gittel, 2011:8). Stanley, Cynthia, Chad and Gregory (2009:222) acknowledge that the use of ICT such as software application packages, decision support systems and the Internet are all effective ways of facilitating information flow within and between supply chain actors. However, the initial cost of investment may be prohibitively high in the developing countries, where the use of information technology infrastructure is still limited.

These information systems help in effective management and coordination of ACTs because they support information flow between departments, market and macro partners. Unfortunately, the accuracy of the supply and demand data is most often disputed, something that has negatively impacted the quality of services offered, rate of responsiveness, and operational efficiency (Smith, *et al.,* 2008:3; Pule, 2014:137; MoH Report, 2011:26).

Lack of reliable data, as Yadav (2015:150) asserts, is one area that affects supply chain performance in public health. It leads to high operational costs and lack of real time information about stock status in terms of consumption levels and orders. Rassi *et al.*, (2016)further contend that while reinforcing the supply chain may reduce the incidence of stock-outs of malaria treatment pills in public facilities, stock-outs reportedly continue to occur. The problem is further worsened due to data inaccuracy along the data recording and reporting chain, henceforth restraining policy makers' capability to react adequately to challenges and trends.

Unlike the public sector, private or profit making supply chains have been quick to adopt information and communication technology (ICT) to improve information flow and decision-making across their supply chains. The resultant effect has been the creation of up-to-date, accurate information, with potential to overcome the numerous problems encountered in the public sector supply chains. In addition, information about stock at hand, orders, consumption, and shipments has also enhanced the desired accountability in the supply chain in the private sector.

According to Kocoglu, Imamoglu, Ince, and Keskin (2011:1637), sufficient information flow also calls for adequate conceptualisation and management of supply chain integration. These scholars view three constructs as being central in supply chain integration (SCI), namely, integration with suppliers, with customers, and within the organisation. They also acknowledge that SCI is a vital coordination mechanism in enhancing linkages among SC members and facilitating timely delivery of services and products. However, Otchere, Annan and Quansah (2013:112) argue that companies ought to embrace cross-functional integration of strategic business processes, both within and externally. Nonetheless, the absence of integration between members of supply chain at the micro-, market- and macro-environments may lead to operational inefficiencies and inhibit the performance of the supply chain. While integration of upstream and downstream supply chains is better, implementation should start from internal functional integration before the organisation integrates with the external actors. This view was later supported by Lambert (2014:137), who advocated for the shifting from a narrow focus to a more coordinated supply chain level, to necessitate investing in health information management systems (HMIS) that eventually would revamp supply chain practices in Africa.

3.3.3 Responsiveness

Responsiveness was perceived as the ability of supply chain members to respond to customer requirements or the ability of an organisation to identify changes in supply and demand, respond swiftly and recover from the volatility in order to sustain a competitive advantage (Singh, 2011:625; Mehralian, *et al*., 2013:80; Holweg, 2005:605). At the operational level, responsiveness enables entities to compete based on quality delivery timelines, cost, quality and time to market. This implies that responsiveness of a firm's logistics (transportation and distribution) process not only enhances the firm's ability to introduce new products faster than major competitors, but also leads to greater ability of a firm to provide the type and volume of product required by customers on time (i.e. increasing delivery dependability). In addition, responsiveness of a firm's supplier network will improve - the ability of the firm to provide on time delivery (i.e. increase its delivery dependability) as these firms will be endowed with responsive suppliers (Sukati, Hamid, Baharun, Alifiah & Anua, 2011:2). In being responsive, flexibility must be harnessed although the latter must be considered in a broad perspective in relation to the aim, strategy and situation at hand. In practice, the problem may arise when the important flexibility dimensions for a particular situation are considered separately instead of jointly.

However, without supply and demand information, the reality may be far-fetched (Williams, Roh, Tokar, & Swink, 2013:543). This means that supply chain actors must be integrated to create the desired visibility through some form of information technology tools. Unfortunately, there is no consensus on how to measure integration. Another challenge is having too much data, which cannot be processed into meaningful information. Therefore, whereas supply chain visibility is a necessary requirement, it is not an adequate condition for supply chain responsiveness.

Singh (2011:633) categorises responsiveness into four dimensions: flexibility, delivery on time, service reliability, and ability to adopt process changes. Responsiveness occurs because of elasticity in manufacturing and distribution of the commodity. Each of the elements ensures that organisations avoid inconsistency in demand, which would otherwise increase inventory-holding costs (Hopp & Spearman, 2004:145). Theoretically, the implication is that supply chain actors need to show capability and also to become innovative in realising the agility. According to Chan, Chung, and Choy (2006: 307), meeting product demands in a timely manner creates customer confidence and customer retention. This is normally a daunting task because supply chain uncertainties at any one stage of the supply chain may prompt sluggishness. In support, Turkyilmaz, Bulak &, Selim Zaim (2015:1), hospitals tend not to pay enough attention to responsive approaches within the healthcare supply chain management, making them uncompetitive. The result is undelivered promises hence affecting the overall health service delivery.

3.3.4 Mutual Understanding

Mutual Understanding was linked to appreciation of organisational goals and building of trust among supply chain members. In an empirical examination of strategy frameworks, Boswell (2006:1504) found out it is not only important for employees to understand the goals but how to contribute to the organisation's strategic goals was more crucial. She therefore, concluded that:

> *"It appears that employees who understand how to contribute to an organisation's strategic goals are more likely to feel a sense of belonging (or fit), perhaps since they are better able to work in alignment with the firm's needs, while this is not necessarily the case for employees that are aware of the strategy but not necessarily know what to do about it"* (p. *1504*).

However, Boswell's framework concentrated analysing the individual employee perceptions and outcomes. We hypothesised that ACTs' availability will be enhanced when employees at all levels share assumptions, beliefs and values that are aligned with strategic goals and capabilities.

Successful implementation of supply chain activities requires members to mutually understand each other, plan jointly, and agree on effective implementation dimensions to deliver the required services and products (Arshinder *et al.,* 2009:785; Kumar, Singh, & Shankar, 2015: 94). Trust is critical in highly interdependent supply chains (Katsikeas, Skarmeas, & Bello, 2009:132). Therefore, when trust is established, joint forecasting of demand becomes possible between partners. This eases modification of orders whenever necessary and minimises frequency of stock-outs (Dudeck & Stadtler, 2005:670; Simatupang *et al*., 2005:257). Gittel (2011:16) argues that while shared knowledge or shared understanding is important, it may not be sufficient to bring about the desired performance among supply chain actors, especially in the absence of shared goals and mutual respect among actors. Therefore, scholars have not fully illustrated how shared understanding at the micro-, market- and macro-environments can be achieved to bring about availability of products and reduce stock-outs in the public health facilities such as general hospitals in Uganda.

3.3.5 Collaborative decision-making

The opportunity to participate in decision-making, teamwork, and organisational activities was thought to contribute to two important outcomes for employees: 1) increased trust among managers and employees, and 2) increased intrinsic motivation owing to more meaningful and significant work (Buller & McEvoy, 2012:47). In Uganda, some scholars have investigated supply chain collaboration from a SMEs perspective (Eyaa & Ntayi, 2010; Ntayi, Rooks, & Eyaa, 2009). However, the mentioned studies did not address the impact of the components of collaborative relationships on supply chain interdependence and availability of medicines in public health sector. In this study, the relationship between the components of collaborative relationships and ACTs availability is examined. Collaboration is about firms or entities working together after realising that working alone is insufficient to resolve common problems (Matopoulos Vlachopoulou, Manthou, & Manos, 2007; Barratt & Oliveira, 2001; Wagner, Macbeth, & Boddy, 2002). According to Simatupang and Sridharan (2004), when supply chain members cooperate, there is likely to be an improvement in the flow of goods / services, finances and information creating improved performance. The key dimensions of collaborative relationships are Information Sharing, incentive alignment and decision synchronisation (Simatupang & Sridharan, 2002; 2005).

In support, Singh (2011:624) contends that collaboration is joint decision-making. Collective decision-making entails joint forecasting of demand that should be properly done to reduce costs, facilitate timely delivery and improve service satisfaction (Simatupang *et al*., 2005:260). Whereas joint decision-making requires trust and flow of information among the supply chain members, scholars stress the need to understand human systems and their complexities (Kohli & Jensen, 2010:3; Malone & Crowston, 1994:91; Fawcett, Magnan & McCarter, 2008: 36-37). However, they observe that one of the impediments to supply chain coordination is failure to conduct regular collaborative meetings among chain partners. The better the relationships, the higher the reporting rates, which in turn may contribute to better decision-making at the planning level (Vledder *et al*., 2015: 13). In this study, collaborative elements between members in supply chain (that is, government, donors and health managers), were examined to determine their effect on availability of ACTs in general hospitals in Uganda.

3.3.6 Top Management commitment

Top Management has an important role to play in effective supply chain coordination (; Singh 2011:623; Sandberg & Abrahamson, 2010:60; Hossain & Wu 2009). It has the mandate to determine the staff to be recruited and to define the organisational structure to accomplish mutual goals (Boella & van der Torre, 2006: 4). The scholars reiterated that Top Management should provide adequate resources and financial support for building an efficacious system to prioritise SCM implementation. However, without good governance and transparency among civil servants, politicians and policy makers in the flow of information regarding medical products, it may not be possible to realise the public sector supply chain outcomes (Yadav, 2015:151). The scholar further contends that leaders should be accountable, measure performance, build staff capacity, encourage cross-functional training, and steer managers and other relevant staff involved in policy management and achievement of organisation's vision and mission. In a commentary on critical success factors for public drug management in India, Singh, Tatanbohotka, Kalvakuntla and Chokshi (2012: 26) argue that a supply chain leader must have leadership skills, blended with technical knowhow, garner participation from a vast number of stakeholders and lobby for political support. Above all, such a person should be a change agent, seek for new opportunities within the existing systems and where applicable, change the whole landscape within the existing laws.

3.4 Logistics dimensions

Availability of funds, transport, staff training and supervision have been identified as key logistical issues which should be addressed for maximum benefits from the pull system of drugs availability (Tumwine *et al*, 2010; Jahre *et al.,* 2012). In another study conducted in South Africa, it was found out that among other things, logistical bottlenecks in the medicines supply chain hampered availability of medicines, at times resultant from inadequate selection (Magadzire, Budden, Ward, Jeffery, & Sanders, 2014).

In Uganda, selection of medicines is considered vital in the supply chain activity. It ensures equitable access to health care. This activity is carried out based on the respective national Essential Medicine List (EML). The selection is done through forecasting public health needs, availability and comparative cost effectiveness, systematic review of evidence of efficacy and safety, and a transparent process (WHO Report, 2011:1). Furthermore, the selection is also based on standard treatment guidelines, resource envelope, safe and effective products, defined priorities for government pharmaceutical and supply procurement. Most importantly, it should promote rational use of medicines and supplies. Good practice dictates that the process of selecting essential drugs for a particular health system should be consultative and transparent; the selection criteria explicit and linked to evidence-based clinical guidelines; and the lists should be divided into levels that are regularly reviewed and updated. Clinical guidelines and essential drugs lists should be reviewed at least every two to three years, and their use and impact should be monitored on a regular basis (WHO, 1998:23).

3.4.1 Quantification

Across the world, the term quantification is variously perceived. For example in Liberia, according to the Ministry of Health and Social Welfare, Report (2010:3), quantification is a critical supply chain activity that links information on services and commodities from the facility level to programme policies and plans at the national level. The report reveals that the activity informs higher level decision-making on the financing and procurement of commodities by providing information on how many of which products should arrive in the country, and at what time.

In Uganda, the health system quantification and determining orders for drugs and other health commodities (not including equipment), relies on dispense-to-user data gained from health unit monthly reports. The reports, part of the health management information system (HMIS), list rates of consumption for a variety of health commodities, and also note the number of stock-out days. However, as earlier mentioned, the accuracy of the dispense-to-user data is questionable. Facilities do not always order correctly or on time. Moreover, since the quantification and health commodity order system does not account for stock on hand at the facilities, the district-level does not have an accurate view of the health commodities that are available, or in danger of stock-out. Furthermore, the quantification utilizes dispense-to-user data from previous months, and health commodity ordering does not accurately forecast the future needs of a facility (MoH Report, 2011).

Nonetheless, WHO Report (2004:9) proposes eight factors that may guide the quantification of drugs. These include disease: pattern, number of inhabitants whom the health institution serves, seasonal variation in disease pattern, monthly (rate of) drug consumption, quantity of each dosage regularly consumed, lead time, and re-order levels. The Report also mentions three main factors that should be taken into consideration when quantifying drugs, namely: monthly consumption, delivery (lead) time, and request indicators. These are considered as the basis for calculating the appropriate quantity of a particular drug to be ordered. Most importantly, based on the pharmacist's experience and daily transactions of drug orders, the drug usage is aggregated each month, and hence the monthly consumption is determined (Kritchanchai & Meesamut, 2015:11).

3.4.2 Procurement management

Procurement plays an important role in influencing the availability of health-related supplies (Arney, Yadav, Miller, & Wilkerson, 2014:295). According to the National Medical Stores (NMS), Customer Charter of December (2012), cited in Kazibwe (2014:10), and also in the Auditor General's Report (2016:24), NMS is mandated to deliver essential medicines and health supplies to the doorstep of all customers, and to deliver essential medicines and health supplies according to the published delivery schedule, although hospitals may receive medicines directly from donors, or procure them from recommended private pharmacies as long as they are not available from NMS. Although the phenomenon of alternative suppliers is useful, it breeds many decision-making centres and agents. This implies that health facilities influence the supply chain owing to the role they play in enhancing the accuracy in forecasting their needs as well as timely preparations and submission of their orders to NMS (Office of the Auditor General, 2016: 11).

In a study carried out in six selected hospitals, it was found out that despite planning the procurements of medical supplies, sometimes health facilities experience variances in both the form of ordering above the planned amounts and in some cases below the planned amount. This greatly affects the availability of medicines in both the supply stores as well as the hospital stores (Okiria, *et al.*, 2016). The challenge may be attributed to poorly developed plans as result of guessing estimates-not scientifically determined. Similarly, during the FY 2015-2016, out of the selected 72 health facilities, 38 health facilities did not receive essential medicines quantities as planned and ordered for (Office of the Auditor General, 2016: 24). The resultant effect is lack of medicines at the service delivery points.

Notwithstanding the existence of different national procurement models across developing countries, public entities repeatedly lack the technical ability to strategically and efficiently carry out the procurement process. The resultant effect is inadequate planning, long lead time, and stock discrepancies (WHO Report, 2011). To date, procurement of medicines remains largely centralised either at the Ministry of Health level and/or a Central Medical Store (CMS) (Hagen, 2017).

Iqbal, Geer and Dar (2016:18) contend that procurement of medicines must be systematic and should be built on conventional scientific principles that ensure the availability of right medicines in the right quantities, at reasonable prices, and at recognised standards of quality. The scholars reiterate that sourcing of medicines may be done under different purchasing models such as scheduled purchasing, perpetual purchasing or annual purchasing, depending on standard operating guidelines. In support, Mikkelsen-Lopez, Shango, Barrington, Ziegler, Smith, and de Savigny (2014: 1) assert that the ACTs procurement system is designed to ensure routine availability medicines in the public sector. Such efficient procurement systems are vital for delivering the required package of medicines, and for cost-effective use of public resources (MoH Report, 2015: 21).

However, various studies have so far indicated that there are several predicaments that affect product availability. For example, Iqbal, *et al*. (2016: 19) carried out a study in three public health facilities in Indiain which they found out that funds to procure medicines were grossly insufficient and lacked justified coordination. Coordination is a key factor in carrying out successful procurement. As Yadav (2015:146) argues, it helps in linking Top Management systems, procurement units, user departments, policy and technical committees, therefore making decision-making elastic and viable.

For Basheka (2009: 206), public procurement in Uganda must start with planning, which is a critical and mandatory function that takes place in complex political, economic, cultural, religious, environmental, technological, and ethical environments. Perhaps owing to the increasing role procurement plays in the global economy, if poorly managed, it becomes a major source of conflicts in many local governments around the world. In a study carried out by Hakiza and Basheka (2012:800), it was underscored that procurement planning process determines all the requirements for a given financial year.

In Uganda, the procurement process of drugs and medical supplies in the public sector begins with a needs assessment, carried out by individual health facilities based on the standard treatment guidelines known as the Essential Medicines List (EML). Procurement initiation starts once funds are available, guided by the *National Medical Stores (NMS) Procurement and Disposal Manual* of December 2004. In addition, there are Public Procurement and Disposal Authority (PPDA) rules and regulations (Baez-Camargo & Kamujuni, 2011: 13). Any delays in procurement initiation create a cycle of uncertainty in the system and result in system-wide unavailability. Therefore, to comply with the Public Procurement Act 2014 as amended and Statutory Instrument Number 11 of 2014, accurate estimates of future medicine requirements are an essential condition for cost-effective procurement.

However, The application of the principles of evidence-based medicine consumption and budget availability analysis should serve as strong criteria in the decision-making process in determining what and how much to procure leading to effective medicines selection (MoH Report, 2015:21). The procurement plan specifies the quantities of each product to be procured and when the products should arrive in the country to ensure an uninterrupted supply at all levels of the system (Hakiza & Basheka, 2012:800). The entity should determine the resources available to meet the country and donor commitments.

3.4.3 Inventory management

The priority of any health facility is not only to make medical services available, but also to continuously avail medicines to patients as and when required (Khurana, Chhillar, Kumar, & Gautam, 2013:9). This is probably why countries develop a drug inventory policy suitable for each medicine category. However, the policy requires understanding the demand pattern for each type of drug within a hospital. This practice enables proper planning in determining when to order, how much to order and how to handle the various types of drugs. The drug distribution policy should describe how and when orders from each ward within the hospital are placed with the central drug department.

Scholars such as Khurana, *et al*., (2013: 9) and Kritchanchai and Suwandechochai (2010: 211), have theoretically proposed other scientific techniques of managing inventory. The techniques include Economic Order Quantities (EOQ) and VED (V-category are lifesaving; E-category are less critical & D-category includes less critical or those whose absence does not pose any life threatening effects among others). However, the foregoing techniques have shortcomings. Nevertheless, Kritchanchai and Meesamut (2015:19) observed that the minimum/maximum is the suitable inventory policy for most vital, high consumption medicines and has the potential to swiftly avert unavailability.

Matthews (2014:3) points out that supply and distribution of medicines and sundries in the public sector mainly relies on a centralised distribution model where the Central Medical Store (CMS) acts as the importing distributor for the national health system. Regional Medical Stores (RMS) receive products delivered by the CMS and transport them to district level stores (DLS) or directly to the health facilities. In Uganda, for instance, ACTs are purchased by Ministry of Health (MoH) and distributed to all national hospitals through National Medical Stores (NMS), the only mandated government stores. Be that as it may, lack of proper coordination between NMS and hospitals had been cited as one of the key factors leading to drug unavailability, and subsequently, the disproportionate number of malaria deaths in Uganda (Results for Development Institute, 2010:i).

Whereas inefficiencies can be found at every level of the supply chain – from forecasting and procurement to storage, distribution and inventory management – the situation is exacerbated by lack of data on demand, coupled with limited donor funding cycles and pre-determined ordering schedules. This, in turn, affects availability of medicines as well as wastages (Mathews, 2014:2). Wastage is also exacerbated by limited storage capacity, poor infrastructure and limited transport capacity with resupply deliveries occurring monthly or quarterly (Dowling, 2011:10).

According to Jan de Vries and Huijsman (2011:161), numerous stakeholders such as the stores/distribution staff, pharmacy department, senior managers, and clinical staff influence in hospitals. While there is considerable involvement of different stakeholders, there is a need for political will to drive the process of coordinating the supply chain for successful implementation and integration of the processes. In addition, several other factors are also at play, including issues such as Top management support and monitoring of health delivery. These factors may not be adequately included in the simulation models.

Notwithstanding the above assertion, it is imperative to follow the principles of rational drug use so that the allotted budget caters for more patients. Theoretically, the Hospital Stores' Managers must, therefore, establish efficient inventory system policies; for normal operating conditions that also ensure the hospital's ability to meet emergency demand conditions (Schöpperle, 2013). However, in a study carried out in hospitals in India by Khurana, *et al.*, 2013:9), they recommended that expensive medicines (Category I drugs) should be managed by top Management to control expenditure. Middle management cadre should control moderately priced medicines (category II) and lower cadre managers can manage low value items (category III).

Management of the medical stores requires prioritising of demands, making decisions on when to procure and distribute specific drugs, close supervision on drugs belonging to important categories and prevention of pilferage (Khurana, *et al*., 2013: 9). In a study carried out in a remote village in Australia, it was observe that pharmacists plays a critical role of crafting a flexible drug distribution systems that ensure patients have quality and easy access to medications more so the rural poor (Rovers & Mages, 2017:2).Therefore, effective inventory and storage of medicines must take into consideration how to maintain and control quality in order to identify opportunities for improvements. It should have dimensions of preventing substandard or falsified products from entering the supply chain, preserving product integrity up to the point of use and minimising waste. Stores should be responsible for ensuring that all commodities that come into their custody undergo standard visual testing and follow prescribed quality control procedures (MoH, 2015:22).

According to Iqbal *et al*., (2017: 81), medicines and supplies should be stored under appropriate environmental conditions taking into consideration proper temperature, light, humidity, sanitation, ventilation, and segregation. However, a study conducted by MoH in FY 2012/13 on the physical condition of medicine stores in all public hospitals, 15% of the health facilities lacked medicine stores, and 29% did not have an appropriate designated dispensing room. Of those that have stores and dispensing rooms, 79% lacked shelves on which to properly store medicines. Out of those with shelves, the majority needed to have them replaced (Ministry of Health Facility Storage Assessment Report, 2012/13: 13).

Previously, the Uganda National Medical Stores (NMS) drug distribution was based on the principle of supply (a push system) but diversion of monies at various points of the distribution chain exacerbated drug shortage. The system ultimately failed and was replaced by a distribution model based on demand, that is, a pull order system where the budget of all drugs and medical supplies became centralised (Kazibwe, 2014:10; Baez-Camargo & Kamujuni, 2011:13). The new system has greatly improved drug availability over the last four years and ACTs drugs increased from 21% in 2009/10 financial year to 48% in 2011/12. .

3.4.5 Dispensing and rational use of ACTs

Sisay, Mengistu, Molla, Amare and Gabriel (2017:2) argued that rational use of medicines requires that appropriate medication is given to patients, based on the clinical condition, in the right doses, and at the lowest cost. However, in sub-Saharan Africa, the situation is reported as being inconsistent despite the existence of a new Malaria Treatment Policy, which requires prior testing of suspected malaria cases. More so, there is a lack of clearly defined adherence to medicines, such as ACTs (Yakasai *et al.,* 2015), which would otherwise inform policy decision making. Hence the need to explore ACT adherence levels and associated factors (Banek, Lalani, Staedke & Chandramohan, 2014).

3.5 Management environment dimensions affecting availability of ACTs

This section discusses objective 3 of the study with the aim of appreciating how to manage the environment dimensions (market and macro environment) affect ACTs availability.

3.5.1 Market environment dimensions and ACTs' availability

According to Watsierah and Ouma (2014), within the market environment, many actors and organisations have to interact with one another (suppliers, manufacturers, wholesalers, and retailers) in order to play a central role, proactively coordinating through regular meetings, and developing joint research and educational plans. Asamoah, Abor and Opare (2011) were the first to propound this view while addressing the supply and distribution gaps in the chain link. They concluded that there was need for a well-built coordination framework to tackle ACT's complex partnerships and sub-national programmes. The current study attempted to address this by reviewing literature on collaborative partnerships, information sharing with suppliers and relationships among health units (summarised in Table 7).

Table 7: Summary of market management environment dimensions

Dimensions	Characteristics/ brief description	Sources
Collaborative partnerships	Formation of strategic alliances with suppliers, agencies, donors e. t. c	Asamoah, *et al*. (2011); Watsierah & Ouma (2014) USAID/PMI (2011); Seiter (2010).
Information sharing with suppliers, MoH, Donors	Sharing supply and demand information between the general hospitals, MoH and donors, e. t. c.	Ongolo-Zogo & Bonono, 2010); Williams, Roh, Tokar, & Swink (2013);
Supply chain interdependence with suppliers	Managing supply chain interdependence (SCI)	Ferguson, Guide & Souza 2006; 376
Relationship among lower health units	Hospital's relationship with lower health units through redistribution.	Ministry of Health (2016)

3.5.1.1 Partnerships and collaborations and availability of ACTs

On the other hand, Watsierah and Ouma (2014) proposed the formation of strategic alliances between the organisation and suppliers, manufacturers and distributors (farmers, manufacturers, pharmacies, and chemist shops) to produce and market ACTs. This conclusion was reviewed and subsequently upheld by Nagitta and Mkansi (2015:33), who nevertheless reiterated that relevant coordination frameworks based on studies in Africa should be developed to enhance strategic management of ACTs. The scholars reviewed publications and institutional reports to assess interactions of the micro-, market- and macro-environments and the level of implementation of the new policy in developing countries with regard to supply and distribution of ACTs. They advised that if internal coordination frameworks are to be successful, then internal supply chain actors should appreciate and implement joint work from the market- and macro-environments.

Given the increased demand for drugs in both public and private sector, collaboration cannot be over emphasised, especially since a lot of subsidized ACTs are being provided through the private sector leading a dramatic improvement in availability of over 70% (Yeka *et al*., 2013). In fact USAID/PMI (2011) had argued that collaborations with donors is critical in ensuring that private sector groups are involved in the coordination efforts since the latter plays a critical role in areas where government service has failed. This was an issue Talisuna *et al*. (2012) over emphasised that the private sector cannot be ignored as it is the first point of call for almost 60% of Ugandan seeking malaria treatment.

Nevertheless, strengthening service delivery in the health sector is a complicated endeavour because of the multifaceted stakeholders (Bhakoo & Chan, 2011: 184). It requires balancing the different conflicting goals and interests of politicians, health workers, patients and citizens without disregard to other stakeholders (Singh, Kumar & Kumar, 2016: 234). Governments often face the dilemma in designing new appropriate decision-making models that balance between the different supply chain players (Saltman & Duran, 2016:33) without compromising quality standards through policy shifts (MoH, FY 2014/2015: 2).

3.5.1.2 Information sharing with external stakeholders and availability of ACTs

Using data from 232 Australian firms, Prajogo and Olhager (2012:54) found out that information technology capabilities and information sharing between stakeholders both have significant effects on integrated supply and distribution systems. It was also ascertained that long-term supplier relationships have both direct and indirect significant effects on information flow and logistics integration However, without sharing supply and demand information between the general hospitals, MoH and donors, the reality may be far-fetched (Williams, Roh, Tokar, & Swink, 2013:543). This means that supply chain actors must be integrated to create the desired visibility through some form of information technology tools. Unfortunately, there is no consensus on how to measure integration. Effective and interactive exchange of information with external suppliers, is crucial if supply chain is to be revitalized (Ongolo-Zogo & Bonono, 2010; Prajogo & Olhager, 2016).

Health supply chains do not only deliver medicines and health products to the populace but they also transmit critical information about need, demand, and consumption to health system planners. Therefore, supply chain plays an essential role in improving health system performance regarding general behavioral aspects of the health system. However, for any health supply chains to be regarded useful, it ought to guarantee the consistent availability of quality medicines at all health service delivery points (Yadav, 2015: 143; Seiter, 2010: 3). The primary goals of the supply chain intervention are to improve stocking levels of essential medicines and reduce the incidence and duration of pharmaceutical stock-outs (Vledder *et al.,* 2015:8).

3.5.1.3 Supply chain interdependence with suppliers and availability of ACTs

Managing supply chain interdependence (SCI) is a critical success factor for SCM and organisations in various industries (Hugos, 2011:183; Boyaci & Gallego, 2004; 3; Ferguson, Guide & Souza 2006; 376). Unfortunately, empirical research on interdependence between buyer–supplier is still limited (Canie¨ls & Gelderman, 2007). SCI has potential benefits, but also the limitations of supplier connections and the crossover effects on firms' performance resulting from interdependencies of supplier business relationships (Roseira, Brito & Henneberg, 2010). According to Zhang (2008:55), effective management of SCI in the health sector requires efficiently integrating manufacturers, stores/warehouses and suppliers, among others, so that products are provided adequately at the right time and delivered at the right places to minimise system-wide cost implications while satisfying service requirements.

In a study conducted in South Korea in the health care industry, results showed that there was a positive relationship between supply chain performance and customer satisfaction (Shou, 2013). Therefore, basing on the findings, hospitals were required to pay attention to health care SCI for sustainable viable operations (Christos, Vicky & Constantinos, 2014; Lillrank, Groop & Venesmaa, 2011; Mathew, John & Kumar; 2010). This inference had been acknowledged by De Vries and Huijsman (2011:161), who postulated that the rationale of an efficient SCI approach ought to be premised on the belief that rigorous coordination between operational processes must lead to a better supply chain performance in the health sector. Also, almost at the same time, Frost *et al.,* (2011: 1) asserted that supply chain management enables the efficient, timely and reliable movement of health commodities and data up and down the supply chain. That is to say, it must be evident from the point of consumption (health facilities where health commodities are dispensed) to the district, regional, and national levels and back.

Although there has been much discussion about the need for cooperation (interdependencies), few studies have, so far, examined how power impacts cooperative relationships from a supply chain management perspective (Zhao, Huo, Flynn, Hoi, & Yeung, 2008; Benton & Maloni, 2005). According to Johnston, McCutcheon, Stuart, and Kerwood (2004), when supply chain partners collaborate, it is likely that there would be flexible adjustments or willingness to vary fixed contractual terms as conditions change such as; cost or budget pressures, volume adjustments among others (Pei, 1999).

By this very fact, a high level of total interdependence like the one in Uganda between NMS and health facilities might be an indicator of a strong, cooperative, long-term relationship, in which both parties have invested time, effort, and money (Alvarado & Kotzab, 2001; Duffy & Fearne, 2004). Nevertheless, in high total buyer-supplier relationships, it would appear challenging when the supply chain partners engage in opportunistic behaviour and negative tactics or coercion (Eyaa, 2017).

3.5.1.4 Working with lower health units and availability of ACTs

In Uganda, within the context of the General Hospitals, lower health units are those that are graded as health centre four. Good practice ensures that medicines do not expire in any health facility when there are either facilities that do not have while other have much in stock. Therefore, health facilities should embrace the strategy of redistribution and or stock exchange as an integral part of the medicine supply management system to reduce risk of expiry at health facilities with excess or unused stocks. This practice enhances the availability of drugs at health facilities where there are known shortages or stock-out (Ministry of Health, 2016). The above guidelines stipulate the three stages to be followed in case of stock transfer or redistribution:

i. When there is an excess quantity of the target medicine in one facility and a deficit in another (where excess is defined as having more than four months of stock).
ii. When the target medicine will expire before use (short shelf life) in one facility.
iii. When stock has been distributed or supplied to facilities where it is not supposed to be used or is not recommended for use at that level of the health service.

3.5.2 Macro management dimension and availability of ACTs

According to various management scholars, such as Sammut-Bonnici and Galea (2015) there are ever variations in the realm of management, which ought to be addressed by acknowledged tools and interventions. The scholars advanced PEST, PESTEL or PESTLE and STEEPLE as requisite tools for the purpose. PEST is a management tool that assesses the environment on the political, economic, socio-cultural and technological dimensions; while PESTEL adds environmental and legal dimensions on PEST. Then, STEEPLE designates the dimensions of social, technological, economic, environmental, political, legal and ethical issues to assess s*tatus quo*. The dimensions used in this study were, however, based on PESTL, which scrutinized the issues of political, economic, socio-cultural, technological and legal factors, among others. However, earlier studies on the macro environment analysis were generally limited to determining and categorizing the factors (Mayaka & Prasad, 2012). Lynch (2012) commented that listing exhaustive factors may produce insignificant consideration in the process. This section reviews literature pertaining to part of object three, which intended to investigate how the macro-environment dimensions affect ACTs availability. The macro issues reviewed included; political, economic, socio-cultural, technological and legal dimensions - presumed to affect availability of ACTs (summarised in Table 8).

Table 8: Summary of macro dimensions affecting ACTs

Dimension	**Characteristics**	**Sources**
Political dimensions	Power, politics and interest relationships	Park, *et al*. (2017); Williams (2001); Jan de Vries & Huijsman, (2011).
Economic dimensions	Financial support from donors and government and subsidizes,	Morris, *et al*, (2014); Lalvani, Yadav, Curtis, & Bernstein (2010); Bate, *et al*., (2010); (Tumwine, *et al.*, (2010); Konde-Lule, *et al*., (2010).
Social-cultural dimensions	Social structures built around social network and Culture of self-medication, beliefs and attitude.	Granovetter (2005); Cohen, *et al*., (2015).
Technological dimensions	Use of Information technology tools Use of phones Rapid Diagnostic Tests (RDTs) m-Health Use of Internet	Dowling (2011); Shewchuk, O'Connell, Goodman, Hanson, Chapman, & Chavasse (2011); Bhakoo & Chan (2011); Cocosila & Archer (2010); Hossain (2016).
Legal dimensions	Detailed guidelines for implementing policies arerequired to safeguard the interests of the patients or users.	Iqbal, *et al*., (2017:83); MoH (2015:9), National Medicine Policy (2015).

3.5.2.1 Political dimensions availability of ACTs

Politically, medicine attracts a high level of interest, owing to its high economic value, the large public and private investment and its impact on the health and well-being of society. Consequently, many pharmaceutical issues are high on the political agenda of society - being the subject of intense political and trade discussions in forums, such as the World Health Assembly, the World Trade Organisation, as well as in bilateral and multilateral trade negotiations (Ministry of Medical Services & Ministry of Public Health and Sanitation, Liberia, 2010:11).

Although several scholars have addressed SCM issues, few examined the subject of power and politics. Power is defined as the ability to influence another or the ability to make another act in a desired way (Park, Chang & Jung, 2017: 1). According to Williams (2001), power, politics and posturing affect the conceptualisation, design, operationalisation, and assessment of supply chains. Given the significance of these variables to supply chain success, it is useful to study the nature and impact of power and politics on supply chain efficiency. Supply chain partners ought to have political discernment in order to realise the distinctive disadvantages when interfacing with counterparts or negotiating with them. Unfortunately, the influence of different stakeholders on establishing supply chain management relationships both within and between different health service providers is not known. Against this background, it is worthwhile to investigate the political factors (power and interest relationships) during the process of adopting, shaping and implementing supply chain management relationships (Jan de Vries & Huijsman, 2011:164).

Robbins (1998: 410) defines political behaviour in organisations as "those activities that are not required as part of one's formal role in the organisation, but that influence, or attempt to influence the distribution of advantages and disadvantages within the organisation". Therefore, political behaviour is an integral aspect of all organisations. As William (2001) asserts, all organisations, irrespective of formality, size or makeup, are made up of structured political aspects that must be understood and managed, and supply chain is not an exception. Supply chain partners need political shrewdness to alter the distribution of rewards and risks within the network. Specifically, partners attempt to sway goals, processes and criteria, in the chain through political manipulations (William, 2001). According to Ivancevich and Matteson (1996: 373), politically oriented behaviour could involve one or more of the following:

(a) Behaviour that is designed to benefit a sub-unit or an individual;
(b) Behaviour that is usually unreasonable or outside the norm, recognised power system (often at the expense of the organisation in general);
(c) Intentional behaviour, which is designed to acquire and maintain power.

In a study carried out by U4 Brief (2012:1) it was concluded that interventions such as informal political power, formal institutional mandates, and the usage of patronage networks across the country ought to be considered if the abuse in the drug supply chain in Uganda is to be curtailed. However, the manner in which power is understood and used can seriously affect intra-chain relationships and outcomes. Altogether, supply partners wield some degree of influence and must use it judiciously and skilfully, taking into consideration the adversative effect and the long-term impact of influence misuse.U4 (2012:4) points out that in Uganda, strategies for motivating those who handle drugs should consider the conferred interests of local politicians who rely on support from their constituents.

Williams (2001) argues that political shrewdness is an important survival component in inter-organisational environments. Practically and theoretically, supply chain partners should promote the interest of the entire network. Nevertheless, most often self-interest maybe encountered. Henceforth, appreciating the power of politics as a balancing mechanism in the chain is essential in overcoming selfish motives. Otherwise, conflicting objectives and lack of coordination between supply chain partners may cause uncertainties in supply and demand (Kumar, *et al*., 2015: 94).

In Uganda, political influence affects health service delivery. Short-term interference in institutional management by elected national, regional and local political actors is cited where the national government plays an operational role in conjunction with senior staff in the Ministry of Health. Political power is decentralised to the district and lower units, with district authorities under the oversight of the Ministry of Local Government (MoLG). Within the districts, the patients are represented by the Health Unit Management Committees (HUMCs) who witness the arrival of medicines and ensure that they actually reach the community (Economic Research Centre Report, 2010:24). Several bodies undertake monitoring activities over the performance of NMS centrally as well as along the drug distribution chain.

3.5.2.2 Economic dimension and availability of ACTs

One of the main goals for national policies on medicine and pharmaceutical management initiatives is lowering the cost of medicines in public and private health service providers. Therefore, realising this dream may necessitate involving a combination of public, private and Non-Governmental Organizations (NGOs). This may involve building constructive partnerships, right incentives and Mutual Understanding (Management for Health Sciences, 2012:1.6).

Parenthetically, the health budget in most sub-Saharan African countries is still below 15% of the total budget on health as required under the Abuja Declaration (MoH, 2015:27). During the last decade, significant sums of money have been invested in global initiatives (GHIs) to address global health issues such as malaria in developing countries (Vledder, *et al*., 2015:2; World Health Organisation, 2009:2137).

In Uganda, medicines are the single most expensive out-of-pocket health expenditure item and, therefore, constitute an enormous burden for the ordinary person (Konde-Lule, Gitta, Lindfors, Okuonzi, Onama & Forsberg, 2010: 5). To complicate the situation unavailability of ACTs is still a reality in many drug supply chains in a country with limited financial support from the treasury and also from donors (Lalvani, Yadav, Curtis, & Bernstein, 2010:17;Bate, Hess & Mooney, 2010:20). As a result, the country has seen a decline in the funding to purchase malaria drugs, resulting in ACT shortages (WHO, 2013: ix; Tumwine, *et al.,* 2010: 560).

This notion was reiterated by Morris, Ward, Moonen, Sabot and Cohen (2014:397), stressing that while ACTs are subsidised and therefore recommended first line treatment for uncomplicated malaria in most endemic countries, they are prohibitively very expensive in the retail drug According to Dowling (2011:13), some specific coordination problems had been closely tied to national contexts and cultural characteristics. However, other important economic factors include:

(i) A demonstrated lack of innovative and or entrepreneurial clinical initiatives;

(ii) Poor incentives embedded in fixed salary and work rule arrangements reflecting politically powerful yet risk-adverse public sector employee unions; and

(iii)The difficulty of maintaining consistently executed and timely capital investment in new equipment and procedures.

Conclusively, economically, the pharmaceutical industry is an important player in terms of producing and distributing a wide range of medicines and health supplies for local consumption and for export. The pharmaceutical sector involves manufacturers, importers, exporters, wholesalers and retailers who provide medicines for healthcare. When properly regulated, the sector can contribute to improved access to essential medicines, including ACTs (MoH, 2018).

3.5.2.3 Socio-cultural dimensions affecting availability of ACTs

It is also important to recognise the dynamic nature of capabilities and culture from which the organisation is operating. Increasingly, organisations have to develop mechanisms to develop capacity to learn from its past, adapt to its present, and envision and create the future (Buller & McEvoy, 2012:49). Socially, medicines are critical inputs into healthcare, taking a significant proportion of the health budget for households and governments. Pharmaceutical personnel are a key component of the healthcare workforce, providing the full range pharmaceutical services such as procurement and supply, dispensing and patient advice, monitoring adherence to treatment, and adverse drug reactions (ADRs). However, with many citizens experiencing poverty, low utilisation of health services is experienced. This is because the poor are more likely to let an illness go untreated, or may incur high expenditures on medicines. Recent measures by Government such as reduction in user fees and improved public supply of essential medicines has led to increased utilisation of health services, especially among the poor. Pro-poor spending in health is therefore critical to the attainment of national health goals (Ministry of Medical Services & Ministry of Public Health and Sanitation, June 2010:11). Therefore, the integrity of a health unit depends on the facility's ability to provide medicines to the patients. In addition, the availability of medicines attracts patients to seek medical help from health facilities and in return, they become receptive to public health messages. This promotes trust and participation in health services. However, when the medicines and supplies are not available within the health facility, productivity of health workers is also affected (Management Sciences for Health, 2012:1.4).

Social structures built around social networks may affect outcomes in three ways. They affect the flow and the quality of information available, a situation that creates disbelief from some actors, especially from impersonal sources and instead they rely on people they know. Social networks create trust or confidence that others will do the "right" thing (Granovetter, 2005:33). The resultant effect is the formation of closely-knit cliques, connected to each other through their weak rather than strong ties. Such ties determine the extent of information diffusion in large-scale social structures. Cohen, Cox, Dickens, Maloney, Lam and Fink, (2015:1) assert that in most malaria-endemic countries such as Uganda, presumptive treatment for malaria is based on symptoms rather than a rapid diagnostic blood test (RDTs). Therefore, where diagnostic testing in public sector facilities is necessary, some suspected malaria patients simply visit private pharmacies and purchase the medicines. Increasing the availability and uptake of rapid diagnostic tests (RDTs) for malaria could help reduce irrational usage of ACTs and hence improve its availability. However, patients' demand for and valuation of testing is less critical in the public sector.

3.5.2.4 Technological dimensions affecting availability of ACTs

Dowling (2011: 162) suggests that technological transformation within the health sector should aim at integrating health care chains, owing to the complex social change process. This may necessitate a shift in strategy, structure and control dimensions. Technology, according to Dowling (2011:161), is characterised by different modes of integration, such as:

(i) Integration and co-ordination of processes;

(ii) Integration and co-ordination of information flow;

(iii) Integration and co-ordination of planning processes;

(iv) Integration of intra- and inter-organisational processes;

(v) Integration of market-approach; and

(vi) Integration of market-development

The health domain has been experiencing new developments in the adoption of mobile ICT or multimedia technologies integrated with wireless health care delivery systems, referred to as m-Health. The tool is now being used in Liberia to disseminate information to consumers and providers of these health services through use of mobile ICT applications such as short messaging service (SMS), which is used when sending health reminders on their cell phones (Cocosila & Archer, 2010: 241; Hossain, 2016:774). M-health is defined as the use of mobile technologies to enhance information and access to health services with the aim of improving the way health professionals deliver health-related services to the general public (Mechael, 2009: 104). Findings from the study by Cocosila and Archer (2010: 241), revealed that adoption of m-Health services is dependent on user satisfaction and perceived value enhanced by quality of the medical advice, platform and interaction quality. However, their study investigated the use of short messaging service (SMS) technology sent to the participants to stay healthy; it was not based on the advanced and more modern mobile services used by browsing the mobile Internet or using applications for smartphones to supply ACT

A variety of literature indicates use of SMS for monitoring weekly ACT stock levels via a mobile phone. For example, in Tanzania, SMS for Life system implementation follows a systematic protocol, whereby weekly SMS prompts are sent on personal phones of selected health unit staff. Respective health workers from the health units are then required to report back within 27 hours on the stock count of full boxes of ACTs in the storeroom. The aggregated weekly summaries of stock status in each facility are subsequently provided automatically to the District Medical Officer (DMO) and the District Pharmacist. This in turn helps to inform the two officials as to which health facilities are at risk of stock-out of ACTs. Information is displayed both graphically and on interactive maps for stakeholders to interpret (Mikkelsen-Lopez, *et al*., 2014: 1).

According to Albabtain, AlMulhim, Yunus, and Househ (2014:11), m-Health applications aid health education and awareness, provide real time information for diagnostic treatment and support services, data collection and remote monitoring services, surveillance, emergency medical services and other healthcare services, thereby helping in the allocation of the right resources for the right individuals. Despite the benefits and initial acceptance of m-Health services in some countries, the uptake is still low; hence, constraining its implementation (Hossain, 2016: 775). Various barriers affecting the implementation of m-Health in developing countries are reported in the literature. For instance, limited access to electricity and landline telephones for dial-up connections (Mechael, 2009: 111) and unreliable or expensive Internet (Mishra & Singh, 2008: 1; Bolton, 2012: 2). In addition, cultural diversity may impede the implementation of m-Health applications owing to language barriers and cultural norms, which in turn affect health behaviour and reduce the ability of patients to take control of their health (Garai & Candidate, 2011:5; Waruingi & Underdahl, 2009: 22).

At the national level, in Uganda, the existing logistics management information system (LMIS) is predominantly paper-based. To a lesser extent, computerised inventory management systems have been introduced in about one third of the hospitals. While NMS is fully computerised, there is currently no synergy between the health facility logistics systems and the central warehouses. This scenario inhibits access, analysis and sharing of pharmaceutical information between users at all levels, let alone efficient coordination (MoH, 2015: 11).

3.5.2.5 Legal dimensions and ACT availability

The process by which consumers obtain pharmaceuticals is complex. It involves several intermediaries and has inherent moral and ethical hazards, besides information irregularities. Pharmaceutical systems do not always guarantee rational decision-making that primarily benefits the consumer. Therefore, strong regulatory enforcement of policies and procedures (that is, detailed guidelines for implementing policies) is required to safeguard the interests of the patients or users (Iqbal, *et al*., 2017:83). This implies that hospital administration and health workers through appropriate committees or Drugs Therapeutic Committees (DTC) must have the will to make appropriate decisions. According to MoH (2015:9), policies such as Uganda Clinical Guidelines (UCG) and Essential Medicines and Health Supplies List of

Uganda (EMHSLU), which were updated in 2012, guide the logistics activities such as selection, procurement and prescription. These are expected to guide the condition of use of ACTs and other drugs, reduce wastage and make them available.

Whereas the Uganda Government developed a National Medicine Policy in 2015, the document lacked clear guidelines on how to coordinate the supply and distribution of medicines. Failure to systematically diagnose and understand why supply chains are underperforming has led to ad hoc projects that address only the surface symptoms of the underlying structural causes. Because of the high value of medicines, the pharmaceutical sector is particularly vulnerable to corrupt and unethical practices, and hence there is a critical need for strong governance and regulatory oversight structures to foster transparency. There must be an effective legal framework with adequate sanctions for handling non-compliance (Ministry of Medical Services & Ministry of Public Health and Sanitation, 2010:11). Nevertheless, Uganda has made significant strides to regulate medicines so that it promotes the efficacy, safety and quality of pharmaceutical products in the country, and protect the citizens of Uganda from the possible ill effects of unregistered, substandard or falsified products. The regulatory agencies propose and enforce regulations governing all aspects of the manufacture, importation, advertising and sale of pharmaceutical products, and they regulate and license all products, personnel, practices and premises for pharmaceuticals (MoH, 2015: 20). Depending on the type of disease, Standard Treatment Guidelines (STGs) may be developed and reviewed as and when the need arises, to address trends in disease burden and control strategies (MoH, 2015:24).

3.6 Summary

In spite of the extant literature on the supply and distribution of ACTs, it is evident that few scholars have assessed availability of medicines in public health centres in developing countries (Chandani, Noel, Pomeroy, Andersson, Pahl & Williams, 2012:120; Jahre, *et al.,* 2012:124). Similarly, little attention has been paid to how coordination dimensions might scale up the availability of various medical supplies. Nonetheless, from the literature reviewed (Singh, 2011; Shukla *et al*., 2013; Arshinder *et al*., 2009; Phong-arjarn & Jeenanunta, 2011), the frameworks propounded by coordination advocates are questionable with specific relevance and suitability to supply and distribution of ACTs in developing countries. However, in order to provide context of this study, the coordination frameworks incorporates most of the dimensions of other scholars by Singh's (2011), vis-à-vis empirical case studies (Dalrmple, 2010; Ongolo-Zogo &Bonono, 2010; USAID/ Deliver Project, 2010; UNDP, 2013; Yeka *et al*., 2013; Talisuna *et al*., 2012; USAID and PMI, 2011; Alba *et al*., 2010; Watsierah & Ouma, 2014; Mutabingwa, 2005; Wild & Cammack, 2013; Chuma *et al*., 2010). Singh's (2011) coordination framework proposes Information Sharing, collaborative decision-making, and top management commitment, consideration of responsiveness and organisational factors underpinning the micro-environment. Hence empirical evidence of ACTs studies in nine developing countries (Malawi, Kenya, Uganda, Democratic Republic of Congo, Tanzania, Cameroon, Zambia, South Sudan, and Zimbabwe) respectively, indicate interaction of the three management environments, namely; micro-, market- and macro-environments and how it (interaction) could influence supply chain coordination to affect availability of ACTs in general hospitals in Uganda (Nagitta &Mkansi, 2015). The market factors are collaboration with suppliers, joint research and training. The macro factors considered in the framework were policies for funding, use of public private partnerships, establishing place of surveillance systems and performance monitoring and working with health workers. What is not entirely clear from the empirical case surveyed is the nature of key critical variables in details, hence the study.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Introduction

This chapter presents the methodology used for the empirical research. This discussion elaborates on the summary of the research methodology set out in Chapter 1. The chapter begins with justifications to the chosen research philosophy followed by a description of the research design. The latter includes details of the chosen study population and sample, the development and design of the data collection instruments and methods for data collection. The subsequent section explains the testing of the validity and reliability of the instruments. Finally, the treatment of data and statistical analysis procedures for scale purification and model.

4.2 Research philosophy

Creswell and Plano-Clark (2007:21) argued that philosophical foundations are critical in clarifying designs, providing answers to questions being investigated. The process of developing a supply chain coordination framework had to bear in mind the critical aspects of research philosophy. Research philosophy is the starting point of the research design as it provides a framework for empirical enquiry guided by five basic philosophical assumptions: ontological, epistemological, axiological, rhetorical, and methodological (Saunders, Lewis & Thornhill, 2009:110). Ontological assumptions constitute social reality while epistemology refers to valid ways of gaining insight into the social reality within a particular ontological perspective (Creswell & Plano-Clark, 2007: 24). While the ontological assumptions are concerned with the nature of reality, epistemological assumptions focus on what constitutes acceptable knowledge in a field of study. The axiological assumptions are, however, concerned with the role of values during the research (Saunders, *et al*., 2009:110). In so far as rhetorical assumptions are concerned, these are related to the type of language used in the study while the methodological assumptions are concerned with the processes of research. A variation in the assumptions leads to different research paradigms.

Although some scholars suggested different philosophies, Tucker (2011:62) argued that research questions should guide the philosophical paradigm of the research, which in turn governs the choice of research methods. However, Guba and Lincoln (1994), cited in Mkansi & Acheampong (2012:278) argued that delving into issues of approaches is trivial to the chosen paradigm and, therefore, examiners can use either quantitative or qualitative or both approaches from any paradigm. In addition, Guba and Lincoln (2005: 183) concurred that these beliefs that guide one in a research activity are human constructs and hence they are prone to adjustment depending on a group of scholars (Daniel, 2016:92). For purpose of this study, pragmatism, constructivism and post-positivist paradigms were adopted and discussed accordingly.

4.2.1 Philosophical foundation of the study and justification

The section below discusses the justification for the selected philosophical stance of the study.

4.2.1.1 Pragmatism paradigm

There are quite a number of world views that inform research such as; post positivism, constructivism, advocacy/ participatory, pragmatism, and critical theory (Guba & Lincoln, 2005: 105; Saunders *et al*., 2009:119; Creswell, 2014). However, for the purpose of this study pragmatism was adopted. The pragmatist epistemology accepts and uses many different viewpoints and methods in research provided that they are appropriate and able to effectively address the problems under investigation. The combination of research approaches (qualitative and quantitative) led to the adoption of a pragmatic position in this research (Creswell, 2009:10; Tashakkori &Teddlie, 2010:5; Creswell & Plano Clarke, 2011:26). The paradigm fit together the insights provided by the two approaches into a "workable solution" to answer the multifaceted research questions (Tashakkori & Teddlie, 2010:8) and offered practical solution in "real world" (Felizer, 2010:8). In addition, it offered a practical, "*middle ground*" orientation in relation to post-positivism and constructivist philosophy (Johnson & Onwuegbuzie, 2004:17-18). Against this background, this paradigm blended in well with the purpose of the study since it analysed how individuals understood the world in which they live.

Unit of analysis*:* Dolma (2010:169) defines a unit of analysis as an object that is being analysed in scientific research. It can be anlysed from four level; individual, organisation, group or social interaction levels. He further asserts that in managerial sciences and organisational behavior, the unit of analysis entails board members; top managers; middle managers; supervisors; employees; work teams; business corporations and those persons that directly or indirectly contribute towards the organisation's success. Easterby-Smith, Thorpe, & Jackson (2012) emphasised that a unit of analysis forms the basis of any sample; countries, cultures races, industrial sectors, organizations, departments, families, groups, individuals, incidents, stories, accidents, innovations.

From the foregoing, both hospitals and Drug Therapeutic Management Committee (DTMC) Members were units of analysis. The multiple cases enabled the anlaysis of issues in their real life context but in different settings. Each participating hospital was treated as case study considering the unique regional socio-cultural and economic conditions within which it is located. She posed in-depth questions, which helped in understanding some phenomena and clarifying hidden information. Van Aken (1994, 16-22) stresses the importance of understanding how organizations work in practice in order to propose how they should work.

4.3 Research design

Research design means a way of planning the research (Wiid & Diggines, 2009:33), thereby serving as an overall plan of the methods used to collect and analyse the data (Hair, Anderson, Tatham, & Black, 2010:36). It details the procedures necessary for obtaining the information or solve research problems (Malhotra, 2010:102). Therefore, the most appropriate research design for this study was a function of the research objectives and information requirements as supported by Hair *et al*, (2010:36). Since pragmatism was the philosophical foundation of this study, the mixed methods research design was adopted. Specifically, exploratory sequential design with a quantitative priority was deemed appropriate (Creswell & Plano Clarke, 2011:86; Zachariadis, Scott & Barret 2013: 856; Dencombe, 2008:273; Tashakkori & Teddlie, 2010:8). It involved a mixture of qualitative and quantitative research methods. Babbie (2013:90-91); Babbie and Mouton (2010: 79) acclaim that the design is appropriate when the problem is persistent and used for developing more focused questions. The study was conducted in two phases. The first three questions followed a constructivist philosophy and were associated with qualitative research techniques. Similarly, validating the developed instrument and testing the theory required a quantitative approach.

The methodological assumption in this study was important in understanding issues related to supply chain management in malaria treatment. These issues were based on the following research questions posed in Chapter 1:

i. How do the critical supply chain coordination dimensions affect availability of malaria treatment therapies in general hospitals in Uganda?
ii. How do logistical activities affect supply chain coordination of malaria treatment therapies in Ugandan hospitals?

iii. How does the management environment affect the supply chain for malaria treatment therapies in these hospitals?

4.4 Research approach

Cohen, Manion and Morrison (2011:4); Johnson and Christensen (2012: 31) asserted that research approaches are either classified as qualitative, quantitative or mixed method. This study adopted a mixed methods (triangulation) approach to answer the research questions restated above. This method was convenient since neither a qualitative nor a quantitative approach was adequate to answer the research questions fully (Tashakkori & Teddlie, 2010:8; Basheka, Barifaijo, & Oonyu, 2010:56; Saunders, Lewis & Thornhill, 2009:153; Onwuegbuzie & Johnson, 2006:48). Specifically, the study adopted an exploratory sequential mixed research approach, involving a mixture of qualitative and quantitative approaches. The triangulation methodology created synergy between the qualitative and quantitative methods. The study was conducted in two phases-qualitative and quantitative.

4.4.1 Qualitative approach—Phase 1

Malhotra (2010:73) defined qualitative research as one that is exploratory in nature based on small samples like focus groups and in-depth interviews. Qualitative research was designed to reveal audience's range of behaviour and the perceptions that drive it with reference to specific topics or issues (Burns & Bush, 2010:233). In this study, the qualitative phase sought to gain insight into the critical dimensions underpinning supply and distribution of ACTs from the experts in the general hospitals (Zikmund & Babin, 2010:50). In addition, Burns and Bush (2010:57) asserted that it is often used when little is known about a problem. Equally, Cowles, Kiecker and Little (2002:629-630) proposed that practitioners and academicians should approach the development of knowledge through "discovery" using exploratory studies.

4.4.1.1 Case study strategy

Under the qualitative phase, multiple cases were used. Using the case study, enabled exploring phenomena within its context using a variety of data sources. Yin (2003:1) argued that a case study research strategy is appropriate when the focus of the study is to answer how and why questions. Myers (2009:73) contended that adopting case study strategy explores the relevant issues or factors applicable in a particular context. The results from one hospital were replicated to other general hospitals in Uganda. The purpose of this inquiry was to develop an instrument that was subsequently validated (Creswell & Plano-Clark, 2007:75). The strategy was inductive in nature and specifically answered the first three research questions. The study explored why and how the critical supply chain coordination dimensions, logistical elements and management environment dimensions affect ACTs in general hospitals in Uganda. In addition, the approach was able to detect similarities and differences in supply chain coordination in the general hospitals.

4.4.1.2 Target population, sample selection and technique for qualitative phase

Wiid and Diggines (2009:35) explained that the investigators themselves must identify the individuals (or respondents) participating in the research at hand. Population is the set of all objects that possess some common set of characteristics with respect to some problem (Kumar, 2000:219). Each individual member is referred to as a population element (Zikmund & Babin, 2010:412. Churchill, Lacobucci, & Isreal (2010:327) defined the target population as that part of the total population (universe) to which the study is directed. This is the group from which the sample was drawn (Tustin, Ligthelm, Martins & Van Wyk, 2005:337). The population and how the sample is selected are discussed in the next section.

Hospitals in Uganda are categorised into national referral hospitals, regional referral hospitals, general hospitals and health centres. There are several contradictions on the number of general hospitals in Uganda. For example, the MoH Statistical Abstract (2010:17) reported that there are 135 general hospitals in Uganda, without disaggregating them either into public or private. MoH Annual Sector Performance Reports (FY 2013/14: xiii) indicated 56 general hospitals from 137 Local Governments. Another report indicated 47 public district general hospitals (MoH, FY 2015/16:21). Meanwhile, the MoH Report FY (2016/17: 26) showed the current total of 45 general hospitals. Therefore, this study considered the most recent report on public general hospitals at the district level with a population of 45 hospitals. This was collaborated from one of the staff from Ministry of Health Research section (Personal communication).

General hospitals at the district level were studied because they offer a big number of outpatient and inpatient services. In addition, they provide supervisory support to lower level health facilities and maintain linkages with communities through Community Health Departments (MoH, Statistical Abstract, 2010:17). The qualitative phase focused on four general hospitals—two from the northern part of the country (denoted as GH A and GH C), and two from eastern Uganda (denoted as GH B and GH D).

Purposive sampling procedure was used to select participants in the first phase of this study. Using replication logic, two hospitals were purposively selected from each of the two most endemic regions of the country, northern and eastern, basing on statistical indicators provided by Uganda Bureau of Statistics (UBOS & ICF International, 2015: 50). In addition, Patton (2015: 276) explained that critical case sampling involves selecting a small number of important cases to "yield the most information and have the greatest impact on the development of knowledge." Besides, Saunders, *et al*., (2012:287) claimed that the data from the different cases help in answering the research questions fully. Theoretical replication logic and cross case comparison within the four hospitals was applied. For every general hospital, there is a DTMC comprising 11 members who share common characteristics.

The 11 DTMC members are the ones directly responsible for managing the supply and distribution of drugs in hospitals. Whereas in the proposal the targeted sample was supposed to be eight DTMC members randomly selected for each hospital as supported by Cooper & Schindler (2011:147), the heads of hospitals encouraged discussions with all the members of the DTMC to get their diverse opinions since they were all willing to participate voluntarily in the study. This approach was taken after careful consideration of how to capture the reality for supply and distribution of ACTs. The participants in the four FGDs were invited in June 2017 to indicate their interest in participating in this study through an information sheet and consent forms. In the reporting of the FGDs and findings, the general hospitals are not identified, but are reported as A, B, C & D to assure anonymity as described in Table 9.

Table 9: Hospital description of selected general hospitals

Hospital	Location	Reason for selection
General Hospital (GH) A	Nothern Region	The District has the highest malaria prevalence in Uganda. It serves other neighbouring districts.
General Hospital (GH) B	Eastern region	It is a referral facility for the district. It serves a catchment population of over 1.5 million covering several districts. The hospital's vision is to improve health and reduce the disease burden by at least 85–90% in the district and surrounding areas.
General Hospital (GH) C	Eastern region	This GH is located in the eastern region of the country. Like all government-owned hospitals, it is supervised by the Ministry of Health. The hospital is within the vicinity of the border town of Malaba and Busia. It serves the general public despite several challenges of poor remunerations of doctors, insufficient medicines, inadequate staffing and funding, and lack of medical equipment.
General Hospital (GH) D	Northern region	The hospital offers a number of services including OPD, inpatient, ophthalmology, X-ray, ultra sound, orthopaedics, health promotion and education, occupational therapy, HIV/AIDS, immunization, environmental health, and special clinics. It was constructed because there were no other hospitals in the region. Other general hospitals are very far. Before this hospital was constructed, there was a small health centre that was started in 1930s. The construction of the hospital started in the early 1970s and it was officially opened in 1974.

4.4.1.3 Focus Group Discussions data collection technique

Under this phase, FGDs were used, involving a small number of participants, who interacted at the direction of a moderator to generate data on a particular issue or topic (Cooper & Schindler, 2011:147). They also provided an opportunity for creative, direct and explicit discussions in a group (Ritchie & Lewis, 2003: 38; Babbie, 2010:92; Myers, 2009:121). The aim was to collect information through group interaction. The data collection method had the following advantages (Myers, 2009:125; Malhotra, 2007: 148):

i. Gathering group participants generated a broad range of information, insight, and ideas. Hence, it is was easy to get very rich ideas as participants tried to explain why they felt the way they did.
ii. Participants' remarks prompted a chain reaction from the other participants.
iii. Since participants were not asked to answer particular questions, their answers were impulsive and unusual and, therefore, gave a precise idea of their opinions.
iv. During the session, the canvassers had more control than in participant observant on, but less control than in face-to-face interviewing.
v. Flexibility of the topic covered.
vi. Because participants were interviewed simultaneously, data collection and analysis proceeded somewhat fast.

The discussions lasted between 90 minutes to two hours, with two research assistants.

Procedure for qualitative data collection

Permission was sought from Ministry of Health Uganda (appendix 3). Use of personal contacts at both Ministry of Health (MoH), Planning Unit and National Medical Stores Sales office enabled the investigator obtain telephone contacts of Medical Superintendents (MS) and Hospital Administrators (HA). On receiving the contacts, she sent out a request to hold FDGs. Thereafter, questionnaires were issued to the selected general hospitals' DTMC members. Follow-ups to the persons named above for actual appointments were made. She obtained permission letters from the MoH indicating the study objective, along with the ethical clearance certificate from the Senate Research and Innovation Higher Degrees committee (SRIHDC). Letters to the respective general hospitals through the HA were sent out.

Briefing and debriefing meetings with the selected focus group members were held. The research team visited the respective hospitals at the appointed time. The MS and HA were requested to invite DTMC members on an agreed date and time to participate in FDGs and surveys. All interviewees gave their consent in writing with clear indication that responding to questions is optional. They were informed about the purpose of the data collection. These ethical considerations were made known to the participants prior to the commencement of FGDs. Respondents were not coerced to give information during the course of this study, and the study team was allowed time to ask questions and record concerns raised by the interviewees.

Once the participants decided to take part, they were given an information sheet and they were asked to sign a written consent form. The FGDs and questionnaire administration were scheduled at a time convenient to the participants, without affecting service delivery. The Hospital Administrator provided a quiet room specifically for this purpose. A debriefing to participants was done at a time convenient to them. Most importantly, participants allowed the team to tape-record the sessions for accuracy and validity purposes. The research assistants signed confidentiality agreements before the actual fieldwork began. The research team used pseudonyms to protect participants' identities at personal and institutional level. Information was stored and may be destroyed after five years.

All participants were from similar therapeutic backgrounds and they discussed the dimensions of coordination, logistical elements and how they affected availability of ACTs in hospitals. Data were generated through interaction of the participants, who were allowed to share their opinions and experience. Eliciting of additional information was allowed. Participants were given an opportunity to ask questions, make reference to what they had heard, prompting discussions. In each of the session, discussions were interactive and permitted individual responses. Group interviews proceeded up to the point where theoretical saturation was reached. Accordingly, scholars such as Guest, Bunce and Johnson (2006:65); Williams, Mukhopadhyay, Dowell and Coyle (2007:2137); and Caldwell, Arthur, Natarajan and Anand (2007:1041) assert that theoretical saturation is based on the principle of diminishing returns, the notion that each additional unit of information would supply less new information than the preceding one.

However, in this study, four principles suggested by Francis, *et al*. (2010: 1234) were followed:

i. Initial analysis of four FGDs were conducted (with 32 DTMC members).
ii. Employed a stopping criterion. This implied that after the initial four FGDs had been conducted with no new themes emerging, the point of data saturation was defined.

However, if after the four FGDs the analysis had proved insufficient, then she would have added another two or three more hospitals to the sample.

iii. Another principle was that at least two independent coders conducted the analysis and they reported agreement levels to establish that the analysis was robust and reliable.

iv. The other principle that was followed was that the data saturation methods and results were described to enable the readers assess the evidence.

4.4.1.4 Qualitative data analysis techniques

The data analysis process involved engaging and reflecting on the collected raw data through coding and grouping of concepts and themes to identify key themes in the data, and eventual interpretation of the data as supported by Quinlan (2011:425). In this regard, Nvivo software to analyse transcribed data from focus groups in order to identify critical key dimensions was used. The tool called for in-depth inquiry for case studies (Quinlan, 2011:182). In the reporting of the FGDs and findings, the general hospitals were not revealed but were reported as A, B, C, & D to ensure anonymity.

Overall, thematic analysis was conducted to analyse the data collected in this study. Thematic analysis identified, organised and reported patterns within data called themes. It was flexible enough to provide rich and detailed accounts of data (Braun & Clarke, 2006:81; Clark & Braun, 2013:81; Penney, Snyder, Crooks & Johnston, 2011:3). Initial analysis involved listening to the digital recordings and matching them with the transcripts in order to generate codes (Creswell, 2012:285). Sections of the data applicable were labelled to outline the meaning of the particular section. Thereafter, the related codes were combined to form themes.

Overall, qualitative data analysis took a three-phase approach: data reduction and data display (extracting recurring themes via coding); *data display* (using matrices, tables and stories); and *drawing conclusions* and verifying them as a means of testing the validity of findings (Creswell & Plano Clark, 2007:148; Miles & Huberman, 1994:11). Organising data was part of preliminary analysis before the next FGD (Merriam, 2009:171). It was instrumental to uncover multiple sources of data. For trustworthiness and credibility, an independent co-coder was consulted. Using the pattern-matching technique, data were displayed in matrices to facilitate comparison of patterns predicted in the hypothesis (Yin, 2009:136). Thereafter, verification was made before identifying common trends of agreement or disagreement and drawing logical connections to inform conclusions. The framework used for data analysis is indicated in Figure 6.

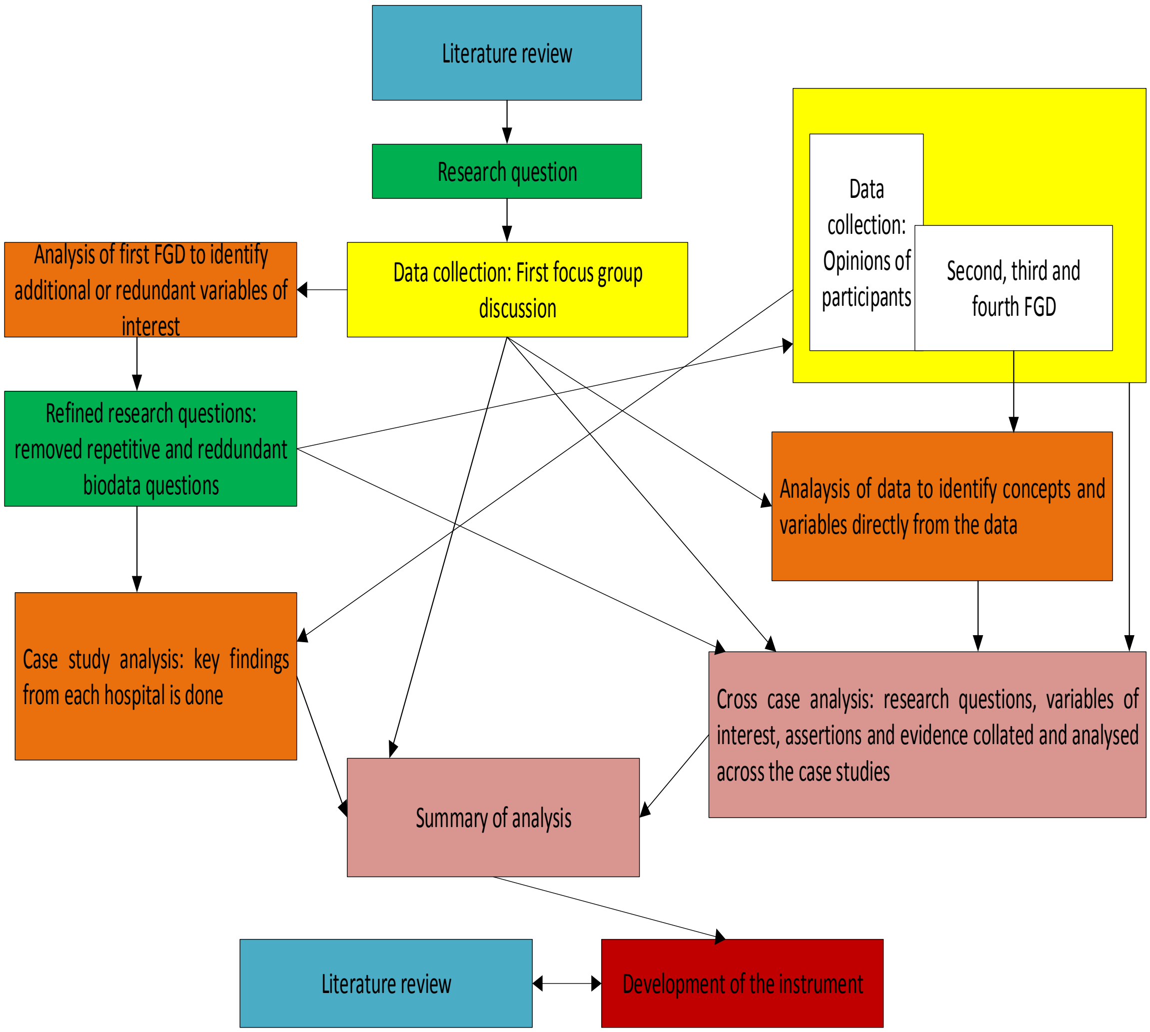


Figure 6: Framework for qualitative data analysis framework

The research design was kept flexible to allow for changes during the research process, hence allowing for alterations in the research questions because of findings and emerging literature without losing focus during the research process. Stake (1995:15) observes that "*the most difficult task of the researcher is to design good research questions that will direct the looking and thinking enough and not too much*". I believe the refined questions were able to achieve this purpose.

The findings were derived from examining each case study independently and the key aspects of the supply chain coordination in the respective contexts, and then examined data and findings across the case studies. The assertions emerging from individual case studies were examined to ascertain their wider relevance. Secondly, the FGD data were examined for variables of interest or emerging key ideas, with relevant statements from interviews being grouped together using Nvivo. The step was useful in the analysis as it synthesised evidence from the data around a concept or variable of interest. Analysed the synthesised data was carried out by examining each of the research questions across the cases. Within each of the research questions, the variables of interest were examined individually alternating between detailed analyses. Results from cross case analysis were then presented in which an instrument was developed and later validated using a survey.

4.4.2 Quantitative approach-phase 2

Malhotra and Peterson (2006:40) asserted that quantitative approach involves a large sample of people, which is representative of the total population, characterised by structure and larger respondent samples. Quantitative approach sought to confirm the hypotheses about phenomena that were stated in Chapter 1 of this study by using questionnaire that was more rigid, structured when eliciting and categorising responses to questions (Creswell, 2014; Saunders *et al*., 2012). In this study, the quantitative approach was adopted in order to measure the intensity, frequency and analysis of causal relationships between variables as supported by Denzin and Lincoln (2013:17).

4.4.2.1 Survey strategy

According to Malhotra and Peterson (2006:40), quantitative research is highly structured and uses larger respondent samples. The study used a cross-sectional survey design, with a large sample to validate the developed framework for coordination of a supply chain in public general hospitals in Uganda. The survey strategy permitted the collection of a large amount of data from a large population in a cost effective manner through administering a standardised questionnaire (Muise, 2011:38). Malhotra (2007:175) emphasised that survey method has the following several advantages:

(i) The questionnaire is easy to manage.
(ii) The data gathered are trustworthy because the responses are limited to the alternatives stated.
(iii) The variability in the results could be reduced because of using fixed-response questions unlike in interviews.
(iv) Analysis, coding, and interpretation of data obtained are quite straightforward.

This enabled drawing inference through measurement of casual relations between variables (Creswell, 2014: 201; Hair, *et al*., 2011:145; Denzin & Lincoln, 2013:17; Saunders, *et al*., 2009:149). Participants were investigated at a particular point in time (Quinlan, 2011:180).

4.4.2.2 Target population, sample size and sampling technique

In this phase, the sample size was guided by the data analysis techniques (Malhotra, 2007). The proposed data analysis techniques for this research were Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA), which are very sensitive to the sample size and less steady when estimated from small samples (Tabachnick & Fidell, 2007: 682). There are diverging criteria for determining a precise sample size using the above analysis techniques (Hair, *et al.,* 2010). For instance, Hair *et al.* (2010:176) suggested that the minimum sample size should be 100 when considering models containing five or fewer constructs, each with more than three items with high item communalities (0.6 or higher); 150 when models contain seven or fewer constructs and modest communalities (0.5); 300 when models contain seven or fewer constructs and low communalities (0.45), and/or multiple under identified (fewer than three items) constructs; and 500 when models contain a large number of constructs, some with lower communalities, and/or having fewer than three measured items. The study sample was 320 participants drawn from 40 general hospitals, which is good when using both EFA and CFA.

For this study, sample size was determined using Krejcie and Morgan table (appendix 2) (Krejcie & Morgan, 1970:608). With the population of 45 general hospitals, the recommended sample size was 40. This assumed 95% statistical significance testing level (confidence level). The population proportion of 0.5% or margin of error/degree of accuracy (5%) was expressed as a proportion (.05). The sample was considered adequate because for factor analysis to be run, a sample size of at least 100 respondents is recommended by Kline (1979:40) even though the number of variable is less than 20 (Arrindell & van der Ende, 1985:166) or at least 10 cases for each item in the instrument (Costello & Osbourne, 2005:4; Velicer & Fava, 1998:232).

There are 45 public general hospitals at the district level in Uganda each with a membership of 11 members of the DTMC. Therefore, this translated to a target population of 495 respondents. Cooper and Schindler (2011:374) point out that there are several probability and non-probability sampling techniques available for consideration when planning and developing a research plan. In choosing the general hospitals, probability sampling method was employed. According to Cooper and Schindler (2011:377), probability sampling is used when every element of the population has a known non-zero chance of being included in the sample. Specifically, simple random sampling technique was used to select the 40 hospitals from 45 general hospitals. Each general hospital within the sampling frame was assigned a unique number written on a piece of paper (1-45). The pieces of paper were placed in a box and picked without replacement. The technique provided an equal and independent chance of each hospital being selected to the survey sample, thereby avoiding bias. From the 11 members of the DTMC from each selected general hospital, eight were selected purposively from each hospital giving a total of 320 respondents.

4.4.2.3 Survey data collection technique

Extensive current literature did not reveal a pre-existing measurement tool suitable for the investigation at hand. This could probably be due to the novelty of the topic relevant to understanding the interplay of the micro-, market-, macro-environments and logistics activities and how they affect the availability of ACTs in general hospitals in Uganda. Shiu, Hair, Bush, and Ortinau (2009:421) explain that there are several attitudinal scales that are useful in many different situations including the Likert scale, semantic differential scales and behaviour intention scales. The process of developing the instrument involved identifying the concepts as derived from the FGDs and measuring the variables related to the research problem (Hair, *et al.,* 2010:38).

In particular, a five-point Likert scale was used. Cavana, *et al.* (2001:206) argued that a five-point Likert scale is as good as any, although beyond five points on a rating scale does not improve the reliability of ratings. Conversely, Aaker, Kumar, Day, and Leone (2011:259) suggested that when using a Likert scale, each respondent is required to indicate the degree of agreement or disagreement with a range of statements related to a subject. Hair *et al.*, (2010:153) further suggested that scale descriptors are a combination of labels, such as "strongly agree" or "strongly disagree" and numbers, such as 1-7, that are assigned using a set of rules. In this study, a five-point Likert scale was used, with each measure on the scale represented by a score, with Strongly Agree (5), Agree (4), Not Sure (3), Disagree (2) and Strongly Disagree (1) (Saunders, *et al.,* 2007:221). Items in the questionnaire were arranged in an order that presented a logical flow to the respondent (Saunders, *et al.,* 2007: 254).

4.4.2.4 Quantitative data analysis

The analysis of the survey data was conducted by applying statistical techniques. These techniques involved descriptive statistics, assumptions for data analysis (e.g., normality, linearity), multivariate analysis using Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) (Hair *et al.*, 2010:39). CFA was used to validate construct measurements. While initially LISREL was proposed to be used, instead AMOS was used because it was much more user-friendly. Additionally, Gallagher, Ting and Palmer (2008) also recommends picking a package that is used by colleagues who have experience with the chosen package. Lastly, Analytic Hierarchy Process (AHP) approach was used to prioritise the supply chain coordination dimensions. AHP organised the CFA parameters into a hierarchical structure (Reizaer, 2015:50). The method is "a theory of measurement through pairwise comparisons and relies on the judgments of experts to derive priority scales" (Saaty, 2008: 83).

Descriptive analysis

In order to describe data, other statistical analyses were used. These included measure of significance and to indicate the relationship between sets of data (Wiid & Diggines, 2009:242). McDaniel and Gates (2010:505) posited that descriptive statistics is the most proficient way of summarising the characteristics of large sets of data. According to Wiid and Diggines (2009:242), descriptive statistics are used to show how the data are distributed, indicate data characteristics and to indicate how the data varies. The data were presented in different ways such as; percentage, measures of central tendency, measures of dispersion, and frequency distribution.

Frequency distribution and percentage

The frequency is the number of times a number (raw response) is in a data set (Shui *et al*., 2009:514). Tustin, *et al*., (2005:523) indicated that frequencies entail the construction of a table that shows in absolute and relative terms (in percentages) how often the different values of the variable are encountered in a sample.

Measuring statistical relationships

In determining whether there was a relationship or association between a set of independent and dependent variables, correlation and regression analysis were used (Wiid & Diggines, 2009:248). In this study, Pearson correlation coefficient was used to measure the degree to which there was a linear association between two variables (Aaker *et al*., 2011:440). Regression methods, on the other hand, were used to explore cause-and-effect relationships between the variables (Wiid & Diggines, 2009:249).

Methods for determining a structure in multivariate data

According to Wiid and Diggines (2009:249), analytical techniques are used to systematise, summarise and simplify complex multivariate data. The scholars further assert that there are a number of interdependent statistical analytical techniques, including among others; cluster analysis, multidimensional scaling and factor analysis. For the purpose of this study, EFA was first used in an effort to reduce the data and to categorise a small number of factors that explain most of the variance observed in a much larger number of manifest variables (Hair *et al*., 2011: 94). This was followed by CFA to test for relationships between the manifest and global latent variables. However, certain assumptions for parametric tests had to be performed (normality and homogeneity) before applying factor analysis (Yong & Pearce, 2013: 80)

4.4.2.5 Parametric test assumptions

Assumption 1: Normality test

The normality tests was done to determine fair distribution of elements in the data set by interpreting p-values far lower than 0.05 (Field, 2009). Three interrelated methods of this assumption are; normal p-p plots, histogram, and scatter plot. Accordingly, these were adopted to test for normality in the data. In addition, other methods such as skewness and kurtosis, Kolmogorov & Shapiro and multi-collinearity were also used to establish normality in the data (Hair *et al.* 2010). The results from the tests are discussed in Chapter 6 of this report.

Normal p-p plots

Under a normal p-p chart plots, observed values fell exactly along the straight diagonal line, with observed values plotted as individual points (Hair *et al*., 2010; Field, 2005). The assumption was that if the data are normally distributed, then the observed values (the dots on the chart) should fall exactly along the straight line. The results are also presented in chapter 6 of this study.

Histogram

Field (2005) suggested that a histogram representing a normal distribution is characterised by the bell-shaped curve. From the result on the data, histograms were developed from responses under the different dimensions and were bell-shaped, indicating that the transformed data was normally distributed. This implied that the data from the study were good enough for further statistical tests as assumption of normality using histogram was achieved and tenable as indicated in appendix 4 (b) in appendix section.

Scatter plots

Scatter plots were also used to test for normal distribution in the data. According to Field (2005), they are used to determine the relationships between the variables by showing trends in the data and indicating whether there is a relationship between these variables, what kind of relationship it is, and whether other cases were markedly different from the others. The analysis was important because it helped to determine the cases that differ substantially from the general trend of the data, which could have severely biased normality in the data.

Skewness and kurtosis

According to Field (2005), skewness is used to describe the balance of the distribution; whether it is unbalanced and shifted to one side (right or left) or is it centred and symmetrical with about the same shape on both sides. If a distribution is unbalanced, it is skewed. A positive skew denotes a distribution shifted to the left, whereas a negative skewness reflects a shift to the right (Hair *et al*., 2010; Cooper & Schindler, 2011:425). Kurtosis refers to the ''peakedness'' or ''flatness'' of the distribution compared with the normal distribution. Distributions that are taller or more peaked than the normal distribution are termed leptokurtic, whereas a distribution that is flatter is termed platykurtic (Cooper & Schindler, 2011: 425; Field, 2005). The recommended range of skewness values is –1 to +1 (Hair *et al*., 2010) and for Kurtosis, the range is -2.0 to +2.0 (Coakes & Steed, 2003). Therefore, the skewness and kurtosis were used to establish normality based on the range of -2 to +2 as a normal distribution.

Kolmogorov-Smirnov and Shapiro-Wilk tests

Kolmogorov-Smirnov and Shapiro-Wilk tests were also used to determine whether the distribution as a whole deviated from a comparable normal distribution in the transformed study data. The test compares scores in the sample to a normally distributed set of scores with the same mean and standard deviation (Field, 2005). The assumption was that if the test is non–significant ($P>.05$), then the distribution of the sample is not significantly different from a normal distribution (it is probably normal), and if the test is significant ($P<.05$), the distribution in the data was considered significantly different from a normal distribution (it is non–normal) was considered.

Multi-collinearity

Hair *et al*., (2010:188) stated that multi-collinearity occurs when any single independent variable is highly correlated with a set of other independent variables. According to Field (2005), the simplest and most obvious means of identifying collinearity is an examination of the correlation matrix for the independent variables. Collinearity may be owing to the combined effect of two or more other independent variables (termed multi-collinearity). According to Field (2009:648), if variables are found to correlate too highly ($r > 0.8$ or $r < -.8$), "it becomes impossible to determine the unique contribution to a factor of the variables that are highly correlated". In the same vein, for variables that correlate lowly with many other variables ($-0.3 < r < 0.3$), meant that they probably do not measure the same underlying construct as the other variables. Either way, highly and lowly correlating items were excluded. Hair *et al*., (2010:193) accentuate that the most common measures for assessing both pairwise and multiple variables collinearity are tolerance and its inverse, the variance inflation factor (VIF). A direct measure of multi-collinearity is tolerance, which is defined as the amount of variability of the selected independent variable not explained by the other independent variables. The tolerance value should be high, which means a small degree of multi-collinearity (i.e. the other independent variables do not collectively have any substantial amount of shared variance. Therefore, instances of higher degrees of multi-collinearity are reflected in lower tolerance values and higher VIF values (Hair *et al*., 2010). Both values of VIF <10 & tolerance above 0.2 as cut-off point indicated a complete lack of multi-collinearity (Hair *et al*., 2010; Tabachnick & Fidell, 2001).

Assumption 2: Homogeneity of variances

The homogeneity of variances assumption means that the variances should be the same throughout the data. According to Pallant (2005:253), if this number is *greater* than .05, the assumption of homogeneity of variance has not been violated. To test this, SPSS was performed using the Levene's test for equality of variances as part of the t-test and analysis of variances analyses. According to Hair *et al*., (2010), if the significance value is less than .05 ($P<.05$), this suggests that variances for the two groups are not equal, and you have therefore violated the assumption of homogeneity of variance. However, if the Levene's test is non–

significant at P>.05, then we accept the null hypothesis that the difference between the variances is zero, and the variances are equal and the assumption has been achieved. Conversely, Field (2005) contends that the variance of one variable should be stable at all levels of the other variables and should not change.

The Kaiser-Myer-Olkin (KMO) and Bartlett's test of sphericity

Furthermore, the Kaiser-Myer-Olkin (KMO) measure of sampling adequacy was carried out to determine the suitability of a set of data for subsequent factor analysis in order to decide whether a factor analysis should be undertaken. Measured by the KMO statistics, sampling adequacy predicted if data are likely to factor well, based on correlation and partial correlation. The KMO varies from 0 to 1.0 (Table 10) and small values of KMO suggest that a factor analysis should not be undertaken. Moreover, the KMO should be 0.60 or higher to proceed with factor analysis (Tabachnick & Fidell, 2007). The Bartlett's test was also carried out as recommended in factor analysis by Field (2005). The test checked for similarity of group variances and whether the independent variables were not correlated. According to Field (2005), the Barlett's test of Sphericity should be significant (significant level of p <0.05), otherwise the implication would be that variables which did not correlate enough constituted another factor. Where the Bartlett's test for sphericity was significant for all variables (sig. 000), then it was concluded that there were some relationships between the variables. The results are depicted in Chapter 6 of this study.

Table 10: Interpretation of correlation

Range	Interpretation
0	There is diffusion in the pattern of correlations, so factor analysis not appropriate
Close to .1	Patterns of correlations are relatively compact, so factor analysis will yield distinct and reliable factors
.5 – .7	Mediocre results
.7 – .8	Good results
.8 – .9	Great results
Above .9	Superb results

Source: Muhwezi (2010:96).

4.4.3 Exploratory Factor Analysis (EFA) justification and procedures

In order to generate a theory explaining the dimensions of supply chain coordination at the micro-, market- and macro-environments and logistics activities, EFA was employed to explore the data set (Costello & Osborne, 2005:8). The aim of the technique was to identify and reduce the number of hidden (latent) constructs and the fundamental factor structure of a set of variables, based on the derived correlation-matrix (Tabachnick & Fidell, 2007: 609). According to Cooper and Schindler (2011: 545), EFA is a widely used interdependence technique in social science and used to determine which items correlate stronger with each other than with other variables, and identifies the number of items and what they have in common.

Since the study variables were grouped into several dimensions, EFA was appropriate in identifying groups of variables and seeing how they were related to each other. As a rule of thumb, a strong conceptual foundation needed to support the assumption that a structure does exist before EFA was performed. Pallant (2010: 180) explains that EFA comprises the following three major stages:

i. Assessment of suitability of data for factor analysis (normality and homogeneity tests were done before embarking on EFA);
ii. Factor extraction (number of factors to be retained); and
iii. Factor rotation.

4.4.3.1 Number of factors to be retained and extraction methods

According to Slocum-Gori and Zumbo (2011:443), there is no universally accepted set of rules or technique to determine the number of factors to be retained when assessing the dimensionality of item response data. The scholars hasten to add that generally, factor analysis is used with the eigenvalues-greater-than-one, or hypothesis testing approaches involving chi-square tests from Maximum Likelihood or Generalized Least Squares estimation. Overall, the number of factors that were retained depended on the number of positive eigenvalues of the correlation matrix although the criteria has shortcomings by way of accepting an eigenvalue that is positive but very close to zero. Therefore, some rules of thumb as suggested by Rietveld and Van Hout (1993:273-274) were observed such as; retention of; 1). Only those factors with an eigenvalue larger than 1 (Guttman-Kaiser rule); and 2). Thereafter a scree-plot was drawn in conjunction with the eigenvalues to determine the number of factors to be retained using the most desirable factor structure. Only those factors before the breaking point or elbow were retained (Yong & Pearce; 2013:85). Communalities were further checked after factor extraction.

The main goal of factor extraction was to determine the factors that summarise the interrelationships between the variables. There are many types of extraction techniques such as principal components analysis (PCA), unweighted least squares, generalized least squares, maximum likelihood, principal axis factoring (PAF), alpha factoring, and image factoring (Costello, 2005:3; Pallant, 2010:185; Tabachnick & Fidell, 2007: 639). However, Tabachnick and Fidell (2007: 638) report that in reality, both approaches (orthogonal and oblique) often result in very similar solutions, particularly when the pattern of correlations among the items is clear.

However, there is almost no evidence regarding which method should be preferred for different types of factor patterns and sample sizes (Fabrigar, Wegener, MacCallum & Strahan, 1999:277). The scholars further suggest that if data are relatively normally distributed, maximum likelihood is the best choice because "it allows for the computation of a wide range of indexes of the goodness of fit of the model [and] permits statistical significance testing of factor loadings and correlations among factors and the computation of confidence intervals"(p.277).

In this study, the maximum likelihood method of extraction method was used since the data were normally distributed. Specifically, the Promax technique was used as the rotation method during the rest of the analysis. Final interpretation of the factor structure was done. However, the strength of the relationship was determined by the respective factor loading, produced by the rotation. The loadings were interpreted as standardised regression coefficients and the results are presented in Chapter 6. Nonetheless, the pattern matrix was examined for factor/item loadings while the factor correlation matrix was expected to reveal any correlation between the factors (Costello & Osborne, 2005:3).

4.4.3.2 Determining the validity of factor structure and individual items

The following were used to determine the validity of the factor structure based on Costello and Osbourne (2005: 3).

i. Use of item communalities - More common magnitudes in the social sciences are low to moderate communalities of .40 to .70. If an item has a communality of less than .40, it may either; a) not be related to the other items, or b) suggest an additional factor that should be explored.
ii. Tabachnick and Fidell (2001) cite 0.32 as a good rule of thumb for the minimum loading of an item, which equates to approximately 10% overlapping variance with the

other items in that factor. Hence the “cross loading” item (an item loading at .32 or higher on two or more factors). Therefore, the scholars suggest that a decision of whether a cross loading item should be dropped from the analysis has to be made, which may be a good choice if there are several adequate to strong loaders (.50 or better) on each factor.

iii. A factor loading with .50 or better was desirable, thus indicating a solid factor.

Therefore, after EFA, further analysis using CFA and structural equation modelling (SEM) through AMOS/21 were performed on the summarised variables from constructs extracted by EFA in order to ascertain the relationships between the observed measures and underlying factors. Therefore, the technique was used to achieve data reduction as explained by total variance in the results. The EFA on the data were performed on the different variables under study and the results were presented and discussed in chapter six (6).

Further analysis using CFA with outputs similar to structural equation modelling (SEM) through Analysis of Moment Structures (AMOS/21) were performed on the summarised variables from constructs extracted by EFA in order to ascertain the relationships between the observed measures and underlying factors. Factor loading above the cut-off point $|0.30|$ were retained for further analysis (Hair *et al*., 2010).

4.4.4 Confirmatory Factor Analysis (CFA)

This procedure was carried out to confirm a pre-specified relationship by testing the set hypotheses. CFA was also used to test whether measures of a construct were consistent with understanding of the nature of that construct. (Hair *et al*., 2010). Factors that scored above 0.5 were directly subjected to CFA. Therefore, same data can be used after removing low loading and cross loading items (Eidecker, Glöckner-Rist, & Gerlach, 2010; Fabrigar, *et al*., 1999). The advantage of CFA is that it allowed for testing hypotheses about a particular factor structure (Albright, 2006). CFA is a special case of the SEM, also known as the covariance-base (CB) structure. SEM consists of two components, namely, a measurement model linking a set of observed variables to a usually smaller set of latent variables and a structural model linking the latent variables through a series of recursive and non-recursive relationships (Albright, 2006). Conversely, Albright and Park (2009:3) assert that CFA is theory or hypothesis-driven based on theoretical relationships between the observed and unobserved. Under CFA, used a hypothesised model was used to estimate a population covariance matrix that was compared with observed covariance matrix. Hair *et al*., (2010) point out that CFA is specifically concerned with the extent to which the observed variables are generated by the underlying latent constructs and therefore, the strength of the regression paths from the factors to the observed variables (factor loadings).

Before the assessment of the measurement model, the process of item purification was applied through multiple iterations of CFA, with the maximum likelihood estimation (MLE) method. Unfitted items were deleted from the measurement model. As recommended by Hair *et al.* (2010), modification of the initially hypothesised model was performed whenever applicable. This was achieved based on such indicators as modification indices (MI), standardised residuals, path estimates, squared multiple correlations, and qualitative review. These model diagnostics were used to suggest model changes, which are known by specification search, whereby an empirical trial-and-error approach was used (Hair *et al*., 2010).

Hair *et al*., (2010) acclaims that goodness-of-fit indices is used to determine how well the observed data actually fit the model. The goodness-of-fit indices (GOF) are the measure indicating how well a specified model reproduces the covariance matrix among the indicator variables. Hair *et al*., (2010) further maintain that using three to four fit indices provides adequate evidence of model fit. This research suggested a fairly common set of indices performed adequately across a wide range of situations, although it was not necessary to report on all GOF indices because they were often redundant. However, at least one incremental index and one absolute index, in addition to the x^2 value and the associated degrees of freedom, were used because using a single GOF index, even with a relatively high cut-off value, is no better than simply using the x^2 GOF test alone. Therefore, reporting the x^2 value and degrees of freedom, the Comparative Fit Index (CFI), the Incremental Fit Index (IFI) or the Tucker Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA) provided sufficient unique information to evaluate the model. Therefore, for the purpose of running CFA, use of analysis of moment structures (AMOS 21) was adopted.

The following cut–off points of GOF indices were used to assess the degree of fit between the model and the sample; x^2, Tucker Lewis Index (TLI; >.90 acceptable, >.95 excellent), the Comparative Fit Index (CFI: >.90 acceptable, and Root Mean Square error of approximation (RMSEA; <.08 acceptable, <.05 excellent). Notwithstanding the above, several criteria to determine the inclusion of the items and model fit were adopted. First, items had to have a primary factor loading of 0.30 as supported by Tabachnick and Fidell (2001).

4.4.4.1 Steps in data analysis using CFA (CFA)

The CFA permitted testing of the hypotheses and provided more informative analytic options (Costello & Osborne, 2005:8). CFA technique relied on several statistical tests such as SEM to determine the adequacy of model fit to the data. Within the SEM, the chi-square test of significance was carried out to determine the amount of difference between expected and observed covariance matrices. Additionally, CFA technique was used to test a theory about latent processes and consequently allowed for the testing of hypotheses in Table 11. This was done in accordance with DeCoster's (1998:5), suggested five basic steps:

a) *Model specification*: The factor model was defined so as to test it by selecting the number of factors using the diagram and defining the nature of the loadings between the factors and the measures. These loadings were fixed at either zero, at another constant value or are allowed to vary freely, or be allowed to vary under specified constraints (such as being equal to another loading in the model).
b) *Data collection:* Measurements were collected using the same (or matched) experimental units; in this case general hospitals were used.
c) *Determining of the preliminary descriptive statistical analysis:* A correlation matrix was generated indicating the correlations or co-variances between each of the variables.
d) *Estimation of parameters in the model and assessing the model fit:* Fitting of the model to the data involved choosing a method to obtain the estimates of factor loadings that were varied freely using the *Maximum likelihood* estimation.
e) *Presentation and interpretation of the data:* The model was evaluated for adequacy to minimize the discrepancy between the correlation matrix and the model and the actual observed matrix. The *goodness-of fit* test was applied to test the null hypothesis (that the model adequately accounts for the data), while the alternative was that there is a significant amount of discrepancy.

Table 11: Null and alternative hypotheses

Hypothesis	Null	Alternative
Hypothesis 1	$H0_1$: There is no significant correlation between the critical supply chain coordination dimensions and ACTs availability in district general hospitals in Uganda.	$H0_1$: There is a significant positive correlation between the critical supply chain coordination dimensions and ACTs availability in district general hospitals in Uganda.
Hypothesis 2	$H0_{2:}$ There is no signification correlation between logistics activities dimensions and ACTs availability in district general hospitals in Uganda.	$H0_2$There is a significant correlation between logistics activities dimensions and ACTs availability in district general hospitals in Uganda.
Hypothesis 3	$H0_{3a1}$: There is no significant correlation between the market management dimensions and ACTs' availability in district general hospitals in Uganda.	$H0_{3a2}$: There is a significant correlation between the market management dimensions and ACTs' availability in district general hospitals in Uganda.
	$H0_{3b1}$: There is no significant correlation between the macro management environment dimensions and ACTs' availability in district general hospitals in Uganda.	$H0_{3b1}$: There is significant correlation between the macro management environment dimensions and ACTs' availability in district general hospitals in Uganda.

4.4.5 Multi-attribute comparison of coordination dimensions using Analytic Hierarchy Process (AHP)

Availing medicines in public hospitals in the right quantities and right quality has been a daunting task in many developing countries. All problems associated with medicine supply and distribution are wicked ones, therefore, having no right answer. According to Okeola and Sule (2012:19), wicked problems are found at the intersection of science and values. Furthermore, Khisty and Mohammadi (2001) asserted that ambiguity in decision-making is embedded in all wicked problems along with the problem of human rationality. Therefore, the solution to wicked problem may either be made better or worse. In the face of wicked problems such the one mentioned above, it is therefore unrealistic to look for optimal solution because it rarely exists. Rather it is essential to be able to find compromise solutions. Therefore, a holistic approach, known as the Multi-criteria Decision Analysis (MCDA) was used to solve wicked problem. The approach is a general forum within which several variables and models can be combined to incorporate all necessary interacting components in the decision-making process (Al-Zu'bi & Al-Kharabsheh, 2003).

After verifying the factor structure of a set of observed variables and testing hypotheses, the next stage was to prioritise supply chain coordination dimensions and sub-dimensions for coordinated supply chain, using Multi-Criteria Decision Method (MCDM). MCDM is generally divided into two categories, namely, Multi objective decision-making (MODM) methods and multi-attribute decision-making (MADM) methods (Rezaei, 2014: 49).

MADM method has different methods including the following:

i. the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS);
ii. Multi-Attribute Utility Theory;
iii. the Analytic Hierarchy Process (AHP);
iv. Fuzzy Set Theory;
v. Case-based Reasoning;
vi. Data Envelopment Analysis;
vii. Simple Multi-Attribute Rating Technique;
viii. Goal Programming;
ix. ELECTRE;
x. 10) PROMETHEE; and
xi. Simple Additive Weighting (Velasquez, & Hester, 2013:56).

MCDM is an approach of solving complex decisions. It was applied in ranking the best alternative or identifying the most influential parameter. For the purpose of this study, analytic hierarchy process (AHP) approach was used because of its mathematical simplicity and flexibility (Singh, 2013:85). Despite the academic debates, the AHP remains one of the most popular MCDM. AHP is one of the extensively used multi-criteria decision-making methods, probably because it is easier to understand and easier to handle both quantitative and qualitative data. The AHP does not only help the analysts to arrive at the best decision, but also provides them with a clear rationale for the choices made by reducing complex decisions to a series of simple comparisons and rankings, then synthesising the results (Chin, Chiu &

Tummala, 1999). In addition, the method does not involve cumbersome Mathematics. Although the purpose of AHP is to capture the expert's knowledge, its main shortcoming is the inability to reflect the human thinking style (Kahraman, Cebeci, & Ruan, 2004: 174).

Conversely, AHP provided a framework to cope with multiple criteria situations involving rational, instinctive, qualitative, and quantitative phases. At all levels of decision-making in organisations, policy makers use multiple criteria to analyse complex problems. Therefore, multi-criteria thinking is used to facilitate decision-making. While using this technique, decisions made should benefit the clients, the entities and society as a whole (Saaty, 1994: 25). AHP helps the analysts to organise theoretical parameters of a problem into a hierarchical structure—family tree. This provides a clear rationale for the choices made. One of the seven pillars of AHP are ratio scales, proportionality and normalised ratio scales (Patil & Kant, 2014). Saaty & Vargas (2012:24) state that the scale must use absolute numbers 1, 2, 3, … 9 or its verbal equivalents as illustrated in Table 12.

Table 12: Saaty's pairwise comparison scale

Degree of importance	Definition
1	Equal importance (no preference)
2	Intermediate between 1 and 3
3	Moderately more important
4	4 Intermediate between 3 and 5
5	Strongly more important
6	Intermediate between 5 and 7
7	Very strongly important
8	Intermediate between 7 and 9
9	Extremely strongly more important

Source: Saaty (1994:26)

The AHP was used to prioritise the most important supply chain coordination dimensions in making ACTs available in general hospitals in Uganda. AHP, a technique used in MCDA, was used to make an important contribution to the practical decision-making process by recognising the decision makers' (DMs) experience and in providing the possible best compromised solution in terms of multiple objectives and multiples DMs and stakeholder's preferences. From the CFA results, four coordination management options were formulated with sub-dimensions within the model. The four options were critical supply chain dimension at the micro-environment, logistics activities dimensions, market and macro-environment dimensions. Whereas the goodness of fit was established under CFA, it was difficult to rank the choices based on the compromise solutions according to the performance of the system under various alternatives. Therefore, to further understand the impact of different measuring variables of availability of ACTs, AHP approach was adopted to rank the magnitude of each factor under the four categories—critical supply chain, logistics activities and management environment (market-and macro-environments).

4.4.5.1 Methodology in carrying out Multi-criteria Decision Analysis (MCDA)

The philosophical bases of multi-criteria approach was to provide insight into the nature of the conflicts among objectives and reach consensus among stakeholders rather than eliminating the conflicts (Kheireldin & Fahmy, 2001). According to Velasquez and Hester (2012:20); Saaty (1994: 20), AHP is a MCDA methodology that allows objective as well as subjective dimensions to be considered in a decision-making process. Like other MCDA techniques, its purpose was to develop a theory and provide a methodology for modelling unstructured decision choice problems. Basically, AHP helped to determine which variable had the highest priority and should be acted upon to influence the decision outcome (Okeola & Sule, 2012:19). AHP relies on the supposition that humans are capable of making relative judgments than absolute judgments; and it is based on the key principles of decomposition, comparative judgement, and synthesis of priorities (Dey, 2003). There were many ways of including the views and judgement of each person in the priority setting process.

In a common objectives context, there are four ways to set priorities, namely,

i. Consensus;
ii. Vote or compromise;
iii. Geometric mean of the individuals' judgement; and
iv. Separate models or players (Okeola & Sule, 2012:19).

AHP was found to be an effective methodology to obtain group consensus in an environment of uncertainty. It is appropriate because the decision support system (DSS) was able to cope with poor data, allow integration of human judgement in the process and create enough discrimination between motivations to make result significant. Singh (2013) employed AHP in prioritising the five strategic dimensions for coordinated supply chain in Small Medium Enterprises in India. Okeola and Sule (2012:19) also used AHP to analyse the competing decisions to model multi objectives management strategies for an urban water supply.

Carrying out AHP, focused groups were utilised in this study to develop the weights that were used to rank the different parameters. A preference tool in form of a questionnaire was used among the focused group members as supported by Saaty (2004: 20). Because of this methodological structure, respondents in an AHP survey are less likely to adopt mental short cuts by concentrating disproportionately on one criteria or level. Therefore, AHP can deliver enough discrimination between motivations to make results significant (Okeola & Sule, 2012:19). A set of comparison matrices of all elements in a level of the hierarchy with respect to the immediate higher level were constructed. This was aimed to prioritise and convert individual comparative judgements into a ratio scale of measurements using Saaty's nine-point scale shown in Table 12.

The AHP model for this study comprised hierarchies that defined: the driving goal; the objectives to achieve the goal; further objectives to evaluate the objectives; and in the formulation of the objectives (criteria) and alternatives strategies to evaluate and synthesise these objectives. In addition, personal interactions were made with individuals among the groups. The data collection was accomplished through preference elicitation using questionnaire anchored on Saaty (1994) scale. The members congregated in one room on an appointed date to attend the moderated FDGs. Information was extracted and used to model the experts' preferences. Specifically, the Decision Making Group (DMG) were composed of the Medical Superintendent, Hospital Administrator, Principal Nursing Officer, Pharmacist, and Stores Assistants.

Regardless of the different approaches used in AHP, the following baseline steps provided by Saaty (2004) and Singh (2013:85-89) were followed;

i. Build AHP model;
ii. Data collection from experts;
iii. Determine the normalised priority weights of individual dimensions and sub dimensions; and
iv. Synthesis-finding solution to problem.

a) Structuring a hierarchy AHP model

Under this phase, an appropriate hierarchy of goals, strategic areas or sub-dimensions were formed. The goal of this phase of the study was to prioritise the dimensions affecting the availability of ACTs in general hospitals in Uganda. This goal is placed on the first level of the hierarchy as shown in Figure 7. The strategic areas included; critical supply chain, logistics activities, market, and macro dimensions—these dimensions form a second level hierarchy. Under each of the second level dimensions, there were sub-dimensions that formed level three.

The 20 sub-dimensions in level three were derived from CFA results; six were related to critical supply chain, five to logistics activities, four to market environment, and five related to macro environment. The two levels (second and third) were assessed by pairwise comparison of elements with respect to parent element. A set of global priority weight were then determined for each of the sub-factor by multiplying local weight of sub-factor with weight of all the parent nodes above it. The fourth level of hierarchy consisted of the result.

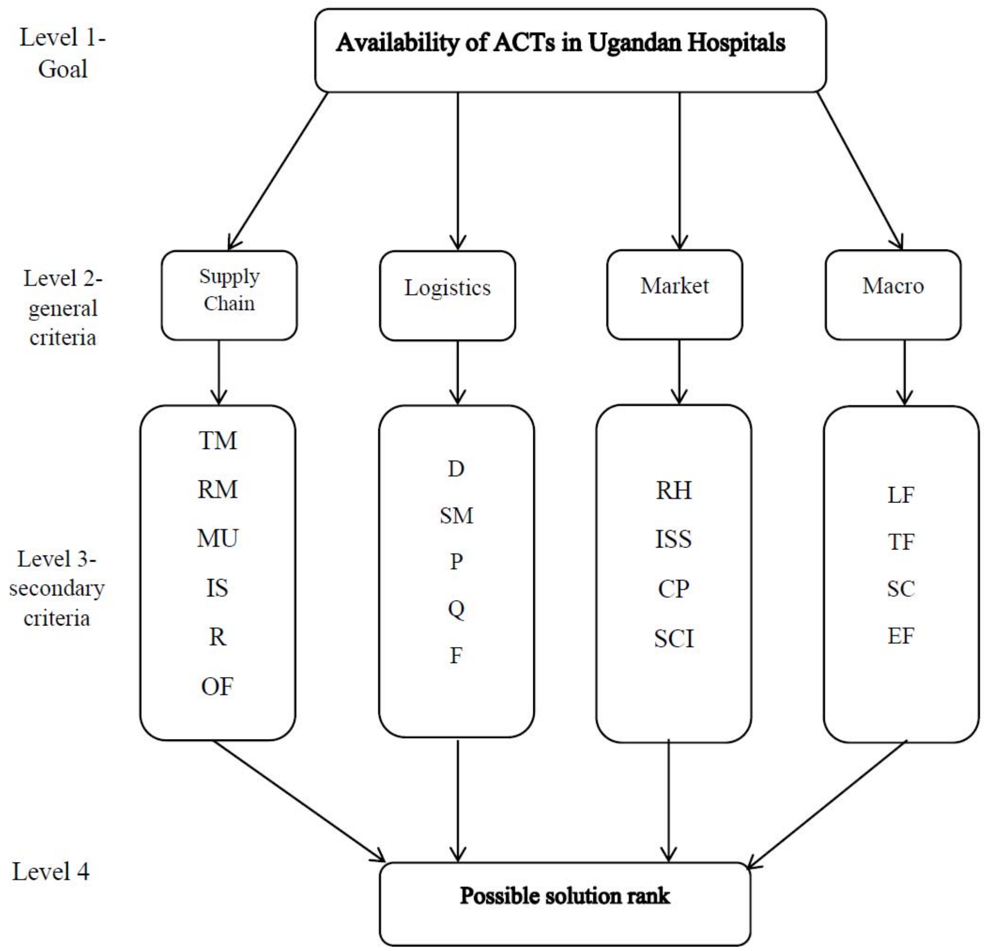


Figure 7: Decision hierarchy for ACTs' availability

b) Sample size and data collection under AHP technique

There is no much restriction for the sample size for AHP technique. Some studies have used varying numbers of respondents. For instance, there are studies with five experts (Singh, 2013: 85; Singh, 2011: 626; Kahraman, *et al.*, 2004:174); six respondents (Aelfers, 2017:26) and 50 respondents (Rezaei, 2014: 54). In this phase, data were collected from four focused or expert groups. Specifically, the focus groups were from the four initial hospitals that were engaged in qualitative phase. Clearance from the medical superintendents and hospital administrators from each of the four hospitals was sought, who in turn identified the key decision makers from among the DTMC. The hospitals were purposively chosen because they had high occurrences of malaria outbreaks as was done under the exploratory phase. After the explaining the tool and aim of the study, the group discussed the dimensions without allowing outspoken persons to override the discussion. The nine-point scale was used to assign relative importance to pair-wise comparison among the dimensions and sub-dimensions. To assign relative scores of each factor, an expert team of five members was formed in the four selected hospitals. The experts assigned a score to each comparison using the nine-point scale set by Saaty (1994:26). The team members had experience in medicine supply and distribution. The attributes in the questionnaire (see appendix 9) were derived from the CFA outputs. The AHP results are presented in last part of Chapter 6 of this study.

Assigning relative score for pair-wise comparison was a critical stage in AHP if consistent results were to be obtained. Scores were assigned to each sub-factor and continued until all levels of the hierarchy and eventually a series of judgment matrices for the sub dimensions was obtained (Saaty, & Vergas, 2012:29). In case of any confusion, clarification was sought by the respondents/experts.

c) ***Deriving the normalised priority weights and construction of pair-wise comparison matrices***

A set of pair-wise comparison matrices was constructed for each of higher and lower level attributes. An element in the higher level was said to be a governing element for those in lower level, since it contributed to it or affected it. The elements in the lower level were then compared to each other based on their effect on the governing element above (Goepel, 2017). In addition, the pair-wise comparisons were done in terms of which an element dominated another. These judgments were then expressed as integers. If element A dominates over B, then the whole number integer was entered in row A, column B and reciprocal was entered in row B, column A. If the elements being compared were equal, one was assigned to both positions. If there were n (n-1)/2 judgment required to develop the set of matrices (reciprocal were automatically assigned in pair-wise comparison). The calibration of pairwise comparison was carried out to ensure consistency of judgement. The geometric mean of each element of the pairwise comparison matrix of individuals was estimated as the group judgement or consensus.

d) Computing the vector of criteria weights

Upon data collection from the experts, pair-wise comparison matrix A was created. The matrix A is an m x m real matrix, where m is the number of evaluation criteria being investigated. Each entry a_{jk} of the matrix A represents the importance of the j^{th} criterion relative to the k^{th} criterion. If $a_{jk} > 1$, then the j^{th} criterion is more important than the k^{th} criterion, while if $a_{jk} < 1$, then the j^{th} criterion is less important than the k^{th} criterion. And if $a_{jk} = 1$, the two criteria have the same importance. The entries a_{jk} and a_{kj} had to satisfy the equation; $a_{jk} \times a_{kj} = 1$.

e) Deriving priorities (weights) for the criteria

In deriving the weights, the approximate method required the normalisation of the comparison matrix; that is, added the values in each column (column addition matrix). Next, each cell was divided by the total of the column for the raw data to derive the normalised matrix. From this normalised matrix, the overall or final priorities were obtained by simply calculating the average value of each row. To do so, normalisation of the column of numbers was done by dividing each entry by the sum of all entries. Then each row of the normalised values was summed up and average considered. This provided a priority vector (PV). Normalisation tables were generated as suggested by Singh (2013: 87); Rao (2013:7-9) and Saaty (1994:38). After constructing matrix A, it was possible to derive from A the normalised pairwise comparison matrix A_{norm} by making equal to 1 the sum of the entries on each column, that is, each entry $\bar{a}_{jk}$ of the matrix A_{norm} was computed as;

$$\bar{a}_{jk} = \frac{a_{jk}}{\sum_{i=1}^{m} a_{ik}}$$

Finally, the criteria weight vector w (that is an m-dimensional column vector) was constructed by averaging the entries on each row of A_{norm} i.e.

$$w_j = \frac{\sum_{i=1}^{m} \bar{a}_{ji}}{m}$$

From this normalised matrix, the overall or final priorities were obtained by simply calculating the average value of each row.

f) Calculating the degree of consistency in order to validate the results

Consistency shows the level of comparison between the pair-wise dimensions. To test for consistency, consistency ratios, developed by Saaty (1994) were used to benchmark the Consistency Ratio (CR). To calculate consistency, the weights of each factor were crosstabulated with the values in matrix A. This gave an nx1 matrix. The nx1 matrix was then multiplied by the weight of factor to generate the consistency valuesλ_i. The average of the λ_i equalled to the highest Eigen value of the size comparison matrixλ_{max}.

$$\lambda_{max} = \frac{\begin{bmatrix} a_{11} \cdots & a_{1j} \\ \vdots & \vdots \\ a_{k1} \cdots & a_{jk} \end{bmatrix} \begin{bmatrix} w_1 \\ \vdots \\ w_i \end{bmatrix} \times w_i}{n}$$

The consistency index was then calculated from the equation below

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

To calculate the consistency ratio (CR), the random index (RI) as provided by Saaty together with the CI values, were used;

$$CR = \frac{CI}{RI}$$

The consistency level should be below 10% for the normalised weights to be acceptable. Calculating the consistency level of the estimated vector (tolerable error in answering questions) was important. Consistency ratio (CR) was used to measure the consistency in the pair-wise comparison. Saaty (1994:28) has set the acceptable CR value for different matrices sizes; the CR value is 0.05 for a 3-by-3 matrix; 0.08 for a 4-by-4 matrix; and 0.1 for large matrices. For this study, the adopted CR was 0.1. However, if the CR is less than 10%, judgments are considered consistent (Saaty, 1994:28). The random consistency index (RCI) and number of elements (N) benchmark is provided by Saaty (1980) in Table 13.

Table 13: Average random index values

N	1	2	3	4	5	6
RCI	0	0	0.58	0.90	1.12	1.24

Source: Saaty (1980)

Consistency ratio and global weight are shown in appendix 10. After computing the normalised priority weights for each pair-wise comparison judgment matrices of the AHP hierarchy, the solution was synthesised for prioritisation of dimensions for coordinated supply chain in relation to the availability of ACTs. The local priority weights of the strategic dimensions and sub-dimensions were combined together with respect to all successive hierarchical levels to obtain the global composite priority weight of all the sub-dimensions. All alternative priorities obtained were combined as a weighted sum—to take into account the weight of each criterion—to establish the overall priorities of the alternatives. The alternative with the highest overall priority constituted the best choice.

4.5 Assessing of validity and reliability

4.5.1 Assessing reliability

The reliability of a measurement refers to the ability of the measuring instrument to consistently measure what it was supposed to measure (Wiid & Diggines, 2009:7). Reliability may also refer to the extent to which a scale produces consistent results if repeated measurements are made (Hair *et al*., 2010:165; Zikmund & Babin, 2010:248) and free from random error (Malhotra, 2010:318). For qualitative data, reliability was ensured by considering trustworthiness of procedures based on the following criteria: credibility, authenticity, dependability, and confirmation (Onwuegbuzie & Johnson, 2006:49-50). For quantitative data, generally three methods of ensuring reliability; a) split-half technique, b) item analysis and c) Cronbach's alpha (Cooper & Schindler, 2011:283; Malhotra, 2010:317) are applied.

In this study, internal consistency was used to assess the reliability of the scale instrument. Internal consistency assessed the reliability of a summated scale (Likert scale), or subscale, where scores for several items were summed up to arrive at a total score for a construct (e.g. attitude) (Malhotra, 2010:319). Bryman and Bell (2007:164) described the Cronbach-alpha test as a commonly used test to determine internal reliability. In this study, Cronbach's alpha coefficient of 0.6 was used in order to determine the reliability of the tool. The closer the Cronbach's alpha is to 1, the higher the internal consistency reliability (Sekaran, 2003: 307). Table 14 summarises the procedures followed to ensure reliability.

4.5.2 Validity

Validity of the qualitative data was tested through trustworthiness, which constituted; dependability, credibility, confirmability, verifiability, and transferability (Onwuegbuzie & Leech, 2007:239; Tobin & Begley, 2004:388; Huberman & Miles, 2002:38; Lincoln & Guba, 1985:290). Table 15 summarises the procedures that were employed to ensure validity of FGDs. In order to determine the quality of the instrument, measurement scales were assessed for validity and reliability (Hair *et al*., 2010:156; Malhotra, 2010:318; Burns & Bush, 2010:319). It is the only way to ascertain that the newly constructed measuring instrument actually measures what it intended to measure. To validate the questionnaire for this study, a pilot study was conducted. The purpose of a pilot study was to pre-test the survey tool before it was distributed to the primary participants.

Table 14: Assessing validity of qualitative data and quantitative data

Validity of qualitative data			**Validity of quantitative**		
Measure	**How it was ensured**	**Reference**	**Measure**	**How it was ensured**	**Reference**
Credibility	Results were reviewed by inquiry participants i.e. The Hospital Administrator, Pharmacist and Stores Assistant were used to gauge validity of the findings by commenting about the fairness, completeness or perceived validity of data from the participants of the study. The above three participants from each of the four hospitals were emailed a report of findings pertinent to their respective hospitals. To validate the findings, participants' quotes were used.	Patton (2002)	Content validity	Gauging whether the content of the items in the measuring instrument provides adequate coverage of the investigative questions of the study. Used Cronbach's alpha coefficient of 0.6.	Cooper & Schindler (2011); Malhotra (2010); McDaniel & Gates (2010), Leedy & Ormrod (2005); Hair *et al.*, (2010).
Applicability or transferability	Thick descriptions of the analysis and findings from the qualitative strand are preserved for the benefit of other scholars to judge whether these findings may be transferable to similar populations. These thick descriptions include notes from the FGDs with the participants, and a review of all materials relevant to the research process such as personal notes prepared during the course of the research process.	Patton (2002)	Construct validity.	Dealt with the nature of measuring constructs or scale characteristics. Measured through Factor analysis.	Malhotra (2010).
Confirmability	Here data and findings were traced back to the participants. Pristine notes and records were kept during the course of the study to facilitate a review of transcripts from FGDs and the coding guide at various stages. These processes ensured that participants' voices were reflected and that the findings accurately represented their perspectives to ensure trustworthiness.	Patton (2002)	External validity	Ensured by randomly selecting the hospitals and use of a large sample for generalisability.	Malhotra (2010).
Dependability or consistency	This ensured triangulation by peer examination and code-recoding procedures as measures to ensure consistency.	Lincoln and Guba (1985)			
Completeness	Checked whether the themes identified in the data analysis were expressly mentioned in the transcripts those deemed unrelated to the study questions were removed from the report.	Moustakas (1994)			

Table 15: Reliability of qualitative data

Reliability of FGDs			Reliability of the questionnaire		
Measure of reliability	**How it was ensured**	**Reference**	**Measure of reliability**	**How it was ensured**	**Reference**
Credibility	Provided relevant information to participants prior to the FGDs. The information included the purpose of the study so that the participants would prepare in advance and provide the appropriate information. Evidence of transcribed group discussions was provided, attached a copy of the consent letter and the ethical clearance certificate.	Patton (2002)	Internal consistency	Assessed the reliability of a summated scale supposed to measure Cronbach's alpha coefficient of 0.6	Cooper & Schindler (2011); alhotra (2010); Wiid & Diggines (2009); Hair *et al.*, (2010); Zikmund & Babin (2010); Bryman & Bell (2007).
Rigour of qualitative research	This was ensured through observance to detail and accuracy in order to ensure the authenticity and trustworthiness of the research process. To ensure authenticity, findings were verified by checking for accuracy. In addition, participants' accounts were using audio-recordings to ensure that participants' voices were not excluded.	Onwuegbuzie and Johnson (2006); Tobin and Begley, 2004)			

4.5.3 Pilot study

Prior to the survey, a pilot study is recommended to give an indication of the validity of the items, to confirm that respondents understand the items in the questionnaire, and to signify the reliability of the data (Leedy & Ormrod, 2005:92). Therefore, the pilot sample characteristic matched the intended sample for the survey. The main benefit of running a pilot study was to provide an opportunity to test the measuring instrument and if necessary adjust it before administering it to other respondents. Hair *et al*., (2010:38) advocated that when developing a questionnaire, the right type of questions must be selected, consider the sequence and format, and pre-test the questionnaire. For this study, a pre-test was undertaken on 10 members of the DTMC of Kayunga General Hospital, which was not part of the final sample. These provided feedback and checked for any issues regarding the clarity of the questions and instructions and the concepts used in the questionnaire (De Vos, Strydom, Fouche, & Delport, 2011:237) and anything that may have been potentially difficult or confusing (Hair *et al*., 2010:38). An adjustment was made on the sequencing of the questions on the factor *storage and distribution.* In addition, there was a repetition on the sub variable - *Verification of expiry dates enhances ACTs' availability structure.*

It was ascertained that the completion of the questionnaire took about 10 or less minutes. The timing was regarded as good, given the fact that respondents work in a busy environment while saving lives. The assumption was that the response rate would be enhanced. Grammatical errors in the questionnaire were identified and corrected. The pilot study also established that all abbreviations were well described.

4.5.4 Data management and processing under survey

After establishing the validity and reliability of the survey instrument and after adjusting it, a survey was conducted in which data were collected. It was necessary to analyse and convert it into meaningful information (Wiid & Diggines, 2009:239). Saunders*, et al.,* (2007: 295) argue that raw data obtained from questionnaires must first undergo preliminary preparation prior to statistical analysis. In order to produce quality and meaningful results in multivariate analysis, initial data screening exercise was carried out. This entailed proof-reading of the original data against the data keyed into computer; finding and checking the existing errors in the data file (Hair *et al*., 2010: 295).

(a) Data entry and identification of problems in the data

Immediately after data collection, questionnaires from the field were serially numbered before being captured into Statistical Package for Social Science (SPSS/21). This data analysis software was used in the first stage (EFA). Responses were captured based on codes assigned to different questions under each variable used in the questionnaire. Raw data from the field was captured into SPSS statistical analysis tool. Thereafter, checks for problems in the data were performed to identify whether there were errors in the data. These are discussed in details below.

(b) Data screening

Field (2005) asserted that the aim of data screening is to check for errors arising from incorrect data entry, out of range and missing values, outliers, and normality, and provide solutions for such errors. Therefore, prior to data analysis, numerous checks were carried out to find errors that were in the data set. This involved screening the data in an effort to check for any mistakes such as missing values and incorrect data. To this effect, descriptive statistics were generated for all the items in the form of frequency distribution table. Values within the data were displayed under each item.

(c) Missing values analysis

A total of 320 questionnaires were administered. However, 304 questionnaires were returned. Of these, 11 were discarded because they had incomplete data (more than 10% missing data). The remaining 293 questionnaires—those with ordinal scale, the missing data was replaced with a median of the nearby point, whereas those with continuous scale were replaced with the mean. Furthermore, seven responses were deleted owing to unengaged responses; they had the same response for every single item. Outliers (age, level of education, and experience)—still, three responses were removed. To the extent possible where missing values were identified while in the field, the team was able to immediately scan the questionnaire, traced the respondents who had not filled specific questions and requested them to complete them accordingly. Hereafter, other parametric test assumptions were performed to ensure that the data were good enough for further statistical analysis as indicated in appendix 4.

Therefore, data were prepared for processing as explained below. Several statistical packages may be used to analyse data, such as SPSS, Statistical Analysis System (SAS) and R-programming (Wilson & Lorenz, 2015:12). In order to determine the best factor structure to represent the supply chain coordination both EFA was performed using SPSS 21. This was subsequently complemented with a confirmatory assessment of dimensionality, reliability, discriminant and convergent validity, under the principles of SEM using the Interactive Amos software. Discriminant validity was one of the most important validity cornerstones of CFA. It measured the extent to which a construct is truly distinct from other constructs, both in terms of how much it correlates with other constructs as well as how distinctly measured variables represent only a given construct (Hair *et al*., 2010).

4.6 Ethical considerations

4.6.1 Ensuring voluntary participation

Since the study involved human beings, moral steps were be taken into account to protect and respect consented respondents as suggested by Myers (2009:45). This was accompanied with an informed consent to make sure that they participate willingly in the study. The information sheet explicitly stated that participation was voluntary and that participants could withdraw at any stage. Most importantly, participants were allowed to unduly participate in the study, and instead explained the benefits to be obtained from the study. The selected hospitals were requested to respond to the invitation and arrange for a suitable time for the FGDs and eventual administration of the questionnaire. Integrity was ensured particularly throughout the research process even after being awarded an ethical clearance certificate by the Senate Research and Innovation Higher Degrees Committee (SRIHDC). In addition, the she followed the guidelines described by Creswell (2014:138). For instance, she did not take sides and avoided academic dishonesty. In the quantitative strand, data were not disregarded whether it was in agreement or not with the hypotheses. Results from the qualitative strand reflect the voices of the participants including findings that may be contrary to the themes. The data were analysed to fully reflect the statistical tests and procedures.

4.6.2 Ensuring anonymity

Anonymity of individuals' names and roles to adhere to respect of the participants' privacy was ensured. For example, in survey (quantitative research), no mention of the names of the respondents throughout the coding process. In qualitative research, pseudonyms for hospitals and individuals were used to protect the identities of participants. She also avoided disclosing information that would harm participants. However, if a participant did not want to hide his or her identity and instead wanted to be identified with their opinion, there was no objection to that as well. However, the respondents were informed about the consequences of non-confidentiality. Moreover, she refrained from falsifying evidence, source of information or data, findings and conclusions. An accurate account of all the information was given. Participants were debriefed and validation was done to check the accuracy of the data with participants or across different data sources. Most importantly, she avoided plagiarism by citing all references and acknowledging the sources of information used in his study. Due credit for the work of others and quotations marks indicate the exact words uttered by others was done.

4.6.3 Use of results and managing bias

Results were not misused for the benefit of one group or another. As much as possible, respondents were clearly communicated to honestly and used suitable language. She guarded against biased words or against specific persons because of their age, sexual orientation, gender or ethnic group or infirmity. Details of the research design and methodology were shared so that others would be able to decide the credibility of the study. Raw data and other materials are to be kept for a reasonable period of five years for publications. Hard copies were shared out while the soft copies were deleted so that they do not fall into the hands of other unscrupulous people who might misuse the information.

4.7 Summary

This chapter presented a detailed discussion of the chosen research design, methodology and the data collection and analysis methods used to conduct the research study. These issues were addressed in light of the research objectives identified in Chapter 1, as well as the theoretical and literature review in Chapter 2 and three respectively. This research used the two-phase sequential method to achieve the study objectives. Phase 1 used qualitative approaches, specifically, FGDs in data collection. The second phase used a quantitative approach under the survey strategy. The target population as well as the sample design in both phases are specified. The process of developing the questionnaire and the main statistical analysis techniques were also discussed. EFA and CFA with properties similar to SEM were used to test the research framework and the proposed relationships. After validating the tool and obtaining the model GOF, the next stage prioritised supply chain coordination dimensions and sub-dimensions for coordinated supply chain, using MCDA. Specifically, analytic hierarchy process (AHP) approach was described because of its mathematical simplicity and flexibility. The subsequent chapters provide the study's results from the first phase, followed by the second phase and discussion of implications of the findings and suggest directions for further research.

CHAPTER FIVE

QUALITATIVE DATA ANALYSIS AND PRESENTATION

5.1 Introduction

This chapter presents and analyses the data from the FGDs with DTMC members in general hospitals. The details on the method used to conduct the FGDs were presented in Chapter 3. The coordination theory advocates for identification of interdependent activities and dimensions among supply chain partners within an organisation in order to enhance better service delivery. The interdependence among the partners is evident through the critical micro supply chain coordination dimensions, the logistics activities and management environment activities.

The findings follow the same sequence as the objectives stated in Chapter 1. Firstly, the study presents analysis of each of the four case studies, followed by a cross-case analysis, which includes a comparison of the individual case studies by study objective. In particular, we examine the research questions and present findings emerging from the inductive qualitative analysis. Individual cases were randomly assigned letters A to D. Participants remained anonymous by using a name that began with the same letter as the case study for simplicity and traceability. Confidentiality was necessary to protect the participants from any personal harm because of being candid in the responses. Likewise, the general hospital's identity was kept confidential as publishing its details could be potentially taken out of context. Keeping the hospital's identity confidential also prevented the reader from applying presumptions or knowledge of the GH while reflecting on the findings. Each of the case descriptions follows a similar format, with variation depending on the depth and breadth of information gathered in each particular case.

5.2 Demographic information

The questions that were asked aimed at establishing how respondents of different demographic characteristics responded to questions that answer the main objectives of the study. In social sciences, it is important to understand participants' demographics because they reduce the error of "absolutism" as noted by Hammer (2011:261) where investigators assume that phenomena of interest have similar characteristics, irrespective of the variations in the data structure. Therefore, this study presents the demographics first in order to develop a detailed understanding of the differences, variations and similarities across the hospitals and within the hospitals. Figure 8 shows the positions and qualifications of the participants respectively.

Positions of participants		
Positions	**Total Participants**	**% of Participants**
Surgeons	1	3
Hospital administrators	2	5
Laboratory Technologists	3	8
Hospital Pharmacists	2	5
Inventory Management Officers	4	11
Nursing Officers	14	38
Medical Officers	8	22
Hospital Dispensers	3	8
Total	**37**	**100**

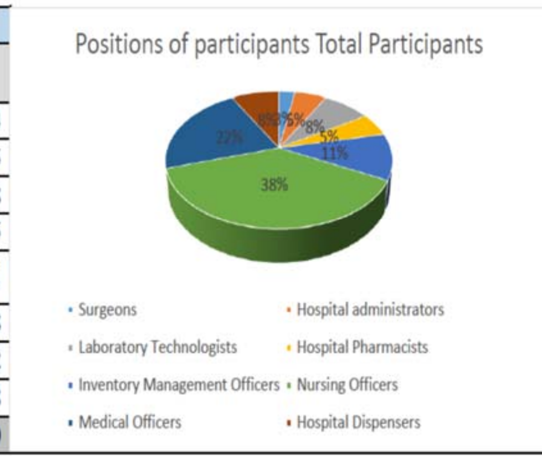
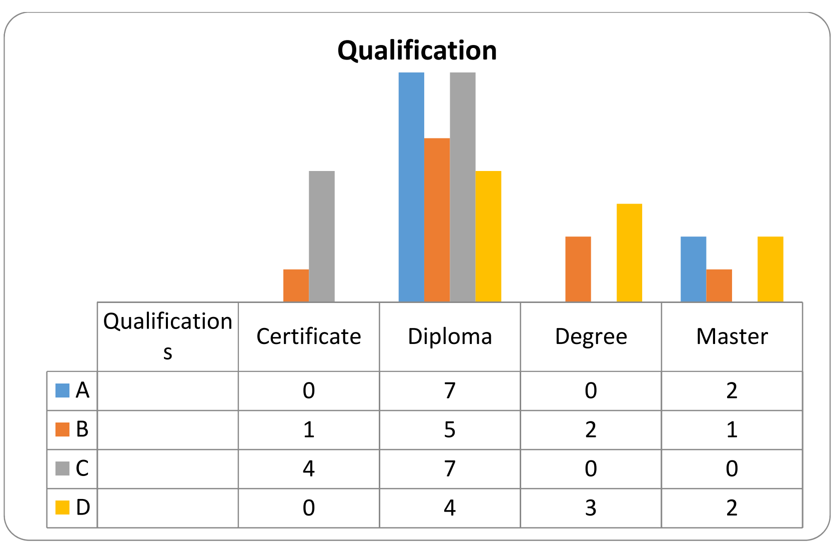


Figure 8: Position of participants

Source: Primary data

Participants held different positions within the hospitals: a surgeon, hospital administrators, laboratory technologists, hospital pharmacists, inventory management officers, nursing officers, medical officers, and hospital dispensers. Figure 8 reflects the positions of the participants from the selected hospitals. The majority of the study participants were nursing officers (38%), followed by medical officers (22%) and inventory management officers who registered 11% of participation. Surgeons (3%) followed by hospital administrators and pharmacists (5% each) registered the least percentage of participation.



	Qualifications	Certificate	Diploma	Degree	Master
A		0	7	0	2
B		1	5	2	1
C		4	7	0	0
D		0	4	3	2

Figure 9: Qualification of participants *(Source: Primary data)*

This implies that the majority of the DTMCs are nursing officers and medical officers who use the ACTs. Figure 9 provides details of representation according to the qualification of the participants per hospital.

The results show that seven participants from GH A had attained a diploma and two had master's degrees. In addition, one participant from GH B had a certificate, five participants had diplomas, two had degrees, and one had master's degree. Besides, four participants from GH C had certificates and seven had diplomas. Further, four participants from GH D had diplomas, three participants had degrees while 2 participants had master's degrees. Over all, from all the four general hospitals, most participants hold diplomas with few having either bachelors or master's degrees. General analysis indicates that 76% of the participants had diploma qualifications, 11% had master's qualifications while 14% were certificate holders. The analysis may imply that they had basic knowledge of ACT supply and distribution. In order to determine general understanding of the supply coordination of ACTs in general hospitals, four FGDs were held using a semi structured interview guide (see appendix 1).

5.3 Overview of supply chain coordination in general hospitals in Uganda

The study assessed the level of knowledge of participants on healthcare structure and systems respectively. In all the four FGDs, participants had similar views concerning their knowledge of health care systems in Uganda. They described the healthcare systems as involving various referral levels, from the Village Health Teams (VHTs) at community level, Health Center II (HC II) at Parish level, Health Centre III (HC III) at Sub-County level, Health Centre IV (HC IV), district hospitals at district level, regional referral hospitals at regional level, and to national referral hospitals at country level.

However, in addition to the above, participants mentioned that a good health system involves putting in place the following critical blocks or pillars: financing, adequate skilled human resources, adequate infrastructure that meets demands for a good health care system, good leadership, governance, and political will. The participants further argued that Members of Parliament ought to play a key role in advocating for adequate funding and policies that promote a good health care system. It was also noted that all public hospitals receive drugs through NMS through a pull system. General hospitals are supposed to make requisition for ACTs as per procurement plan and adhere to schedules distributed by NMS.

The analysis on the knowledge on ACTs used in Uganda shows convergent viewpoints of the participants. All the participants described ACTs as drugs that are made from the plant called Artemisia with combination of Artesunate-Amodiaquine and Artemether-Lumefantrine Therapies and adopted as a first, second, and third line treatment for the management of both complicated and non-complicated malaria.

5.4 Supply chain coordination of malaria treatment pills in general hospitals in Uganda

In line with objective 1, the study analysed supply chain coordination of malaria treatment pills in general hospitals in Uganda. The purpose was to determine how supply chain coordination dimensions affect availability of malaria treatment pills in general hospitals in order to develop an enhanced supply chain coordination framework. Table 16 indicates the main themes from the FGD guide, focus group questions, key quotes from the participants per question, key word narratives per general hospital, and dimensions derived from the narrative.

In all the Tables, # represents number that was assigned to the individual participants and A, B, C, and D denotes the hospital.

Table 16: Interpretive Structural model for Critical supply chain coordination

INTERPRETIVE STRUCTURAL MODELLING: CRITICAL SUPPLY CHAIN COORDINATION DIMENSIONS								
Objective 1: Supply chain coordination of malaria treatment pills in General Hospitals in Uganda								
Categorised areas from focus group discussion guide	**Focus group discussion guide questions**	**Key Quotes**	**GH A Key words from Narrative**	**GH B FGD Key words from Narrative**	**GH C FGD Key words from Narrative**	**GH D FGD Key words from Narrative**	**Dimensions derived or emerging from narratives**	**Transcripts references**
Organisational factors:	1. How effective are the institutional structures to ensuring availability of ACTs and what are the institutional and structural issues that exist in the supply and distribution of ACTs?	#A4. Now there is early warning system where the NMS tells you, that you may not have this particular combination of this particular drug. There is also some bureaucracy when requisitioning. #C1. There is a drug and therapeutic management committee which sits and then we decide the quantities to buy depending on our consumption. #C6. … We should, reactivate the existing committees one of them is the therapeutic committee … #D7. We also monitor the distribution frequently. #A4. … Some checks and balance may need to be done. #B1. The drugs are controlled by the pharmacist from the central store who monitors the consumption. #B1. The structures are effective; there is a drug and therapeutic management committee which sits and then we decide the quantities to buy depending on our consumption #C7. It is effective because there is a schedule, which is given and followed on how drugs are supplied and distributed. #B5. It is effective because the hospital now have pharmacist who guides the process of dispensing medicine. #A5. … We also have tools like medicine registration and issuing voucher to the pharmacy… We also have Out Patients' Department (OPD) register which states the diagnosis and treatment given and we also have the dispensing logs for tracking medicines. #D3. … There are things like local guidelines that help us on how to use ACTs.	#4. Yes, Early warning system (Transcript 1, 1). Monitoring drugs issuance or carry out spot checks (Transcript 1,4)	#B1. DTMC is in place, (Transcript 2; 1); Centralized supply and distribution of drugs by Pharmacist (Transcript 2, 2).	#B 5.Need for an active pharmaceutical committee (Transcript 3, 1). # B5. Monitoring, External supervision (Transcript 3, 2).	#5. Monitor distribution; Lobbying for funds. Issuance of local guidelines (Transcript 4:1); delegation (transcript 4, 6); Centralization (Transcript 4, 7); Accountability (Transcript 4, 3); #7. Supervision Transcript 4, 5).	Early warning system; regular monitoring of distribution, spot checks; drug therapeutic committee; Regular meeting; lobbying of funds; issuance of local guidelines; delegation; centralization of distribution by Pharmacist ; accountability; Supervision.	Transcript 1,1; 1,4; Transcript 2,1; 2,2; Transcript 3,1- 2; Transcript 4,1; 4, 3;4, 5-7
	2. How would you describe the supervision system that currently exists for drugs in this hospital? How has this fostered quality and	#D8. The medicines received and issued out are recorded in the medicine registers for ease of accountability. #D5. So through lobbying … Health centres receive the ACTs and the patients receive the	#A5. #A4. #A7. Monitor the Distribution frequently. #A4. Checks and	#B6. Minimal delegation Internal monitoring of drugs issuance (Transcript 2, 2).	#C5. Carry out internal monitoring, and external supervision (Transcript 3, 2)	#D3. Based on local guidelines issued#D7. Top- bottom administration #D7. Frequent	Internal and external monitoring of distribution Checks and balances Delegation Use of local guidelines	Transcript 1, 4 Transcript 2, 2. Transcript 4,3) Transcript 4,3

	availability of ACTs?	treatment. #A6. There is minimal delegation. #C5. Hmm… I and a colleague have tried to do some monitoring. However, we normally get supervisors from MoH, NMS, Global Fund, and Malaria Monitoring units, Donors. #A 4. Laughter... Aaaa, normally … we just monitor the consumption where it has been requested for. #C6. The structure has helped on the part of enabling quicker distribution for the ACTs – instead of going to collect consumption data from different places. #C1. With quality we have no problem apart from checking or monitoring expiry dates. #D7. It's always top to bottom- that is administration and then to the distribution point. #D7. It's ok, We also monitor the distribution frequently, we get to pharmacy to find out how much was received, what quality. We also check the consumption notes, to find out how much was distributed and how much stock is still available. Quality of drugs is monitored using thermometers in store	balance. (Transcript 1, 4).	.		monitoring of the distribution and quality (Transcript 4,3)		
Information flow	1. What role does effective information flow among SC members play in efficient ACTs management?	-#A7. We normally share status of the ACTs and other items. If we are running out of stock, we generate a list, print it out then we pin it on notice boards around pharmacy and wards to guide the usage of the available ACTs. #A4.When there is any information concerning stock availability, we disseminate the information verbally during CMEs or a staff meeting. #A4. Apparently, we have Rx-solution, which is being installed. That is electronic drug management system. #B7. We use stock cards mainly. #C2. The information shared is which drugs have come and which ones have not come and the quantity supplied. #D4. Yes, we have the Rx tool used only in stores. Apparently centralized because of the low numbers of computers.	#A4. Verbal Dissemination of information (Transcript 1, 7). #A4. Use Rx-solution (Electronic Drug Management System) (Transcript 1, 7)	#B7. Stock cards.	#C5 Use of stock cards; Rx solution (Transcript 3, 4-5)	#D6. Use Rx Solution. We share information regarding stock Pin lists on the walls so that the drugs that are out of stock are not prescribed (Transcript 4,5)	Verbal dissemination; Electronic drug management; hard copies; stock cards; notice boards; share stock status	Transcript 1,7 & 12; Transcript 2, 3; Transcript 3, 4-5 Transcript 4, 5.
	2. What sort of Information Sharing/exchange and SC linkages occurs with regard to management of drugs Inventory?	#A7. Share status of ACTs on notice boards (Transcript 1, 7). We share information regarding stock Pin lists on the walls so that the drugs that are out of stock are not prescribed (Transcript 4, 5). #B2. #C5 Information shared is mainly stock status (Transcript 2, 3). #D6. We share information regarding stock lists on the walls so that the drugs that are out of stock are not prescribed (Transcript 4, 5).	Status of ACTs on notice boards (Transcript 1, 7).	#B2. stock status (Transcript 2,3)	#C5 &#C9. stock status (Transcript 3, 4-5)	#D6. Stock status (Transcript 4,5)	Stock status	Transcript 1,7 & 12; Transcript 2,3; Transcript 3, 4-5; Transcript 4,5;
	3. What specific Information Technology (IT) tools and techniques used?	#A4. No IT tool is used. Disseminate the information verbally during CMEs or a staff meeting (Transcript 1, 7). Rx-Solution used to share information (electronic drug management system) (Transcript 1, 7) only by management. #C5 We use stock cards and the Rx solution, which electronically calculates optimum, stock level. #D6We have RX is only centralized	#A4 Verbal communication during staff meeting (Transcript 1, 7).	#B6. #B7. We use stock cards mainly. (Transcript 2, 3).	#C5 Rx solution which we use in store (Transcript 3, 4)	#D6 Rx solution only centralized at stores for the moment, due to lack of computers (Transcript 4, 5)	Verbal dissemination Rx. Solution Stock cards	Transcript 1, 7; Transcript 2, 3; Transcript 3, 4 Transcript 4, 5

		at stores for the moment, due to lack of computers						
Responsiveness	**1.** In your view, does the current ACT supply chain coordination mechanisms promote timeliness and reduce frequency of stock-outs	#A4. The system is flexible with all key players. Stores has in place a schedule in which they issue to other units; Monday, Wednesday and Friday. #A.2 Normally … we consider them for immediate response. Also when there is any demand let's say it's an emergency from the distribution area and we need supplies from store we also have to adjust always to the demands.	#4. Flexible distribution system. Scheduled timelines (Transcript 1, 9).	#B6. Specific days for requisitioning and issuing medicine from the general store are known. #B1. One can easily transfer drugs to another unit using the stock cards (Transcript 2, 4).	#C5 & #C4. Supply is very timely. (Transcript 3, 6).	#7. Easily call using personal phones in case we run short of stock before the next cycle (Transcript 4, 2). #6. Specific days for distribution; with some flexibility. Use supplier's schedule, place an emergency (Transcript 4, 6).	Flexible system; schedule for issuance; Timely supply; internal redistribution; Placement of emergency orders; easy of calling the supplier, Efficient delivery time from pharmacy; Use supplier's schedule.	Transcript 1, 9; Transcript 2, 4; Transcript 3, 4; Transcript 4, 2; 4,6;
	2. Describe the level of responsiveness, in terms of flexibility, delivery on time, service reliability, the level of adaptability with process change within internal SCs of ACTs?	#A4. Flexible distribution system. Schedules timelines by stores in which they issue to other units (Transcript 1, 9). #A.2 We respond immediately in case of an emergency. #A4. Internal redistribution, between units (Transcript 1, 9). #B1. When there is an emergency before NMS delivers, the DHO (District Health Officer) is notified through the Medical Superintendent. The DHO gives us a vehicle, which the hospital fuels and then pick ACTs from NMS, Entebbe. #B6 &#B3. We always have general guidelines like at least every Monday, we know that it is a day for requisitioning medicine from the general store. #B1. One can easily transfer drugs to another unit using the stock cards. #C5 The lead time is two months/every two months orders are made for six months. There is flexibility- a letter through the MS is secured. Sometimes redistribution is done and emergence orders are also made. #D6. We do distribute to pharmacy every Monday and Thursday but when there is need, we can distribute more. Delivery from NMS normally takes a month, before the two months elapse…they tend to work within their schedule…. When we are badly off, we can place an emergency order… from NMS in Entebbe. #D7. Easily call using personal phones in case we run short of stock before the next cycle #D6. Specific days for distribution; with some flexibility. Work within supplier's schedule. When we are badly off, we can place an emergency.	#A4. Flexible distribution system. (Transcript 1, 9). #A.2 immediate response in case of an emergency (Transcript 1, 9). #A4. Internal redistribution, between units (Transcript 1, 9).	#B1. Provision of transport in times of emergencies #B6. Specific days set for requisitioning and issuing medicine. #B1. Easy transfer of drugs within units (Transcript 2, 4). #B3. Efficient delivery time from pharmacy (Transcript 2, 4).	#C5 & #C4. There is flexibility. Redistribution & emergence orders are also made (Transcript 3, 6).	#D7. Easily call using personal phones in case we run short of stock before the next cycle (Transcript 4, 2); #D6. Specific days for distribution; with some flexibility. Work within supplier's schedule. Emergency orders (Transcript 4, 6).	Flexible distribution system. Emergency orders; Internal redistribution, between units; Provision of transport in times of emergencies; Efficient delivery time from pharmacy	Transcript 1, 9 Transcript 2, 4; Transcript 3, 6; Transcript 4, 6.

Mutual Understanding	1. Is there a common or mutual Understanding among members expectations in making ACTs available?	#A2. There is staff coherences. #A7. The user departments have been able to understand that these ACTs are not picked directly from the store. So there is no case where someone comes insisting that they should be issued with such items because these ACTS are managed by the pharmacy. #A4. Normally we share the goals in CMEs and general meetings. #B2. There are guidelines on the drugs and they are also placed on each ward, like showing any likely changes and side effects of the drugs such that whoever comes has to read and understand. #B4. Yes, everyone is trained to know who to administer, how and when to administer ACTs. #C3 We do not have a vision as a hospital but we have a district vision. #C4. Yes, everyone knows and has to do what is expected of them. Standard procedures are followed throughout. #C12. We are aware of our expectations by each one is given a job description and normally we have appraisal forms which we fill at the end of the financial year and recently we are supposed to produce a work plan. #D7. We understand that we operate on a pull system, we send requests to NMS and they deliver as per the procurement plan formation. #D7. There is common understanding among staff members and their expectations. #D3. There is some degree of trust - from the clinical area to the prescriber, to the laboratory and then pharmacy. #D6. Yes, members have to follow standard procedures throughout.	#A2. There is staff coherence (Transcript 1, 9). # 4. Follow standard guidelines (Transcript 1, 8). # 9. New the policy change (Transcript 1, 7).	#B2. Understand Guidelines on the drugs usage (Transcript 2, 3). #4. Staff awareness of how and when to administer, ACTs (Transcript 2, 3). #B3. High level of trust because drugs are prescribed mainly using guidelines (Transcript 2, 3).	#C12 Each staff is aware of their expectations based on job description. We are supposed to produce a work plan (Transcript 3, 3-4); #C3 We have a district vision (Transcript 3, 4). #C9. There is trust (Transcript 3, 4).	#D4. Staff awareness of the demands of the job (Transcript 4, 4). #6. Shared vision & following standard procedures (Transcript 4, 4). #D7. General understanding of the pull system (Transcript 4, 4); #D3. Degree of trust (Transcript 4, 4-5). #DD6. Common understanding among staff (Transcript 4, 4).	Staff coherence; shared vision and shared goals; staff knowledge of procedures; awareness of expectation; work plan; Understanding of the new the policy change; mutual trust between staff; standard instructions on use ACTs; general understanding of the Pull system;	Transcript 1, 7-9; Transcript 2,3; Transcript 3, 3-4; Transcript 4, 4-5.
	2. Is there shared vision and goals among members of supply chain?	#A4. Normally we share the goals in CMEs and general meetings #4. Yes, everyone is trained to know who to administer, how and when to administer ACTs. (Transcript 1, 10): #C3 We do not have a vision as a hospital but we have a district vision. #C6 it may be there but not shared apart from one for the district. For hosp. not shared.	#A4. Normally we share the goals in CMEs and general meetings (Transcript 1, 8).	#B4. Yes, everyone is trained to know who to administer, how and when to administer ACTs. (Transcript 2, 10):	#C3 We have a district vision. #C6 For hosp. not shared. (Transcript 3, 4).	#D6. Yes, members have to follow standard procedures throughout (Transcript 4, 4)	Shared goals, shared visions Follow standard procedures	Transcript 1, 8 Transcript 2, 10 Transcript 3, 4. Transcript 4, 4
	3. What is there level of trust among staff?	**# A**2. For the clinical officers, we have been putting a lot of trust in them. **#**4A. Yes, trust is there. But some patient always come up with prescriptions not aligning with the results. #A10 Trust for the ACTs it is there. Because many times patients have received ACTs as per prescription and when our patients receive we are happy that shows there is trust to our clients at least they receive something. **# A**2. For the clinical officers, we have been putting a lot of trust in them. **#**4A. Yes, trust is there. But some patients always come up with prescriptions not aligning with the results. #B3. Yes, there is trust. #C9 yaa me I can say that there is trust. #D3. There is some degree of trust - from the clinical area to the prescriber, to the laboratory and then pharmacy.	**# A**2. **#**4A. #A10 Trust (Transcript 1,8)	#B3. Trust. (Transcript 2,3)	#C9 yaa me I can say that there is trust (Transcript 3,4)	#D3. There is some degree of trust (Transcript 4, 4).	Trust	Trust (Transcript 1,8); Transcript 2,3; Transcript 3,4; Transcript 4, 4).

Relationship, management and decision-making	1. In terms of Relationship Management and decision making, why are better relationships with NMS important for the hospital?	#A 4. I will generalise it as good. … But for back orders or emergency they will not reply. So we generalize it as fair or good. #A 1. Internally we normally make joint decision on how much to procure per drug depending on resource envelop at the time of planning. #B6. I think it is fairly good – because at times we get communication from them (NMS) whenever there is a delay in the delivery of medicines, though sometimes they don't give feedback. #B3. It is good because in most cases during day time, all of them are able to get ACTs, apart from the time when the pharmacy is closed. #B2. Overall, there is inter departmental cooperation on ACTs has improved internal relationships. #C9The relationship is fair. … Because for the time I have spent here, we have never run out of stock. #C5 Yeah!! We normally do a redistribution from various facilities. Sometimes we collect all supplies from within the lower facilities. #C7 When the ACTs are given to the patients we normally instruct them on how to use them. #D7. The relationship we have is great – we are operating on the pull system; so we send our orders and they deliver to us the drugs as per schedule and whatever they have not delivered, we notify them and send them a discrepancy note and it's corrected. #D6. When we are coming up with a joint procurement plan with the support and guidance from the supplier (NMS) between April/May. #D4. When you need something from another unit, you can walk there.	# A5. Good relationship between patients and hospital. Prescribed ACTs, are availed to patients. # A1. There is joint decision making during procurement planning (Transcript 1, 7).	#B6. The relationship is a fairly good with the supplier. Supplier communicates Though sometimes they don't give feedback (Transcript 2, 3). #B2. Overall, there is inter departmental cooperation on ACTs (Transcript 2, 4).	#2C & #C5. There is inter departmental cooperation in terms of redistribution from other facilities. (Transcript 3, 4). #C5. There is a feedback loop from other units (Transcript 3, 5).	#D7. Good relationship with Supplier. Orders are sent and delivery made as per schedule. #D6. Joint procurement planning with the support and guidance from the supplier (NMS) (Transcript 4, 4-5).	Good relationship with supplier, joint decision making during procurement planning; interdepartmental cooperation; feedback loop with other units; orders are met.	Transcript 1, 7; Transcript 2, 3; Transcript 3, 4-5; Transcript 4, 4-5
Top Management commitment	1. How is Top Management of this hospital committed to ensuring that ACTs are available and well utilized? a. Are they committed to the goal?	#A4. Yes, Top Management is committed to the goal. I would give a scenario where every other time when there is any issue or there is a gap in supply of ACTs when I do normally consult from the top people, they give me a positive feedback. …. they gave me transport. Always giving out feedback on the status of ACTs for planning purposes. #A5. Yes, I have seen them adapting to changes. Ordering drugs is now done online, using Internet …. #A 9 We normally have CMEs, which is a government policy that every institution conducts them. So most of the people are invited for workshops. And when they come, we give them a feedback on say how to use artesonet or coaterm. #B7. They give guidelines on how to use these ACTs and even the monitoring is done and they communicate whenever there is out of stock and support training. #C6. I think that the new idea may be the recruitment of the pharmacist, which is also one of the innovations, which we still have. #C5 We came up with a strategic plan for the next financial year.	#A4. Provides transport in case of emergency demand; (Transcript 1, 5). #4. Invest time and resources-use monitoring tools. Give feedback on the status of ACTs for planning purposes (Transcript 1, 5-6). #A5. Adopt to new ideas through online ordering of drugs (Transcript 1, 5)	#B7. Issue guidelines on how to use and monitor ACTs (Transcript 2, 2). #B1. Frequent communication whenever there is out of stock; Invest time and resources in monitoring drugs (Transcript 2, 2).	#C5 Commitment to goal-facilitates strategic planning (Transcript 3, 3); #11. new innovations is participative planning, recruitment of a pharmacist (Transcript 3, 3); #C10 refresher courses/training could be of use (Transcript 3, 3). #C5 Commitment to goal-facilitates strategic planning (Transcript 3, 3);	They invest resources in providing transport, encourage redistribution system (transcript 4, 3). Invested in IT tool; management supports staff training especially through CMEs #D6. Support Just in time ordering (Transcript 4, 4) .	Invests in transport, issue guidelines; frequent communication; monitor medicines; support for refresher training; support for redistribution; support for strategic planning. supports for CMEs for stock management	Transcript 1, 5-6; Transcript 2, 2; Transcript 3, 3; Transcript 4, 3-4.
	2. Do they invest time and resources for this activity?	#A4. Invest time and resources-use monitoring tools (Transcript 1, 5). #A4. Provides transport in case of emergency	#A4. Provides transport in case of emergency	#B1 monitoring drugs (Transcript 2, 2).	#C10 Training on ACTs (refresher courses).	#D6. Resources for monitoring; Support Just in time ordering	Online ordering; frequent feedback; Transport; monitoring	Transcript (1, 5). Transcript (1, 5-6 Transcript (2, 2).

		demand; (Transcript 1, 5). #A4. Invest time and resources-use monitoring tools. Give feedback on the status of ACTs for planning purposes (Transcript 1, 5-6). #A5. Adopt to new ideas through online ordering of drugs (Transcript 1, 5). #B1. Frequent communication Invest time and resources in monitoring drugs (Transcript 2, 2). #C5 Commitment to goal- Facilitate strategic planning (Transcript 3, 3); #D6. They have put in place checks to ensure that drugs can be easily monitored. They invest resources like provision of transport, when we run short of supplies such that we can get supplies through the redistribution system. #D6. Yes, management supports training especially the CME (CMEs) for stock management. #D7. With support of our partners and SURE project and the stores, pharmacist – all these people were trained. We also have had hands-on training from the stores….a team from MoH has trained them. #C10 yeah! I hope am not mistaken. All members have been trained on ACTs although it has taken long almost five years ago. However, refresher courses/training could be done and it would be of benefit.	(Transcript 1, 5). #A4. Provides monitoring tools. Give feedback on the status of ACTs for planning purposes (Transcript 1, 5-6). #A5. Adopt to new ideas through online ordering of drugs (Transcript 1, 5)	#B7. Issue guidelines on how to use and monitor ACTs (Transcript 2, 2) #B1. Frequent communication Invest time and resources in monitoring drugs (Transcript 2, 2).	#C11. Participatory planning, recruitment of a pharmacist (Transcript 3, 3); #C10 refresher courses/training could be of use (Transcript 3, 3).	(Transcript 4, 4). Provide transport, encourage redistribution system (transcript 4, 3). Invested in IT tool; CMEs #D6. Support Just in time ordering (Transcript 4, 4).	tools; Monitoring feedback Monitoring drugs	(Transcript 3, 3). (Transcript 4, 4).
	3. Are they ready to adapt to new innovations and ideas that ensure ACTs are available and well utilized?	#A5. Online ordering of drugs (Transcript 1, 5).They invest resources in providing transport, encourage redistribution system (transcript 4, 3). Invested in IT tool; management supports staff training especially through CME (CMEs) #6. Support Just in time ordering (Transcript 4, 4)	#A5. Online ordering of drugs (Transcript 1, 5)		#C11 - participative planning, recruitment of a pharmacist (Transcript 3, 3).	Online ordering ; Participatory ordering; (Transcript 4, 4)	Transcript 4, 4	

5.4.1 Case analysis General Hospital A-D

General Hospital A

Effectiveness of SCC*:* The supply chain coordination seems not to be effective because of the way information is channelled from the hospital to the national drugs procurement and distribution facility (NMS) and then to MoH. It was noted that the hospital rarely gets feedback from the MoH regarding the submitted information. However, funding is normally directed from MoH to NMS. Whereas this may be the case, the hospital is not told how much funds are allocated for ACTs. This dilemma creates gaps in the planning and budgeting for ACTs at the hospital. The facility's supply chain starts when a patient has been admitted through the Out Patient Department (OPD) with special attention paid to those in critical condition after a Laboratory Technician has confirmed that the client is malaria positive.

Organisational factors: Now there is early warning system where the NMS tells you that you may not have this particular combination of this particular drug. The case in point is this facility now has a crisis of artesonet where we shall run short of the drug in the next three days. Now for a patient to attain treatment based on ACTs, the person must be tested and confirmed that he/she is positive. Currently, a policy states that for a patient to attain treatment based on ACTs, the person must be tested and confirmed that the blood sample is positive.

Information sharing: Typically, the hospital depends on the information about internal ACT usage patterns shared between it and the supplier of the drugs. The use of the Rx-solution (the electronic drug management system) is the primary tool to share information and as such, a key mechanism that ensures external interface between the supplier and the hospital. The internal information is shared using traditional methods such as pinning the status of ACTs supply on notice boards or during staff meetings or training sessions.

Responsiveness: This is experienced at the time of issuance. At issuance of drugs, flexibility is the other critical mechanism used to address drug shortages. Although drugs are issued on specific days (Monday, Wednesday and Friday), emergencies also increase the need for flexibility. Likewise, the organisation also allows internal redistribution or transfers from one unit to the other and from other lower health units. The internal transfer process is much faster whereas the external inter-facility transfers have to be authorised by the District Health Officer. Because of the manual system, internal documentation regarding redistribution is most often missing, unlike between health facilities. However, although NMS issues delivery schedules, sometimes lead-time is not consistent. This may signal disjuncture in the coordination structures.

Mutual Understanding: One of the mechanisms of Mutual Understanding is knowledge of the vision and goals among the staff. These are usually shared during CME and general meetings. The level of Mutual Understanding is built on the level of trust among staff because patients receive the dosages as prescribed. However, at times, trust diminishes owing to over requisitioning of the drugs by some units when they still have stocks of ACTs leading to wastages owing to expiry of drugs. Similarly, some patients always come up with prescriptions that do not match with the lab results. And also in some instances, patients are treated with ACTs without prior testing. The situation may signal non-compliance to standard treatment guidelines, which partly erodes the level of confidence, dependability and honesty among supply chain partners. Yet, it is expected that no party should exploit the other party.

Relationship and joint decision-making: In essence, there is good relationships between staff and departments allow airtight relationships between departments from procurement to dispensing. It is only when emergencies arise that internal systems are overridden. There is usually joint planning of all procurements and in times of emergencies. In some cases, internal redistribution of drugs between units ensure availability of ACTs to patients. By so doing, supply chain members respond swiftly to customer requirements (responsiveness). This further eases modification of orders whenever necessary. Despite the well-defined supply systems, the hospital occasionally still struggles with internal availability of ACTs.

Top Management commitment: In emergency situations, a vehicle is provided by the District Health Officer to transport medicine from another hospital or suppliers. As such, the hospital management is increasingly investing time and resources to monitor correct usage and is willing to receive feedback on the status of ACTs for planning purposes. Another aspect of top management is that they provide policies on internal usage and requisitions are scheduled and known almost by all staff in the treatment chain, and occasionally, this information is made available through notice boards, CME or staff meetings. They are also committed to innovation through ordering drugs online using Internet with some connections they had to NMS and have put in place monitoring tools.

(b) General Hospital B

Effectiveness of the SCC: The ACTs drugs supply process at the hospital is relatively efficient. The DTMC meets quarterly to plan for the hospital's drug needs.

Organisational factors: On the storage part, the highly centralised supply and distribution systems under the control of the pharmacist helps them to monitor the consumption and to report any impending shortage and usage patterns. Here, the hospital seems to be well organised internally and well-functioning but the supply side is letting them down. This may imply a disjuncture between micro and market-coordination structures.

Information sharing: The pharmacist shares information on stock status with the various players in the system using personal mobile phones and manual systems. It invokes the aspects of accuracy, timeliness, adequacy, and credibility of exchanged information.

Responsiveness: The hospital has general guidelines of issuing of medicines from stores. One can easily transfer drugs to another unit using the stock cards. Delivery time from pharmacy is not a problem at the moment – it is efficient.

Mutual Understanding*:* However, the suppliers affect the service levels. Nonetheless, trust has been created among internal supply chain partners. The hospital has well-defined guidelines on how to use and monitor ACT, the dispensing staff are well aware of how and when to administer the ACTs, which reduces waste.

Relationship and joint decision-making: Although the relationship between the hospital and the supplier is described as fairly good, there are concerns of the lack of information and feedback on stocks availability. Supply Chain coordination fails if internal and external coordination dimensions are not well aligned. In addition, it seems as though literature ignores this part significantly.

Top Management commitment: More importantly, the hospital's Top Management has invested significantly in detailed guidelines that govern requisitioning and issuing of medicine, drugs usage, and transfer of drugs to other units, which has increased the quality of service at the pharmacy and the hospital.

(c) General Hospital C

Effectiveness of systems: The hospital makes an effort to balance the demand with supply by ensuring that ACT drug stock information is shared.

Organisational factors: It was noted that the organisational structures are quite effective. Since they had never experienced a stock-out, the one in charge prompts requisitions and of course we get enough supply and units have not run out. However, the absence of an active Pharmaceutical Committee and an in-charge of these essential medicines compromise the system. In terms of the hospitals, they normally get supervisors from MoH, NMS, Global Fund, and Malaria Monitoring units, donors. Top Management is composed of the Medical Superintendent, head of all units, and the in charge of medicines. There is a delegated authorisation in ordering, requisitioning and in terms of emergences.

Information sharing: The hospitals have an Rx solution based in stores only that electronically calculates optimum stock levels. Despite the fact that the hospital's supply chain activities are not integrated, the internal team spirit enhances availability of ACTs. Main information shared is the stock status. The hospital is not integrated. They mainly use personal phones.

Responsiveness: ACTs are timely supplied in all the units. The hospital normally goes for a redistribution from various facilities. Sometimes they supply it earlier and we are not hit up by stock-outs. It is very timely. There is flexibility. Sometimes redistribution is done and emergency orders are also made.

Mutual Understanding: The staff are aware of their expectations since each one is given a job description and normally appraised based on the job description. The hospital maybe having a vision but unfortunately, the staff are not aware of their vision. However, they are aware of the district vision. There is some level of trust especially the Pharmacist because of the systems he and management has put in place from requisitioning to filling orders.

Relationship and joint decision-making: There is also intra-departmental cooperation in redistribution of drugs across other facilities, and the use of the standard. The hospital jointly developed a strategic plan for the next financial year. The relationship with NMS fair relationship since they have not run short of medicines. However, the relationship has over time deteriorated over time, especially in this cycle at least half of it had been delivered. Relationship with the drugs supplier is described as fair because in most times, orders are not met. There is a general concern regarding the supplier's remorsefulness on unfulfilled orders. The anxiety of a bad working relationship may cause variability in demand and may prompt sluggishness in the supply chain. Theoretically, this may mean that supply chain actors need to show capability and also become innovative to realise agility. Therefore, lack of proper coordination between NMS and hospitals can be seen as a key factor causing drug unavailability in health facilities.

Top Management commitment: Also, the hospital's management lacks commitment to service delivery. Even then, internal innovations such as participatory planning, recruitment of a qualified pharmacist, and refresher training courses, are less helpful if the distribution of the drugs is not streamlined. This may sound as if the micro-environment is weak compared to the market environment, or that the managers have little appreciation of the internal issues. Top Management is committed to recruitment of new staff e.g. Recruitment of the pharmacist. Otherwise, almost everyone has had the opportunity to be trained internally.

(d) General Hospital D

Effectiveness of supply chain: The hospital draws on well-structured internal dimensions to coordinate demand and supply of ACTs and has made strong use of these robust systems to lobby for funds from donors to procure the drugs through NMS.

Organisational factors: The system is structured on the independence and trust of each player across the internal clinical chain – from the clinical area to the prescriber, to the laboratory and the pharmacy.

Information sharing: When the stocks arrive, status of stock is pinned on notices so that the out of stock drugs are not prescribed to patients. These are further supplemented by personal phone calls to alert the different stock users of the available stock quantities before the next order cycle. The monitoring of these stocks is done by the standard Rx IT solution and issuing is guided by this centralised system. This mode of distribution allows for accountability within chain players as well as across units within the hospitals.

Responsiveness: The hospital has specific days for distributing medicine (Monday and Thursday) but when there is need, then flexibility is done. Delivery from NMS normally takes a month, before the two months elapse. They tend to work within their schedule, before the period elapses. They also place emergency orders from Entebbe.

Mutual Understanding: Each member of staff in that chain has a good understanding of the pull system of such drugs. It starts with joint procurement planning with the support and guidance from the supplier. Consequently, each player in the hospital seems to have a very good understanding of guidelines for issuance and usage of ACTs because of a shared understanding of standard procedures. Both suppliers and staff are aware of the defined days for drug distribution and they work within supplier's schedule. In order to continuously improve this supply system, the hospital has invested resources in providing transport for redistribution, in IT systems, and staff training especially through CME (CMEs).

Relationship management and joint decision-making: It appears as though the joint planning system is relatively effective, but that effectiveness lies in the independence of players within the system—both the micro and market systems.

5.4.2 Cross case analysis: The critical (micro) supply chain coordination dimensions

5.4.2.1 Organisational factors

Across all the general hospitals in Uganda, there is a common structure of centralised stores to improve supply and distribution of malaria treatment therapies. General Hospital A (GH A) emphasises an early warning system whenever the supplier is not in a position to deliver, monitors whether the drugs have been given the right patient, and carries out spot checks as key dimensions for improved supply and distribution of ACTs. General Hospital B (GH B) ensures that the Drug Therapeutic Committee (DTC) is in place to meet on a quarterly basis and monitor consumption of drugs. For GH B, this is an important ingredient for improved supply and distribution of ACTs.

In General Hospital C (GH C), the ACTs drug supply process is hampered by lack of an active pharmaceutical committee and an in-charge of these essential medicines, which compromises the system. Overall, monitoring and external supervision are methods for improved supply and distribution of ACTs. Similarly, General Hospital D (GH D) draws on well-structured internal dimensions to coordinate demand and supply of ACTs. It has made strong use of these robust systems to lobby for funds from donors to procure the drugs through NMS. Furthermore, in this hospital, issuance of local treatment guidelines, accountability for drugs requisition and supervision are all key dimensions for improved supply and distribution of ACTs.

5.4.2.2 Information sharing

The general dimensions across the general hospitals indicate that sharing information in hard copies enhances information flow on the status of stocks, which improves supply and distribution of ACTs. GH A typically depends significantly on the information of internal ACTs usage patterns shared between it and the supplier of the drugs. This is the first cog in the supply wheel. The use of the Rx solution (the electronic drug management system) to share information is only a tool to this mechanism of interdependence between the supplier and the hospital. However, using verbal dissemination of information during CME and staff meetings promotes supply and distribution of ACTs. In GH B, information is stored on stock cards. Sharing of stock status improves supply and distribution of ACTs. GH C makes an effort to balance the demand with supply by ensuring that ACTs drugs stock status is shared; that there is there is intradepartmental cooperation in terms of redistribution of drugs across other facilities, and the use of the standard Rx solution that electronically calculates optimum stock levels. However, the lack of an active pharmaceutical committee and an in-charge of these essential medicines, compromises the system. Overall, GH D views the use of Rx solution and sharing of stock information as helping in improving supply and distribution of ACTs.

5.4.2.3 Mutual Understanding

The general theme from the four general hospitals shows that trust among supply chain partners improves supply and distribution of ACTs. GH A emphasises that staff coherence, following standard guidelines and understanding new policy changes towards treatment and using ACTs are the main dimensions that improve supply and distribution of ACTs. In GH B, clinicians have a high level of trust in the internal systems and well-defined guidelines on how to use and monitor ACTs. The dispensing staff are also well aware of how and when to administer the ACTs, which reduces waste and improves supply and distribution of the malaria treatment pills.

In GH C, however, the hospital's commitment to the district's vision of apt service delivery is questionable. Even the internal innovations such as participatory planning, recruitment of a qualified pharmacist, and refresher training, are less helpful if the administration of the drugs is not streamlined. The hospital management has nevertheless tried to improve drugs monitoring through external supervision, and it assumes that each staff member is aware of their expectations based on job description and their departmental work plans. As a result, supply is timely, thereby enhancing supply and distribution of ACTs. In GH D, each player in the hospital seems to have a very good understanding of issuance and usage of ACTs guidelines as a result of a shared understanding of standard procedures. It appears to be the same with the suppliers. Therefore, staff awareness of the job demand, a shared vision and general understanding of the pull system, have all improved supply and distribution of ACTs.

5.4.2.4 Relationship management and decision-making

The emerging theme in most general hospitals is that a good working relationship among supply chain partners has improved supply and distribution of ACTs in public hospitals. GH A shows that good relationships between patients and hospital staff, prescription of ACTs to patients and joint decision-making during procurement planning, have improved supply and distribution of ACTs. GH B stresses that good working relationships, communication and feedback from the supplier and inter-departmental cooperation have improved supply and distribution of ACTs. In GH C, interdepartmental cooperation in terms of redistribution from other facilities and existence of feedback loops from other units has enhanced supply and distribution of ACTs. In GH D, a good relationship with suppliers ensures that orders are sent and ACTs are delivered as per schedule. Owing to the clinicians' high level of trust in the internal systems and well defined guidelines on how to use and monitor ACTs, the dispensing staff are well aware of how and when to administer the ACTs, which reduces waste. The system is structured on the independence and trust of each player across the internal clinical chain – from the clinical area to the prescriber, to the laboratory and then pharmacy. The hospital gets support and guidance from the supplier leading to improved supply and distribution of ACTs. When there are emergency needs, flexibility prevails.

5.4.2.5 Top Management's commitment

From the FGDs with different general hospitals, the general theme emphasises more on support of staff trainings through CME. GH A emphasises provision of transport in cases of emergency demand, investing time, resource use, monitoring tools that give feedback on status of ACTs and planning, and adoption of new ideas, all of which lead to improved supply and distribution of ACTs. GH B advocates for issuance of guidelines on how to use and monitor ACTs, frequent communication whenever there is stock-out and investing in time and resources in monitoring ACTs. This has led to improved supply and distribution of ACTs. In GH C, commitment to facilitating strategic planning, new innovation in participatory planning, recruitment of new staff and refresher training, have improved supply and distribution of ACTs. In order to continuously improve this system, GH D has invested resources in providing transport for redistribution, IT systems, and staff training through CME, which have all improved supply and distribution of ACTs.

5.4.2.6 Responsiveness

A cross case analysis of the common theme in all the general hospitals shows flexibility in the redistribution system. The theme in GH A is that of timeliness in schedules by stores from where they issue ACTs to other units. Internal redistribution between units are also key dimensions that improve supply and distribution of malaria treatment pills. In GH B, there are specific days for requisitioning and issuing medicines from the general store, easy transfer of drugs to other units using stock cards and efficient delivery time from pharmacy. These are important dimensions for improved supply and distribution of malaria treatment pills. GH C emphasises timely supply, redistribution and requisitioning of emergency orders, which have improved supply and distribution of ACTs. Finally, GH D uses personal phones to call when stock runs out before the next cycle, sets specific days for distribution, has a schedule for the supplier, and makes emergency orders, all of which have led to improved supply and distribution of malaria treatment pills.

Table 17: Summary of Critical supply chain coordination dimensions at the micro level

Organisation factors (OF)	Early warning systems Drug Therapeutic Committee Issuance of local guidelines Supervision Spot checks Centralised distribution by Pharmacist Delegation enhances the swift ordering of ACTs Regular monitoring Regular meetings Accountability Lobbying of funds Pharmacist's guidance
Information sharing	Verbal communication Information on stock cards Notice boards Electronic drug management system Rx-solution Sharing of stock status Use of hardcopy reports
Responsiveness	Scheduled issuance Supplier schedule Ease of calling the supplier Placement of emergency orders. Internal redistribution between units Efficient delivery timelines from Pharmacy Flexible ordering system Internal transfers
Mutual Understanding	Communicating of policy change Instructions on use of ACTs Staff knowledge of the procedures Shared vision General understanding of the pull systems Development of work plans enhances ACT availability Understanding of the new policy change Staff awareness Staff coherence Mutual trust Shared goals
Relationship and joint decision making	Interdepartmental cooperation. Good relationships among staff Joint decision making during procurement planning Good relationship of the hospital with her suppliers Feedback loop with other units
Top Management commitment	Frequent feedback on stock status. Online ordering Provision of transport in times of emergencies Issuance of guidelines Frequent communication. support for hands on training enhances ACT availability Strategic planning. Investment in monitoring Support for redistribution CMEs

5.4.3 Emerging themes and dimensions (critical supply chain coordination)

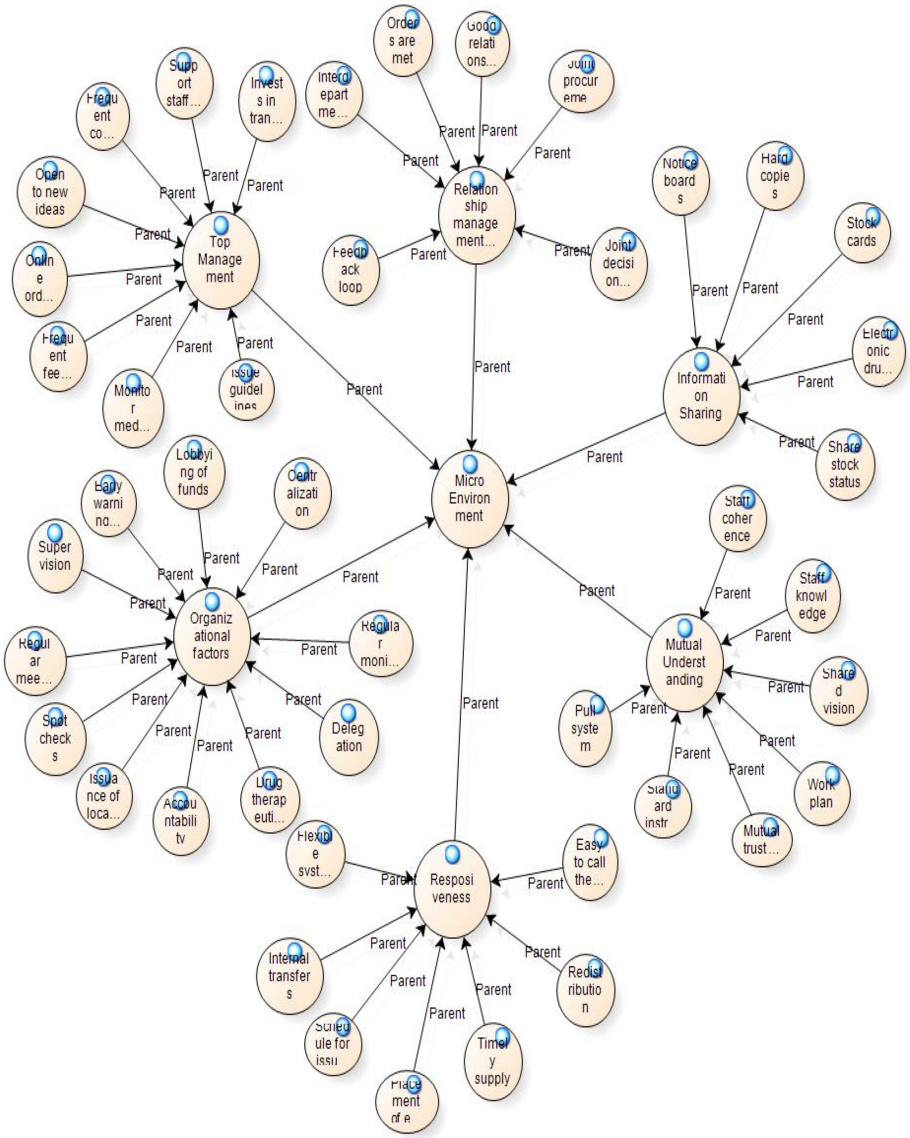


Figure 10: Hierarchical model for supply chain coordination of ACTs in GH in Uganda

5.5 Logistical activities dimensions and SCM in GH of Uganda

This section explores logistics factors affecting supply chain coordination of malaria treatment pills in general hospitals in Uganda in order to develop an enhanced supply chain coordination framework as in line with objective 2. Table 18 illustrates the themes and emerging dimensions.

Table 18: Interpretive Structural Modelling: Logistics activities dimensions

INTERPRETIVE STRUCTURAL MODELLING: SUPPLY CHAIN COORDINATION OF LOGISTICS ACTIVITIES								
Objective 2: logistics activities that affect supply chain coordination of malaria treatment pills in General Hospitals in Uganda								
Categorized areas from focus group discussion guide	**Focus group discussion guide questions**	**Key Quotes**	**GH A FGD Narrative**	**GH B FGD Narrative**	**GH C FGD Narrative**	**GH C FGD Narrative**	**Dimensions derived or emerging from narratives**	**Transcripts references**
Forecasting methods	1. What forecasting method is used to predict future demand?	#A4. For ACTs we use average monthly consumption then we quantify for the next three months. #B3. We depend on the consumption and the disease pattern. We aggregate the consumption patterns per month and we look at the stock cards to identify what have been used. #C5. The monthly consumption i.e. average consumption is used. #D6.Forecasting is done using AMCs.	#A 4. Average monthly consumption (Transcript 1, 10).	#B3. Aggregated monthly consumption (AMC) and disease pattern. (Transcript 2, 5).	#C5 Average consumption is used (Transcript 3, 7).	#6.Forecasting is done using AMC (Transcript 4, 7).	Average monthly consumption; disease pattern;	Transcript 1, 10,
Demand quantification	1.How do you quantify the demand of ACTs	#A4. … After getting the average monthly consumption, the team sits and quantifies based on the consumption in the hospital #B3. We count and sum up the consumption in dispensing logs. #C4. Quantification is by totalling consumption manually. I take into consideration of seasons and peak times. #D6.quantifcation done using the average monthly consumption patterns	#A 4. Use average monthly consumption (maximum stock) (Transcript 1, 10). Quantification is done by a team (Transcript 1, 11).	#B3. Count and sum up the consumption in dispensing logs (Transcript 2, 5).	#C5 Average monthly consumption is used (Transcript 3, 7). 4. Manual quantification seasons and peak times (Transcript 3, 7)	#6. Average monthly consumption patterns. (Transcript 4, 6-7).	Average Monthly consumption; minimum-maximum stock; Use of dispensing logs; seasons and peak times	Transcript 1, 10-11;

Procurement and ordering	1. Using examples, describe how are ACTs are sourced for this hospital?	#A 4. At beginning of the financial year, we sit down as a team, with persons from National Medical Store (NMS) including the management, then we start the process of procurement plan according to the previous consumption and fixed budget. #A4. … Ordering is per schedule. #B1. We annually plan the procurement… then NMS delivers to us. Pharmacy and stores raise the requisition and the Drugs therapeutic committee then approves it. We … have to follow budget allocation. #B5. We also follow NMS Schedule for delivery. #C5. Every financial year we sit and come out with a procurement plan. #D6. Before anything is procured, there must be a need, from which a procurement plan is derived. … The schedule for the FY shows when to order and when to expect... #D5. We make bimonthly orders by sending an email to NMS; In case NMS does not deliver on time, we have a redistribution plan.	# 4. Annual procurement plans to inform ordering of ACTs with the team from national medical store (NMS) (Transcript 1, 9).	#B1. We make annually plan the procurement (Transcript 2, 4)	#C5. Every financial year we sit and come out with a procurement plan (Transcript 3, 7).	#D6. Identification of a need, from which a procurement plan is derived. This gives a schedule for the FY as to when to order and when to expect (Transcript 4, 6) # 1. Orders placed according to the consumption (Transcript 4, 6). #5. Orders sent by email to NMS (Transcript 4, 6).	Identification of need; Annual Procurement planning; team involvement; Follow approved budget; orders as per schedule by NMS; requisitioning; lead time	Transcript 1, 9; Transcript 2,4; Transcript 3,7; Transcript 4, 6. Transcript 1-11; Transcript 2, 4-5, 10; Transcript 3, 7-8; Transcript 4-6
Storage	1. How would you describe the management and storage of ACTs stock? \	#A7.When they are brought after verification we sign the delivery notes. And in case of any missing item, it is recorded in the other discrepancy note then taken back to NMS. Then we enter the quantity which has been delivered, into the stock card capturing all the details (the expiry date, the quantity, the serial number). After which, we can now issue … after authorization. #A6 Issuing method we use FIFO (First in First Out). But we also consider the expiry date. #A7. Here we store ACTs in shelves, in their …. Then others are left in the big boxes. #A3. … For easy access to those drugs we label them… for easy identification. #B6. The moment the medicine arrives, the first thing we have to do is to verify as a team. We have shelves for storage and we keep the boxes intact …, apart from what we are going to use. Sore using pallets. #C4 So when supplies are brought…. We have a team which verifies them. #C4.We store using shelves, palates and temperature controls recorded every morning	#A7. On delivery, medicines are verified, stock entered into stock cards (Transcript 1, 10). #A3. Labelling for easy identification (Transcript 1, 10).	#B6. Team verification takes place (Transcript 2, 4-5). #B6.Verification of expiry dates (Transcript 2, 4). #B3. We store in boxes, shelves and pallets, enter the receipts in the stock cards (Transcript 2, 5).	#C4 supplies are verified by a team (transcript 3, 7). #C4. Stored in shelves, palates and monitor temperature (Transcript 3, 8).	#D8. Recorded in the medicine registers for accountability (Transcript 4, 3). #D3. Follow drug management policy; stock cards and dispensing logs. (Transcript 4, 6).	Team verification; labelling; verification of expiry dates; stock cards; shelves; palates; monitoring room temperature; medicine	Transcript 1, 10; Transcript 2, 4-5; Transcript 3, 7-8; Transcript 4, 3-8.

		using a thermometer. #D5. When drugs are received, we are supposed to update the stock cards. #D6. Minimum –maximum stock level is observed. #D5. We have shelves – when ACTs arrive, we unpack them and put on the shelves for easy monitoring and issuance.						
Distribution	1. How would you describe the signing powers of ACTs? Who is responsible for accounting for ACTs distribution?	#A4. Signing powers originates from the Pharmacist who raises the requisition with authorization from the Top Management. Accountability is mainly done by the stores and pharmacy. But also the respective wards have to account for the drugs given to them through the dispensing logs. #B1. Accounting is by stores and pharmacy staff. #B6. We use stock card system in the stores … whenever we issue, we record the quantity that has gone out so we can also get the consumption patterns. #C5 the authority is one i.e. the Medical Superintendent (MS). …. Principle Nursing Officer (PNO) authorizes and accountability is by heads of units. #D6.Every member of the supply chain; pharmacy, stores…ACTs have a dispensing pharmacy but whichever unit they are distributed to, the in-charge takes responsibility.	#A7. Pharmacist (Transcript 1, 10).	#B6. Accounting by stores (Transcript, 2, 6).	#C5. Authorised personnel (Transcript 3, 10).	#D6.done by pharmacy (Transcript 4, 8).	Pharmacist; Stores;	Transcript 1, 10; Transcript 2, 6; Transcript, 3, 10. Transcript, 4, 8.
Dispensing	1. How are these drugs dispensed to the public?	#A3. Before the drugs are dispensed to the public, prescriber assesses the condition of the patient. … Patient is sent to the laboratory for a blood sample test. If positive, the patient is sent to the pharmacy where the drugs will be dispensed with instructions of how to use the drugs before that patient goes home. #B2. Every patient has a prescription that has been given. We record the prescription and issue the ACTs dosage. #B6. We verify the prescription… and we as well look at the results of the test that has been done. There are cases where patients are given drugs without being tested; this is caused by shortage of equipment to use for the lab testing equipment. #C10 &# C1 Normally ACTs are given on written prescription by the clinician and they also normally depend on the lab results. However it has also been a challenge sometimes ACTs are given to without a smear result (testing) due to lack of RDTs (Rapid Diagnostic tools. #D3. Before dispensing, they	#A6 FIFO (First in First Out), and consider expiry date (Transcript 1, 10). #A3. Laboratory results (Transcript 1, 11).	#B2. Use prescription. #B6. Verify the prescription, and test results (Transcript 2, 5).	#C10. Use of prescriptions by the clinician and lab results (Transcript 3, 8). 1 tools) (Transcript 3, 9).	#D8.Medicine registers for accountability (Transcript 4, 3). #D3. Follow drug management policy; stock cards and dispensing logs. (Transcript 4, 6). #D6. Mini-maxi stock level (Transcript 4, 7). #D5. Shelves (Transcript 4, 7).	FIFO, LIFO; prior testing of blood; verification of prescriptions; clear instructions; authorized signatures; dispensing log	Transcript 1,10-11; Transcript 2,5; Transcript 3, 8, Transcript 4, 8.

		check to see whether there is a positive BS and an authorized signature. There is a list of signatures that are allowed to be put on the prescription and once that is ascertained, the prescription is entered in the dispensing log.						

5.5.1 Case analysis of logistical activities

(a) General Hospital A

Forecasting and quantification: The hospital makes an effort to forecast and quantify demand for ACTs using aggregated average monthly consumption and drawing information from the dispensing logs.

Procurement and ordering: This critical supply chain activity links ACTs information from the facility level to the supplier level. Patients and internal departments are important in the needs-versus-demand alignment of these processes hence a highly participatory drugs procurement process. Similarly, ordering typically follows the given schedules that are issued by the NMS while paying attention to minimum-maximum policies.

Storage and distribution: Upon prescription, ACTs are issued to patients. The process is based on an understanding that medical staff need to ascertain first that the patients actually need the drugs through adequate testing. Similarly, use of first in first out (FIFO) or last in last out (LIFO) model also minimises expiries. In addition, this limits misuse and loss in the supply chain.

Dispensing: Before the drugs are dispensed to the public, prescriber assesses the condition of the patient, blood sample tested and if positive, the patient is sent to the pharmacy where the drugs will be dispensed with instructions of how to use the drugs before that patient goes home. Issuing method, we use FIFO (First in First Out). However, we also consider the expiry date. Notably, the hospital lacks adequate storage space and therefore requires labelling for easy access and identification of ACTs. Most importantly, the hospital may require a new structure in order to hold and enable internal movement of inventory.

(b) General Hospital B

Forecasting and quantification: In this hospital, logistical activities begin with forecasting management. This activity focuses on requirement estimation, analysing consumption and disease patterns covering a specific period of time.

Procurement and ordering: The hospital procurement practice enables proper planning in determining when to order, how much to order and how to handle various types of drugs. The ordering relies on NMS's delivery schedules, which are issued by the supplier. The internal drug distribution policy describes how and when orders from each ward within the hospital are placed with the central drug department.

Storage and distribution: The hospital stock management process involves team verification and thereafter stocks are stored on shelves, pallets and boxes. However, there is insufficient storage space that would otherwise facilitate handling medicines scientifically and efficiently. Most staff members at the hospital agree that this may entail investment in storage infrastructure for warehouse management. If this is considered, adequate space will enable order picking, packing and distribution within health facilities. Overall, the distribution of medicines in the hospital is dependent on timing of regular deliveries established at a frequency given by NMS to the hospital although at times it is dictated, in part by given requirements. This may indicate that medicines usage is suboptimal.

Dispensing: However, rational use of medicines requires that appropriate medicines be given to patients based on the clinical condition, in the right doses, based on age and weight. In contrast, some patients are given ACTs prior to testing owing to shortage of testing kits and at times, dispensers accede to patients' demands. The impact of this irrational use of medicines can be significant and it results into waste of limited public sector financial resources, poor quality of care and treatment outcomes and increased risk of adverse reactions and resistance.

(c) General Hospital C

Forecasting and quantification: In this hospital, forecasting is the starting activity in the drug distribution processes. The forecasts are based on the average monthly consumption to predict demands for the subsequent months, typically three months.

Procurement and ordering: Joint procurement planning is held with respect to the allocated budget. Equally, ordering follows a systematic pre-ordering schedule from NMS and on receipt of the ACTs, the hospital conducts a joint verification exercise with external partners. This ensures that deliveries are made as per the orders. This system seems to have greatly improved availability of ACTs.

Storage and distribution: Similarly, ACTs are stored under appropriate conditions as recommended by the manufacturer taking into consideration proper temperature and segregation using shelves, pallets and boxes.

Dispensing: Management has also put in place dispensing guidelines. For example, blood tests have to be carried out before dispensing of ACTs. This has improved availability of ACTs. At times, ACTs are given to clients without a smear result (blood test) owing to either pressure from patients or owing to lack of rapid diagnostic tools. This inappropriate drug use may have serious health and economic connotations for the success of the national health care system. Logistical problems related to lack of transport for drugs and inadequate funding in cases of high prevalence were also cited.

(d) General Hospital D

Forecasting and quantification: Average monthly consumption (AMCs) patterns are used to do forecasting and quantification. In order to ably identify consumption patterns, logbooks and stock cards are considered key sources of data.

Procurement and ordering: To supplement the forecasting activity, the hospital carries out a needs assessment from which it develops a procurement plan. Once these series of activities are complete, the ordering follows based on the annual ordering schedule. Authorised personnel must approve requisitions.

Storage management: Similarly, storage follows guidelines for inventory and storage of medicines, which predominantly focus on how best to maintain and control quality of the ACTs in storage. An internal team carries out verification of delivered items, typically with representation from an external party. This mechanism prevents substandard or falsified products from entering the supply chain, preserving product integrity up to the point of use and minimising waste. The minimum–maximum stocking policy is observed and for ease of retrieval, labelled shelves are used.

Dispensing: More importantly, the hospital adheres to the dispensing policy for management of ACT stock. This, according to the hospital management, is critical in ensuring availability.

5.5.2 Cross case analysis of logistics activities

5.5.2.1. Forecasting

The common theme in the four GHS is that forecasting is based on average monthly consumption of the ACTs drugs as a key mechanism that improves supply and distribution of malaria treatment pills. Whereas forecasting and quantification are done using average monthly consumption, it is constrained by several factors such as manual systems of recording information and storage space.

5.5.2.2. Demand quantification

All the general hospitals emphasised average monthly consumption for supply and distribution of malaria treatment pills. In addition, GH A emphasised that quantification conducted by a team led by the Pharmacist improved supply and distribution of ACTs. On the contrary, GH B emphasised that aggregation of consumption in dispensing logs improved supply and distribution of malaria treatment pills. GH C advocated for average monthly consumption used and manual quantification seasons and peak times as key dimensions for improved supply and distribution of ACTs. In GH D, they emphasised average monthly consumption patterns as a key ingredient for improved supply and distribution of ACTs.

5.5.2.3 Procurement and ordering

In general hospitals A, B, C, and D, joint procurement planning is held with respect to the allocated budget. The common emphasis among the four general hospitals is preparation of annual work plans to inform ordering of ACTs with a team from NMS. The four hospitals also pointed out that ordering follows a schedule issued by NMS. Although the funds are insufficient, the ordering mechanism has enabled strict adherence to planned schedules and orders. GH A and GH B further emphasised that adherence to agreed lead time improved supply and distribution of ACTs. GH B highlights that requisitioning based on budget improved supply and distribution of malaria treatment pills. GH C mentioned ordering every two months as dimensions for improved supply and distribution of ACTs. GH D puts emphasis on identification of needs and online ordering using personal e-mails, hence the improved supply and distribution of ACTs.

5.5.2.4 Storage management

Overall, general hospitals carry out joint verification exercises on delivery of malaria treatment pills. The joint verification exercise on receipt of ACTs has enhanced identification of discrepancies, which can be followed up with the NMS. GH A particularly ensures entry of stock into stock cards and labelling for easy identification of ACTs, leading to improved supply and distribution of malaria pills. In GH B, verification of expiry dates and storage in boxes, shelves, pallets, and entering receipts in stock cards improve supply and distribution of malaria treatment pills. GH C advocates for storing medicines in shelves and pallets and monitoring of temperature as dimensions that improve supply and distribution of malaria pills.

GH D maintains a record of stock in medicine registers (stock cards and dispensing logs) for accountability purposes, following its drug management policy, monitoring the minimum and maximum stock levels and stocking in shelves. All these measures have improved supply and distribution of ACTs. When the stocks arrive, pinned notices share information regarding stocks status so that the out of stock drugs are not prescribed to patients. These are further supplemented by personal phone calls to alert the different stock users of the available stock quantities before the next order cycle. The monitoring of these stocks is done by the standard Rx IT solution and issuing is guided by this centralised system. This mode of distribution allows for accountability within chain players as well as across units within the hospitals.

5.5.2.5 Distribution

In all the cases, the emerging dimension is centralisation of distribution points, leading to improved supply and distribution of ACTs. On one hand, GH A and GH C emphasise authorisation by specific personnel before issuance takes place, while GH B emphasises use of stock cards. In GH D, both suppliers and staff are aware of the defined days for distribution by the supplier and they follow the supplier's schedule. The dimensions have improved supply and distribution of malaria treatment pills in general hospitals.

5.5.2.6 Dispensing

In all the general hospitals, dispensing follows a particular procedure. For instance, prior to testing of blood samples using Rapid Diagnostic Tests (RDTs) and issuance of prescription by the clinicians based on test results has improved supply and distribution of malaria treatment drugs. GH A pays attention to First in First out (FIFO) or Last in Last out (LIFO) depending on expiry dates for dispensing, which have improved supply and distribution of malaria treatment pills. In addition, this particular hospital takes into consideration the condition of the patient and ensures that if laboratory tests done are positive, the drugs will be dispensed with instructions of how to use the malaria medicine. GH B emphasises use of prescriptions, verification of the prescription and test results, while GH C emphasises that ACTs are given on prescription by the clinicians based on blood test results using RDTs. Furthermore, GH D ensures that patients test positive for malaria with an authorised signature on the prescription. The prescription is entered into the dispensing log, and this is one of the main ingredients that have improved supply and distribution of ACTs. The summary of the interpretive structural modelling is presented below.

Table 19: Summary of Logistics activities dimensions

Forecasting	Estimating the average monthly consumption Disease patterns Information from stock cards
Quantification	Monthly consumption maximum–minimum stock levels Information from the dispensing logs Malaria seasons enhances peak times enhances
Procurement and ordering	Identification of needs availability. Annual procurement plans Team involvement during procurement planning Ordering based on approved budget Adherence to delivery schedules Requisitioning as per plan Observance of lead-time
Storage management and distribution	Team verification before storage Labelling Verification of expiry dates Stock cards Storage equipment (shelves or pallets) Monitoring of room temperatures Medicine registers Enforcing of the Drug Management Policy Observance of minimum –maximum levels Authorised distribution by specific personnel
Dispensing	First in first out or last in last out policy Prior testing of blood Verification of prescriptions Clear instructions on medicine usage Authorised signatures Verification of dispensing logs

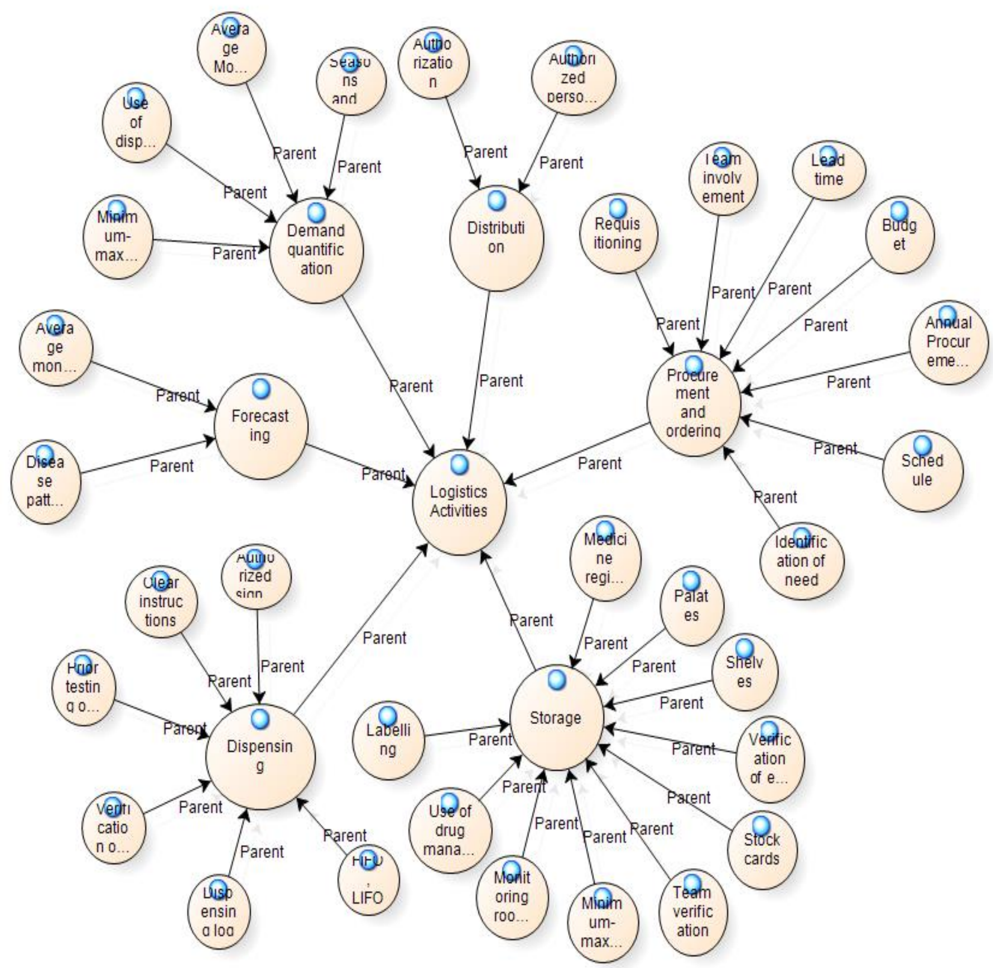


Figure 11: Hierarchical model for logistical activities that affect the supply chain

5.6 Management environmental dimensions that affect ACTs in Uganda: Market perspective

This part of objective 3a explored in depth the management environmental dimensions that affect supply chain coordination of malaria treatment pills in general hospitals in Uganda in line with research question 3. This was intended to determine how market environmental dimensions affect availability of malaria treatment pills in general hospitals in order to develop an enhanced supply chain coordination framework. The summary of themes and attendant dimensions are summarised in the interpretive structural modelling Table 20 below.

Table 20: Interpretive structural modelling of market environment

INTERPRETIVE STRUCTURAL MODELLING: SUPPLY CHAIN COORDINATION OF MANAGEMENT ENVIRONMENT								
Objective 3a: Management environment factors that affect supply chain coordination of malaria treatment pills in General Hospitals of Uganda- Market environment factors								
Categorized areas from focus group discussion guide	**Focus group discussion guide questions**	**Key Quotes**	**GH A Key words from Narrative**	**GH B FGD Key words from Narrative**	**GH C FGD Key words from Narrative**	**GH D FGD Key words from Narrative**	**Dimensions derived or emerging from narratives**	**Transcripts references**
SC interdependence with suppliers	1. How do you manage the supply chain inter dependences between all stakeholders e.g. national stores and other suppliers?	#A4. Communication is the key but we use mails and phone calls. They give us their contacts. We …. Use personal Internet. #A1. We use phones or walk in someone's office or through meetings #A2. There is constant flow of information from the pharmacists and stores to Top Management. #B6. We use phone contacts to NMS and Rx tool, which is centralized at medical superintendent at the hospital. #A1. Joint forecasting and planning is done and where possible we call NMS for guidance at the time of procurement planning and budgeting. #B7. There is a communication channel from the district to the different centres using the M-track system; #C5 … follow their schedule. I do order through email and I use a personal mail (using online ordering) or at times hard copies are sent out later #D7. Rely on correspondences-communicate quite often. There is also NMS Eastern region representative who visits the hospital to find out the challenges and any other information.	#A4. Use e-mails, phones and meetings (Transcript 1, 12). #A1. Joint forecasting and planning with NMS for guidance (Transcript 1, 12).	#B7. Use the M-track system; connected to individual phones (Transcript 2, 6). #B6. Communicate using phones and Rx tool #B7. There is a communication channel from the district to the different centres using the M-track system; (Transcript 2, 6).	#C5 Use emails and personal phone #C5 … (NMS) schedule. Order through email and I use a personal mail (using online ordering) or at times hard copies are sent out later (Transcript 3, 10).	#7D. Regular Correspondences; liaise with NMS regional representatives (Transcript 4, 8).	Regular communication; meetings; e-mails; personal phone calls; routine regional monitoring and evaluation meetings; M-track and Rx tools; Schedules; Correspondences with regional representative.	Transcript 1, 12; Transcript 2, 6; Transcript 3, 10; Transcript 4, 8.

Collaborative partnerships for training	1. Do you have any collaborative partnership for joint training with your suppliers and district local government?	#A4. There is malaria focal supervisor external and internally we have CMEs. No joint training with NMS. We have routine regional monitoring and evaluation meetings. #B1. Training was held last year, hosted by NMS on how the supply and distribution system works. #B2. The drug monitoring unit has also offered some refresher training on drugs usages. #C5 We have never got any training from NMS. #C6. …. concerning malaria we have been partnering with the malaria consortium and they are the ones who organise the training. #C7. Ministry of health came one time… They collaborate together with malaria consortium and they come and train. #D6. Uganda Health supply chain; TASO and some other NGOs who train on drug monitoring and supervision.	#A4. No joint training with NMS. #1. Routine regional monitoring and evaluation meetings (Transcript 1, 12).	#B1. Training by NMS held last year. #2. Drug Monitoring Unit offered some training on drugs usages (Transcript 2, 6).	#C6. Refreshers training held; Ministry of health in collaboration with Malaria Consortium train staff (Transcript 3, 10).	#D7. Trainings done with NGOs on drug monitoring and supervision (Transcript 4, 8).	joint training with NMS; collaborative training with malaria Consortium; refreshers training; with drug monitoring unit./MoH/NGO on drug monitoring and supervision	Transcript 2,6; Transcript 3,10; Transcript 4,8
Information sharing with suppliers, MoH, Donors	1. How do you share Information about schedules between general hospital and NMS?	#A4. We share schedules through the emails and hard copy. When the financial year starts, they bring schedule in form of a chart, in hard copy and they also e-mail us or when you visit their website you will find the information. #A4. Generally it has in a positive way. We simply follow the given schedules and when we run short, the system allows for emergency orders unless NMS does not have stocks... #B1.We have personal contacts of some of the NMS staff and we communicate to them using personal phones. #B1. The RX system is available although centralized. #C5.Yes NMS issues the schedules at the beginning of the financial year both in hard and soft copies. #C9. We share information weekly or through quarterly meetings. #D5.It does not affect ACTs availability in any way. #D6. When their deliveries come in, they come along with the schedule but they also email.	#A4. Share schedules through emails and hard copy or use information from NMS website (Transcript 1, 12)	#B1. Communicate using personal phones and the Rx system (Transcript 2, 6).	#C5. Online ordering or hard copies with NMS (Transcript 3, 10). #5. Monthly and weekly reports using M-Track; #9. Weekly or quarterly meetings (Transcript 3, 11).	#D6. Hard copies of schedules used or use e-mail (Transcript 4, 8).	Online ordering; Hard copies; Personal phones; IT tools (M-track);Weekly or monthly or quarterly meetings	Transcript 1, 12; Transcript 2,6; Transcript 4,8;Transcript 3,11
Public private partnerships	1. Are there any public private partnerships between your hospital and private pharmacies?	#A1. For sure the period I have been in management I can't recall any private partner. #B3. We don't have PPPs because this is a government institution and those are private business places, except when the drugs are not available, that is when the patient can go and buy but that is an individual's decision. #B7. There might be something that is not official and not directly dealing with ACTs. #C 5 Such partnerships do not exist. #D7. There is some understanding with some pharmacies though not official.	#A1. No public private partnership (Transcript 1, 12).	#B3. Do not exist. #7. Not official (Transcript 2, 7)	#C 5 No partnerships.	#D7. some understanding though not official (Transcript 4, 9)	Informal understanding with private pharmacies	Transcript 2, 7; Transcript 4, 9.

Relationship between lower health units	1. What is the relationship between lower health units and ACT availability**?**	#A4. Relationship is good. We support each other. For instance, in a situation where a lower facility runs out of ACTs, the communication is channelled to the DHO for permission to redistribute to the other health units. #B1 & #B6. Mainly redistribution – if they have enough and it's about to expire, they do redistribution and also when we have more, we can do redistribution to them. So it is good.#C9 I can say the relationship is good and we always coordinate with the store man at the district and in-case the ACTs are not there, we also coordinate with our fellow in-charges of the lower health centre. There has been a good coordination that's why …. ACTs are available. #D6.We go for redistribution when they have some supplies such as ACTs in excess and we don't have	#A4. Redistribute to the other health units (Transcript 1, 12).	#B1. & #B6. Redistribution (Transcript 2, 7).	# C5. No partnerships (Transcript 3, 10).	#D6 Redistribution (Transcript 4, 9).	Redistribution	Transcripts; 1, 12; Transcript; 2, 7; Transcript; 3, 11; Transcript 4, 9.

5.6.1 A case analysis of the management environment—Market environment

(a) General Hospital A

Supply chain interdependences: The hospital manages its own supply chain interfaces with other stakeholders through regular communication via e-mails and personal phones. The relationships with other lower health units can be described as good because there seems to be an understanding of redistribution policy, which partly explains availability of ACTs at GH A.

Information sharing with external stakeholders: Increasingly, the hospital is investing in electronic and manual Information Sharing dimensions among various players including NMS, donors and MoH. This has positively impacted on availability of ACTs at GH A. The implementing partners' routine regional monitoring and evaluation meetings have also boosted availability of ACTs.

Collaborative partnerships: It is doubtful whether there is a collaborative training partnership between MoH and suppliers, apart from training held jointly with the district's malaria focal person.

Public private partnerships: Likewise, strategic alliances commonly known as public private partnerships are non-existent. This maybe because of the policy change of 1993 where all public hospitals do not manage their budgets, and this limits the hospital's ability to make decisions with whom to partner with.

Relationship with lower health units: The hospital management, in its discretion, is flexible in that it can transfer medicine from where stock level are high to areas lacking the items and can borrow from other health centres with permission from the District Health Officer**.**

(b) General Hospital B

Collaborative partnerships: Training exists between the hospital and NMS and the Drug Monitoring Unit, especially in the area of ACT uptake.

Information sharing with external stakeholders: The M-track tool is often used to manage supply chain interdependence. The tool is used to send SMS to key stakeholders' phones while the Rx (electronic stock management tool) enhances communication to make ACTs available. The relationship between lower health units is good and this boosts ACTs' availability through inter-facility redistribution. However, the sharing of information between the health facility and NMS is counterproductive because once there are stock-outs and the supplier's schedule is not in tandem with the GH's schedule, it inevitably affects availability of medicines. Pre-determined ordering schedules, in turn, affect availability of medicines.

Public private partnerships: However, there are no direct alliances with other private pharmacies. Other than recommending patients to purchase stocked out drugs, the hospital has no known formal private partnerships.

Relationship with lower health unit: Regardless of the foregoing, the Hospital Superintendent may, in some emergency cases, write informally to the specific pharmacy to supply the needed drugs. This saves life and makes the drugs available in critical conditions.

(c) General Health C

Collaborative training: There were divergent views on whether the hospital has had any collaborative training with the supplier. Some were of the view that no training has ever been conducted jointly with the supplier. Others consented that the hospital had been partnering with the malaria consortium to organise training for its staff. Other training sessions have been held in collaboration with the MoH on management of severe malaria once in a while. There are no public private partnerships with other private pharmacies.

Public private partnership: Being a government institution, the hospital has no direct alliance with private partners or business other than recommending patients to buy drugs from private business during stock-out periods.

Relationship with lower health units: Like other general hospitals, the hospital often coordinates with the lower health unit on availability of ACTs.

Information sharing with external stakeholders: Instant communication using Internet, hard copy reports and use of information feedback platform from with MoH enhances ACTs availability. Group agreement and complementation must be present in coordinated relationship to smoothen coordination. While private firms, for instance, can decide what information they can exchange and how to achieve integration by coordinating mutual interests, public sector organisations may be subject to state regulations. This may endanger implementation of feasible coordination dimensions to facilitate service delivery.

(d) General Hospital D

Supply chain interdependence: Supply chain interdependence between the supplier and the hospital is managed through regular correspondences to the stakeholders. There is also an NMS Eastern Region representative who visits the hospital from time-to-time.

Information sharing with external partners: Information is shared via manual systems with NMS followed by email. Mutual exchange of information with respect to schedules may help supply chain members to develop timely, accurate and complete delivery plans for products, thereby improving delivery. However, at times, not all the ordered quantities are delivered and that affects the availability of ACTs and calls for emergency supplies. The deficiency may hinder decision-making and, at worst, it can cause a bullwhip effect in case of high demand uncertainties.

Collaborative partnership: The hospital jointly hosts collaborate training with Uganda Health Supply Chain and some other NGOs that hold training programmes on drug monitoring and supervision.

Public private partnership: With regard to strategic alliances with private pharmacies, there seems to be an unofficial understanding with some pharmacies, which meet demand for drugs in times of emergencies.

Relationship with lower health units: There is such a good **relationship** between lower health units and the GH that any unit, which experiences stock-outs can easily request for redistribution. Cross case analysis of the market environment

5.6.2 Cross case analysis of market environment dimensions

5.6.2.1 Supply chain interdependence with suppliers

All the general hospitals emphasise the use of communication channels to improve supply chain interdependence with suppliers and distribution of malaria treatment pills. GH A uses emails, telephones and routine regional monitoring and evaluation meetings that have improved supply and distribution. GH B uses the M-track system connected to individual telephones and the Rx tool, and this has improved supply and distribution. GH C points out that following the NMS schedule has helped to improve supply and distribution. GH D emphasises regular correspondences and liaison with the NMS regional representatives as a way to improve supply and distribution.

5.6.2.2 Collaborative partnerships for training

All the general hospitals emphasised that training has improved supply and distribution of malaria treatment pills. GH A reports that it had no joint training with NMS, which affected supply and distribution of ACTs. GH B emphasised that training offered by NMS and other training programmes offered by the Drug Monitoring Unit improved supply and distribution. GH C emphasised that refresher training held by MoH in collaboration with the Malaria Consortium improved supply and distribution of ACTs. GH D emphasised that training done by NGOs on drug monitoring and supervision improved supply and distribution of ACTs.

5.6.2.3 Information sharing with suppliers, MoH and Donors

All the general hospitals emphasised that sharing of information has improved supply and distribution of malaria treatment pills. GH A emphasised that sharing of schedules through emails and hard copies or visiting their website for information has improved supply and distribution of ACTs. GH B emphasised that communicating through personal phones and the Rx system has improved supply and distribution of medicines. GH C emphasised that online ordering or hard copies with NMS, monthly and weekly reports using M-track and weekly or quarterly meetings, have improved supply and distribution of drugs. GH D emphasised that hard copies of schedules used or use of email has improved supply and distribution of malaria drugs.

5.6.2.4 Public private partnership

The common theme emerging in all the general hospitals is that public private partnerships have affected supply and distribution of malaria treatment pills. GH A has no public private partnership, which affected supply and distribution of ACTs. In GH B public private partnerships do not exist and there is no official effort to create such partnerships. This has affected supply and distribution of medicines. Similarly, in GH C, there are no public private partnerships as well, which affects supply and distribution. On the contrary, GH D emphasised that it has informal understandings with some pharmacies, and this arrangement has positively affected supply and distribution of ACTs.

5.6.2.5 Relationships between lower health units

The general hospitals emphasised that relationship with lower health units has improved supply and distribution of malaria treatment pills. GH A emphasises a good relationship, support for each other and redistribution of ACTs to other health units when they run out of stock. This has improved supply and distribution of drugs. GH B emphasises that a good relationship in redistribution has improved supply and distribution. In the same vein, GH C emphasises that a good relationship has improved supply and distribution of malaria medicines. Similarly, GH D also emphasises redistribution as a key mechanism for supply and distribution. The summary of themes and attendant dimensions are summarised in Figure 12 and Table 21.

Table 21: Market management environment dimensions

SC interdependence with suppliers	Regular communication with supplier (NMS) Regular meetings with the supplier Use of e-mails with to the supplier Use of personal phone calls with NMS Routine regional monitoring with stakeholders Evaluation meetings with supplier Use of M-TACK with other external stakeholders Use of the Rx tool Sharing of schedules with the supplier Regular correspondence with the supplier’s representative
Collaborative partnerships for training	Joint training with NMS Collaborative training with Drug Monitoring Unit Refresher training with Ministry of Health Collaborative training with NGOs
Information sharing with suppliers, MoH, Donors	Online sharing of information Regular exchanges information using hard copies of reports Use of IT tools (M-Track) Sharing of weekly or monthly reports Holding of quarterly meetings with external stakeholders
Relationship between lower health units	Hospital’s relationship with lower health units Support for redistribution enhances ACT availability

5.6.3 Emerging themes under the market environment

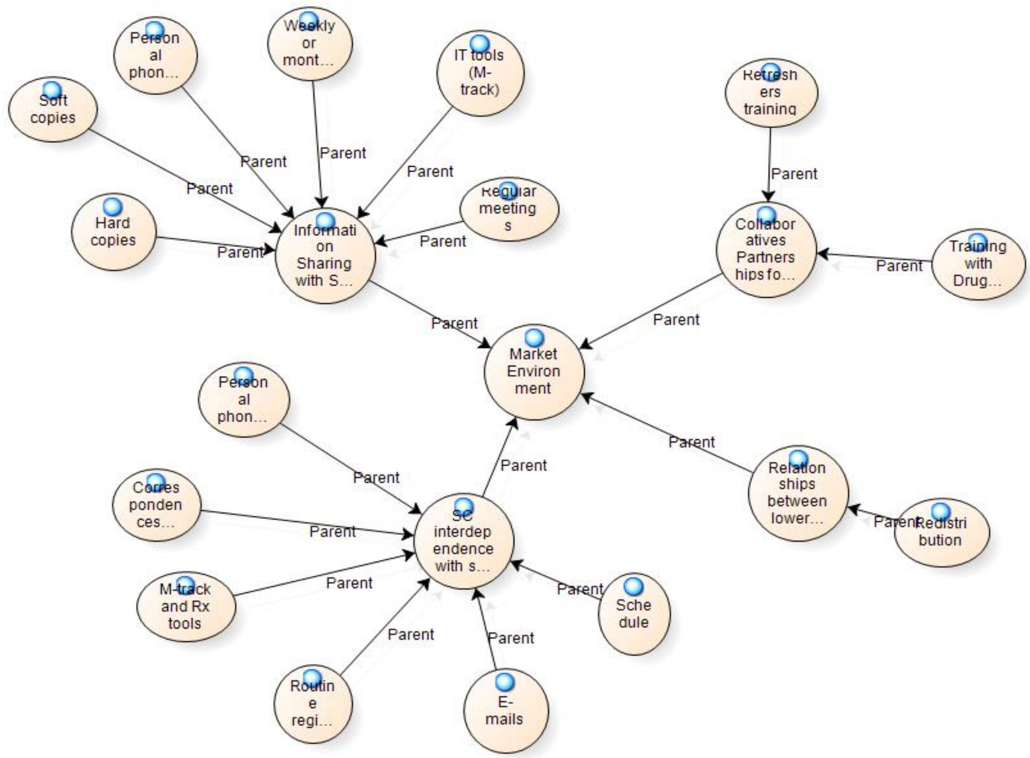


Figure 12: Hierarchical model for market environment dimensions that affect ACTS in Uganda

5.7 Macro environmental dimensions that affect ACTS in Uganda

The section explores objective 3b of the management environmental dimensions (macro) that affect supply chain coordination of malaria treatment pills in general hospitals in Uganda in line with research question 3. This was intended to determine how the macro supply chain coordination dimensions affect availability of malaria treatment pills in general hospitals in order to develop an enhanced supply chain coordination framework. The themes and emerging dimensions from the narratives are presented in Table 22.

Table 22: Interpretive Structural Modelling: Macro environment

INTERPRETIVE STRUCTURAL MODELLING: SUPPLY CHAIN COORDINATION OF MANAGEMENT ENVIRONMENT								
Objective 3b: Macro environment factors that affect supply chain coordination of malaria treatment pills in General Hospitals of Uganda- Macro environment factors								
Categorized areas from focus group discussion guide	**Focus group discussion guide questions**	**Key Quotes**	**GH A Key words from Narrative**	**GH B FGD Key words from Narrative**	**GH C FGD Key words from Narrative**	**GH D FGD Key words from Narrative**	**Dimensions derived or emerging from narratives**	**Transcripts references**
Political factors	1. How does the political, environment affect availability of malaria treatment pills?	#A1. First of all ACTs belong to the category of extra vital drugs and by virtual of that name I will also baptize, politicized they want members to take on, they really politicize. # A 2. Politicians have propaganda and want their interest met to their expectations and when you do not meet them, then you are regarded as someone who is against the common goal or their interest. #A9 and #A 6. People have elected their representative at the district level. So … politicians bypass normal procedures that should be followed. #A 3. Nods his head and says yes. Those politicians … do not want to adhere to the first line treatment. #A 1. Sometimes politicians are supportive creating public awareness. They discuss issues on radio talk shows between technocrats and political leader hence clarifying on issues regarding ACTs. A 4. ACTs are so much politicized. They will be very active then telling people that drugs are available in the hospital. B8. Local politicians communicate to the public that medicines are available even when they are not. C9 … political leader may request that please, can you give me ACT just for home use. C11. On delivery, the verifications are always done together with the political leaders. … To me I think it has led to ACTs being stable without having many stock-out. C11 Yes, patients have gone to report to politicians and they come to find out from us and at times thinking that the drugs are sold. C 8. Another thing politicians go to the community announcing on the radio that everything is free. D7. Politicians come and ask for ACTs, without getting laboratory results. They put you in a tight corner … 8. When we liaise with them concerning our activities, they have the political will and can communicate to influential people so we can get a speedy response.	#A1. & #A4. ACTs are politicised. 2. Political propaganda Transcript 2, 14). #A9. & 6. 3. Politician interference. 1. Political support (Transcript 1, 15). Public awareness ACTs 1, 14-15).	#B8. Local politicians communicate to the public (Transcript 2, 7).	#C11. Joint verifications with the political leaders of ACTs; political interference by some politicians. #C8. Politicians announce on the radio (Transcript 3, 12).	#D7. Politicians put you in a tight corner and tempt to issue to a non BS positive person #D8. Politicians communicate to influential people for speedy response (Transcript 4, 10).	Politicization; political propaganda; political interference; political support; awareness creation; verification of ACTs stock; Advocacy by politicians; Surveillance and monitoring;	Transcript 1, 14-15; Transcript 2,7; Transcript 3.12; Transcript 4, 10;
Economic factors	2. How does the economic environment affect availability of malaria treatment pills?	#A 4 ACTs are provided in this country using donor funds. … Which means that the availability of ACTs will depend on funds by the donor. If they do not provide the funds, it will affect the availability of ACTs. #A 4. … Co-sharing… had the capability of supplementing what the government supplied. #B6. …	#A4. ACTs are provided using donor funds; Co-sharing (Transcript 1, 15).	#B6. Adequate funding for ACTs from development partners (Transcript 2, 8). #B7. Poor community cannot afford ACTs (Transcript	#C11. We have got donors and we cannot run out of stock (Transcript 3, 14).	#D3.Poor communities cannot buy ACTs. They are very costly. (Transcript 4, 10).	Donor funding; poverty; possibility of co-sharing	Transcript 1, 15; 2, 8; 3, 14; Transcript 2, 8; 4, 10.

		ACTs are donations from development partners. If they do not supply, then we run out of stock. #B7. Our people are poor and cannot afford ACTs …#C11. We have got donors and we cannot run out of stock. D3. Where there is poverty, it affects consumption of ACTs. For the poor undernourished person who has nothing to feed, cannot even take ACTs. … Even the malaria that was simple becomes complicated. … Poor communities cannot buy ACTs, they are very costly.		2, 8).				
Social Cultural factors	1. How does the social-culture, environment affect availability of malaria treatment pills?	#A 5. Villagers form clicks when they see NMS truck cruising from the furry up to here. Once it NMS delivers, the following day people will flock in here those are sick on not sick. # A 2… relatives will ask; have you brought for us some anti-malarials? #A2. Yaa. People believe in self-medication leading to expiring of drugs of ACTs. #A 5. … people already have at the back of their minds that you need to be on standby with some Anti-Malarial just in case any time a member of the family is falls sick. #B7. Once they know that the drugs have come, they just come for them even when not sick. # B8. Some relatives want to be given ACTs for keeps just in case. #B2. We have a challenge of people who come to this hospital disregarding the health centres. Even patients with a minor sickness come here – for them they believe that the people who are in the hospital are well trained and those in the lower health centres are the ones who failed. The problem could be attitudinal. #B6. People also believe that medicines are only here and other health centres don't have. #C10 These ACTs at times are on demand by the patients. #D3. We still have that belief in the community where by community members want ACTs to keep in their homes. D8. D4. Most people still don't complete their dosages and thus fall sick often and even develop resistance.	# A5. & #A2. Clicks in the villages to demand for ACTs. #A2. Culture of self-medication. #A5. Culture of having standby anti-malarial just in case (Transcript 1, 16-17).	#B7. Culture of wanting to be given ACTs #B8. Some relatives want to be given ACTs for keeps just in case #B 2. & #B6. Attitudinal disregarding the lower health centres (Transcript 2, 7-8).	#C11. Very complex community. Not easy to isolate the culture. #C10 high demand by the patients. (Transcript 3, 13).	#D3. Beliefs of keeping ACTs at home and want to be issued ACTs without prescription. #D 4. Compliance to dosages resistance (Transcript 4, 10).	Clicks; Self-medication; Disregarding lower HCs; beliefs of holding ACTs at home;; compliance to dosage	Transcript 1, 16-17; Transcript 2, 7-8; Transcript 3, 13; Transcript 4, 10).
Technological factors	1. How does the technological environment affect availability of malaria treatment pills?	#A4. It is really tedious doing everything manually. If technology was there like this current one, just a click of a button you would know everything about each drug. #B7. The facilities are there but inadequate given the number of patients … when patients are sent to the lab, they take so long before getting the results. No IT tools used for information flow. C11. … If M-track is not accessed by the users … there is a toll free line, any member of the community can call that line which is given to the public (8002) and talk …# D6. Has helped to ensure ACTs are availed in time, since we order via emails. #D1 & #D4. There have been challenges where the testing kits have caused some doubt (technology issues), whereby a person tests for malaria and the results turn out negative, thus they don't get ACTs, yet	#A4. Manual systems (Transcript 1, 18).	#B7. Laboratory test done although takes long to get the results. No IT tools used for information flow (Transcript 2, 8).	#C11. Use of M-track, toll free line (Transcript 3, 15).	#D6. Order via emails. 4. 1. Rapid Diagnostic Test (RDT) (Transcript 4, 10-11)	IT tools (Internet, phones; M-track , RDT and toll free lines	Transcript 1, 18; Transcript 2, 8; Transcript 3, 15; Transcript 4, 10-11.

		they actually have malaria.						
Legal factors	1. How does the legal environment affect availability of malaria treatment pills?	#B3 & #A4. There is a test and treatment policy although it is not implemented a lot. Overall, it curbs drug stock-outs. C10 we use only clinician's guide but not follow to the letter. These ACTs at times are on demand by the patients. They are the ones who ask for it delivery because most time when we don't have the required drugs to treat the patients, it brings conflicts between the nurses.	#A4. Test and treatment policy available although not fully implemented. (Transcript 1, 18).	#B3. There are guidelines for using ACTS; There is a compliance problem to treatment instructions (Transcript 2, 8-9).	#C10. Clinician's guide (Transcript 3, 15).	#D8. Policy change brings conflicts between the nurses, and the patients. 6. Regulating consumption. Given to BS positive patients (Transcript 4, 11).	Test and treatment Policy implementation; Clinical guidelines; pull policy change ; Regulating consumption	Transcript 1, 18; Transcript 2, 8-9; Transcript 3, 15; Transcript 4, 11.

Key: # -number assigned to the individual participant. A, B, C, D-Represents general hospitals

5.7.1 Case analysis of the management environment -macro environmental dimensions

(a) General Hospital A

Political dimensions: ACTs attract a high level of positive and negative political interference. The medicines are highly politicised. For instance, some politicians used their power positively to advocate for constant supply of ACTs to the hospital when ACTs issues are properly channelled to them. They used platforms such as health education and sanitation committee meetings and sectoral committee meetings to address critical issues related to ACTs. Nonetheless, they also engaged in negative propaganda. For example, they mostly talked to the community negatively about service delivery in the hospital to their benefit. This resulted in loss of trust by the community in the health staff, which affected the utilisation of ACTs.

In addition, politicians directly interfered with the hospital operations. In any event, they used their political weight to bypass normal procedures that should be followed and even dictated what should be administered. Patients too want special treatment because of support from politicians. Political shrewdness used by supply chain partners, therefore, seems to sway goals, processes and criteria, in the chain through political manipulations.

Economically: ACTs are provided in Uganda with support from donors. This means that the quantity and frequency of donor funding to the government affects the availability of ACTs. However, the high level of poverty among the community members affects the availability of ACTs because they cannot afford to buy the medicine; they depend purely on the hospital supply. Yet, the health system in Uganda does not permit cost sharing with the community to supplement what the government supplies, which greatly affects the availability of ACTs owing to the high level of demand for these drugs.

Social-cultural: Beliefs also have an impact on availability of ACTs. For instance, the community members flock to the hospital on the day ACTs are delivered by the supplier, regardless of whether they are sick or not, because they believe “the truck has brought their medicines.” The attitude does not spare health workers either once they visit the villages. Notably, relatives have a tendency of demanding for ACTs. People also believe in self-medication and rarely come to the hospital for treatment.

Technology: The hospital also lacks robust equipment for making work less tedious and effective. Ideally, the presence of more robust systems would have made it easier for the hospital to know the quantity to order on a click of a computer.

Legally, NMS is a monopoly when it comes to supply of ACTs and they often dictate what to supply and when to supply.

(b) General Hospital B

Politically, the hospital noted that often times, local politicians misinform the public that medicines are available even when they are not. Politically oriented behaviour is often designed to benefit a subunit or an individual to acquire and maintain power.

Economically, there seems to be inadequate funds for ACTs even though development partners are funding them. This may mean that if donors do not provide funds, then availability is affected. ACTs are expensive medicines and yet the community is poor and cannot afford ACTs outside the hospitals.

Community culture and beliefs are a critical issue that affects ACTs usage. For instance, when drugs are delivered by NMS, people fake sickness with the hope of getting ACTs. To make matters worse, sometimes ACTs are either given without prior testing or relatives of hospital staff demand them so that they keep the drugs just in case they fall sick in future. The community belief is that any fever is malaria and, therefore, patients must be given ACTs. This affects their availability. In addition, the community members have a culture of disregarding health centres because they prefer to get treatment from the GH. Besides, patients believe that the hospital staff are well trained and offer better services than those in the lower health centres. This seems to pose a challenge to the hospital staff as the number of patients overwhelms them.

Technologically, the hospital seems to lack modern IT tools for information flow, making it difficult to efficiently deliver services on ACTs.

Legally, there is a national operational framework within general hospitals and the supplier operates within these frameworks. The ACTs budget is managed by NMS and they release the grant quarterly to the hospital as per the framework. The hospital operates under set guidelines for dispensing ACTs respectively. This affects availability of ACTs regardless of whether the guidelines are followed or not.

(c) General Hospital C

Politically, the hospital has divergent issues regarding the politicians' role in making ACTs available. On one hand, it was ascertained that sometimes politicians visit the hospital and demand for ACTs regardless of whether they are sick or not, without following the right procedures. On the other hand, politicians often announce on radios that ACTs are available in the hospitals and that they are free. This puts the hospital in a difficult position during stock-outs, as patients will be required to buy the ACTs from private clinics. Hospital management, therefore, have to take into account the vested interests of local politicians, who rely on support from their constituents. At the same time, politicians can also play a supportive role. For example, they are involved in the verification of the drugs on delivery to the facility. This seems to have led to stability of the supply of ACTs as they know of the records and are able to advocate for more supply from an informed point of view. In some instances, patients have reported to the politicians about the stock-out of the drugs. This seems to have positive effects on availability of ACTs because they can lobby for more supplies.

Economically, ACTs are donations to the population and the high level of poverty among the population puts them in vulnerable position during stock-out periods as they may not have the money to buy the drugs from private clinics. This implies that high-level subsidies from the donors are crucial in making ACTs available.

Socially, patients report to the politicians that hospitals refuse to give them ACTs, even when the drugs are out of stock. This seems to create confusion and conflict between general hospitals and politicians and it affects service delivery. In addition, community members believe that anyone with malaria is bewitched and they do not seek medical treatment. Other community members believe that children with malaria should not be injected. Therefore, this complicates sickness and it affects the use of ACTs and management of malaria. Patients at times demand ACTs even when they are not sick, especially when the patients see an NMS truck delivering drugs to the hospital.

Technologically, the hospital is using the M-track system and provided toll-free lines to the community to ease Information Sharing and tracking of the disease prevalence. This seems to create a positive impact on the management of malaria and provision of ACTs.

Legally, other than clinical guidelines, participants do not seem to be aware of a strong regulatory framework that guides the use and supply of ACTs, which may affect availability.

However, the clinical guidelines on the use of ACTs have improved their availability regardless of whether the guidelines are followed or not.

(d) General Hospital D

Politically, the politicians have misused their power by asking for ACTs without prior blood tests. However, when the hospital has challenges with ACTs stock-outs, politicians have helped out by communicating to influential people in government so that the hospital gets a speedy response. This short-term interference by elected political leaders in the institution's management influences availability of ACTs.

Economically, poverty levels in the community affect the consumption of ACTs. The poor undernourished persons who have nothing to eat cannot take ACTs, and this poses a high disease burden that in turn affects ACTs availability. In addition, communities cannot afford buying ACTs owing to the high cost of the medicine. While ACTs subsidies are meant to inspire patients to demand for the recommended medicines, it is unclear whether patients with suspected malaria take advantage of these subsidies and use these drugs.

Socio-culturally, the community culture of stocking ACTs at home for use in an emergency, or forging prescriptions, may affect ACTs availability. Sadly, most people within the community still do not complete their malaria dosages and they fall sick often and even develop resistance.

Technologically, the traditional technology tools (e-mail and mobile telephones) seem to have helped to ensure that ACTs are availed in time. However, there are challenges with the testing kits where a person tests for malaria and the results turn out negative when he or she actually has malaria. RDT tests only one species of malaria, leaving out the other four and someone might be declared malaria free yet they actually have malaria. This causes mistrust because the community members may think that the laboratory staff are not competent.

Legally, there are regulatory guidelines for ordering ACTs need to be integrated with all the other hospital supplies. Guidelines for stocking ACTs require that the GH does not overstock or under stock. Therefore, strict adherence to guidelines should be observed. Guidelines for consumption of ACTs help to avert wastage since the medicine is given to malaria positive patients as per the hospital regulations. The legal environment for free distribution of ACTs to patients has often created conflict between the patients and nurses during periods of stock-outs, and this has affected service delivery in the hospital. When properly regulated, the sector can contribute to improved access to essential medicines. Cross case analysis of the macro environment

5.7.2 Cross case analysis of macro environment dimensions

5.7.2. 1 Political factors

It is clear in all the general hospitals that the support from politicians in supply and distribution of ACTs improved availability of ACTs. In GH A, ACTs are politicised. There is political propaganda at play, political support and public awareness on ACTs, which have improved its supply and distribution. In GH B, politicians communicate to the public for improved supply and distribution of malaria treatment pills. In GH C, there are joint verifications of ACTs by hospital staff and political leaders, some patients report drug stock-outs to politicians, and the politicians make public announcements on radio, all of which have improved supply and distribution of malaria treatment pills. In GH D, politicians try to force medical staff to issue ACTs to persons who are not malaria positive, and this negatively affects availability of ACTs. Overall, politicians' ability to communicate to influential stakeholders has led to speedy responses and improved supply of ACTs to the hospital.

5.7.2.2 Economic dimensions

Availability of funds is a common factor that affects supply of malaria treatment pills in all the hospitals. GH A emphasises donor funds and cost sharing as factors that affect supply of ACTs. In GH B, adequate funding for ACTs from development partners and the poor community's inability to afford ACTs are the main factors that affect drug supply. GH C emphasises that because they have donors, they cannot run out of stock of ACTs. On the contrary, GH D emphasises that ACTs are very costly and poor communities cannot afford them, and this affects drug supply and distribution.

5.7.2.3 Socio-cultural dimensions

The general theme on socio-cultural factors has to do with the beliefs by the local people that they need to keep ACTs in their homes. GH A notes that the habit of individuals in the villages who demand for ACTs, the culture of self-medication and people wanting to keep anti-malaria drugs in their homes, affects drug supply and distribution. In addition, GH B emphasises that the culture of people wanting to be given ACTs regardless of whether they are sick or not, and the attitude of disregarding the lower health centres, affects drug supply and distribution. GH C also emphasises that the community complex practices and the hospital's inability to deal with them, affects drug supply and distribution. In GH D, there is a general belief that keeping ACTs at home, wanting to be issued ACTs without prescription, and non-compliance to dosages affects supply and distribution.

5.7.2.4 Technological dimensions

Technological factors affected supply and distribution of malaria treatment pills. GH A demonstrated that using manual systems affected supply and distribution of ACTs. In GH B timely release of laboratory test results and lack of IT tools for information flow affected drug supply and distribution. GH C emphasised that using M-track and toll free telephone numbers affected its drug supply and distribution. In GH D, making orders via emails and rapid diagnostic tests (RDT) influenced supply and distribution.

Table 23: Macro dimensions affecting availability of acts

Political dimensions	Politicisation; Political publicity Politicians' interference; Political support Awareness by politicians; Verification of ACTs Advocacy by politicians; Surveillance or monitoring
Economic dimensions	Poverty within the communities; Cost sharing Availability of donor funds
Social-cultural dimensions	Clicks within the community Culture of self-medication Belief of keeping ACTs by households Public attitude towards the lower health facilities Compliance to dosage
Technological dimensions	Use of phones Use of toll free lines M-track system RDT Use of Internet
Legal dimensions	Testing and dispensing policy Clinical guidelines Regulating consumption Pull policy change
Availability	Timely deliveries We always get the quantities we order for National quality standards Supplier meets orders (quantities) Improved stock levels Reduced out of stock

5.7.2.5 Legal dimensions

The common issue in the legal environment is existence of policies that affected supply and distribution of malaria treatment pills. In GH A, failure to implement fully the existing policy affected ACTs supply and distribution, while in GH B guidelines for use of ACTs and patients' failure to comply with treatment instructions affected drug distribution. In addition, GH C argues that the clinician's guide was important in supply and distribution of ACTs. In GH D, policy changes that result into conflicts between nurses and patients and regulating consumption of drugs given to BS positive patients, affected distribution of ACTs.

5.7.3 Emerging themes and dimensions in the macro environment

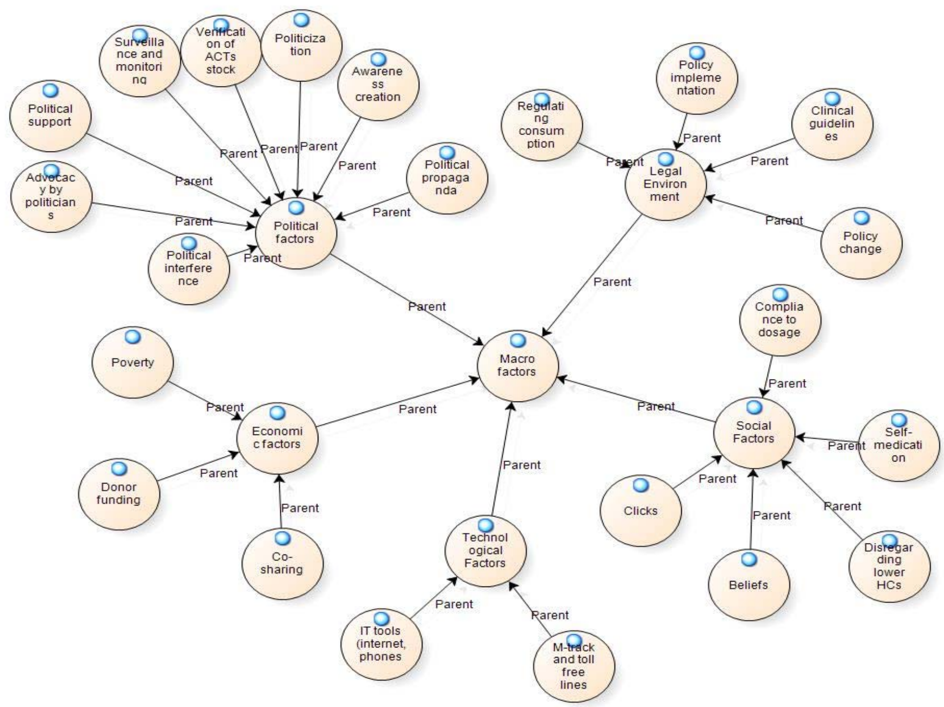


Figure 13: Hierarchical model of macro-environmental dimensions that affect ACTS in Uganda

5.8 Summary

From this chapter, results of FGDs in four general hospitals have been presented. It is from the above results that an instrument was developed (see appendix 3). The instrument was first piloted and validated as shown in the next chapter.

CHAPTER SIX

QUANTITATIVE ANALYSIS AND INTERPRETATION OF FINDINGS

6.1 Introduction

This chapter reports findings from the survey that was developed from the qualitative phase of this study. The questionnaires were self-administered and the data from the instrument was first subjected to data screening, then demographic analysis of participants followed by parametric test. The data were then examined through EFA and Convergent Validity (CV) to test the suitability and validity of research objective 1, 2 and 3. CFA assesses the hypotheses of objective 1 to 3. The chapter ends with Analytical Hierarchy Process (AHP) to answer the research objective 4.

6.2 Response rate and Data screening

A total of 320 questionnaires were issued to DTMC members in 40 general hospitals. However, 304 questionnaires were returned. Of these, 11 were discarded because they had incomplete data (more than 10% missing data). From the remaining 293 questionnaires (those with ordinal scale), the missing data was replaced with a median of the nearby point, whereas those with continuous scale were replaced with the mean. Furthermore, seven responses were deleted owing to unengaged responses; they had the same response for every single item. For outliers (age, level of education, and experience), three responses were removed.

The remaining 283 questionnaires represented a response rate of 88.4%. According to Amin (2005), this response rate is high enough to ensure more accurate survey results. The high response rate was owing to the prior lessons learnt from the focus group discussions. Communication with potential GH respondents was made through sending a personalised advance-notice letter to the respective hospital administrators, before visiting the selected general hospitals and issuing the survey package, which included a questionnaire, a covering letter, and clear instructions on how to complete the survey. The unreturned questionnaires could be attributed to either unavailability of some members of the DTMC owing to emergencies in theatre or others were reluctant to complete the questionnaires because at the time of data collection, there was a nationwide strike by the Uganda Medical Association members who were demanding for adequate medicine supplies, better remuneration and improved working conditions.

6.3 Demographics distribution

The aims of questions 6 to 10 were to describe the characteristics of participants in this study. These questions were intended to establish how respondents of different characters responded to questions that answer the main objectives of the study.

6.3.1 Region

The results indicate that 16.6% of the respondents were based in central hospitals of Uganda, 26% in North, 29.7% in the East, and 27.6% in the West of Uganda. The results indicate that a least number of the respondents were from central hospitals as shown in Table 24. In this study, all the major regions in the country were well presented—at least each region had more than 10% representatives.

6.3.2 Age bracket

No participant was below 20 years of age. It takes at least 20 years for someone to become medical personnel in Uganda. Therefore, the information was collected from well-educated people who had knowledge about the medical systems in the country. Table 24 summarises the age distribution of the respondents.

6.3.3 Level of education

According to Table 24, the majority of the practitioners hold a Diploma. Having more Diplomates helps to understand the core challenges facing the medical sector in Uganda—since they are involved more in day-to-day operation of the hospitals than any other group.

6.3.4 Position held by the respondents

At least 80% of the participants had experience of more than one year in the medical sector. Therefore, the information was collected from well-informed people who knew the medical sector business in Uganda. Middle managers participated more than any other group—Table 24.

Table 24: Summary of demographic factors

Region	**Percentage**
Central	16.6
North	26.1
East	29.7
West	27.6
Gender	
Male	47.3
Female	52.3
Age bracket	
<20 years	0.0
20-29	23.7
30-39	36.0
40-49	26.9
>50	13.4
Level of education	
Certificate	17.3
Diploma	58.0
Degree	17.7
PhD	7.1
Supply chain training	
Yes	29.3
No	69.3
Position	
Senior manager	11.3
Middle manager	21.2
Supervisor	17.3
Others	49.5
Experience	
<1 year	10.6
1-3	20.8
4-6	19.1
7-9	15.2
>10	34.3

6.4 Parametric test assumptions

Under this section, data validity was assessed to see if it is suitable for EFA. EFA helps to validate the inter-relationship between the measured parameters. EFA techniques helped to group parameters (independent) that have the same influence towards the dependent variable (ACTs availability) together. Normality and homogeneity were assessed.

6.4.1 Assumption 1: Normality test

Three interrelated methods of this assumption included p-p plots, a histogram and scatter plot. Other methods such as skewness and kurtosis, Kolmogorov & Shapiro and multi-collinearity, were also used to establish normality in the data (Hair *et al.,* 2010). The results from the tests are discussed under the respective sub-sections.

6.4.1.1 Normal p-p plots

The test performed on the transformed data revealed that the normal p-p plots observed values (dots) along the straight line. This implied that transformed data from the study was good for further statistical tests as assumption of normality using normal p-p plots was achieved and tenable as shown in appendix 4 (a).

6.4.1.2 Histogram

From the result on the data, the histograms developed from responses under the different dimensions were bell-shaped, indicating that the transformed data was normally distributed. This implied that the data from the study was good enough for further statistical tests as assumption of normality using histograms was achieved and tenable as indicated in Appendix 4 (b).

6.4.1.3 Scatter plots

Scatter plots put emphasis to whether results show variables related in a linear (straight line) or curvilinear fashion. Remember, only linear relationships are suitable for correlation analyses. They also add whether there was a positive (high-high scores) or negative relationship (high-low relationships). In addition, they mention the strength of relationship that is blob-type arrangements or vague cigar shape-clumping of scores around the imaginary straight line. Scatter plots test indicated that the transformed data is normal since most cases are clustered together and seem to fall within the vicinity of other points showing signs of association between the cases as shown in the appendix section. The scatter plots show a linear straight line with Parejo cigar shape scores around the imaginary line. This implied that the data were good for further statistical tests as assumption of normality using scatter plots was achieved and tenable as indicated in appendix 4 (c).

6.4.1.4 Skewness and kurtosis

The aim for using skewness and kurtosis in testing for normality was to show the flatness and pointiness of normal distribution, which is not shown by the other methods. Results are shown in Appendix 6. The 283 questionnaires were subjected to skewness and kurtosis analysis. Skewness values for all the items were in the range of -2.0 to 2.0, while apart from the six items that had kurtosis value greater than 2.0 but less than 2.5, all kurtosis values were in the range of -2.0 to 2.0. Therefore, the items were normally distributed (Henseler, Ringle, & Sarstedt, 2015; Brown, 2008).

6.4.1.5 Kolmogorov-Smirnov and Shapiro-Wilk tests

Results generated from the data indicated that all items apart from logistics had values non-significant at P>.05. This implied that the data were normally distributed and suitable for further statistical test as assumption of normality using Kolmogorov and Shapiro tests were achieved and tenable as indicated in Table 25.

Table 25: Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Supply	.053	283	.053	.991	283	.069
Logistics	.052	283	.064	.994	283	.390
Market	.063	283	.080	.986	283	.006
Macro	.063	283	.090	.994	283	.291

6.4.1.6 Multi-collinearity

Results from the final study data revealed that there was no multicollinearity between the independent variables under study as indicated in Table 26.

Table 26: Multi-collinearity results showing normality

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Statistics
	B	Std. Error	Beta			VIF
(Constant)	1.314	.360		3.646	.000	
Supply	-.004	.147	-.002	-.024	.981	2.319
Logistics	.674	.136	.412	4.949	.000	2.415
Market	-.098	.109	-.071	-.900	.369	2.147
Macro	.161	.103	.118	1.567	.118	1.970

6.4.1.7 Assumption 2: Homogeneity of variances

Table 27: Test of Homogeneity of variances

	Levene Statistic	df1	df2	Sig.
CSCCD	1.599	20	260	.053
Logistic	1.194	20	260	.259
Market	1.040	20	260	.416
Macro	.982	20	260	.485

Results from the final study data revealed that all the variables showed Levene's test non–significant at P>.05. This implies that assumption of homogeneity of variances is achieved and tenable. Against this background, the data are deemed fit for further statistical tests. Both EFA and CFA apply the "common factor model" that proposes that the set of indicators are causally influenced by one or more underlying latent factors. That means, this model is a causal model, in which the factor represents some empirical, one-dimensional entity that exists independent of the measurement procedure and causes the correlations among the indicators. Therefore, same data can be used after removing low loading and cross loading items. Factors with good loading can be subjected to CFA directly (Eidecker, *et al*., 2010).

6.5 Exploratory Factor Analysis (EFA)

This section addresses the suitability and validity of objective 1, 2 and 3 of this study. In using EFA, discovery of the underlying structure of a relatively large set of variables was made. That is to say, EFA enabled the identification of underlying variables or factors that explain the pattern of correlations within a set of observed variables. This statistical technique was used in this study for its strength in producing a smaller number of linear combinations of original factors that may positively and negatively influence the accessibility of ACTs.

6.5.1 Extraction, suitability, coding, and reliability of supply chain coordination dimensions

6.5.1.1 Extraction

Maximum likelihood analysis (MLA) using Promax with Kaiser Normalisation was performed to reduce the number of variables under critical supply chain dimensions at the micro level. Upon analysis of the SCCD parameters, the results loaded on six principal components. These results are in line with the scree plots that show an L elbow at around seventh component (appendix 5a). These principal components can be categorised as organisation factors (OF); information sharing (IS); Responsiveness (R); mutual understanding (MU); Relationship Management & decision-making (RM), top management commitment (TM); and availability (A).

Table 28: EFA—SSCD

	Component						
	1	2	3	4	5	6	7
CA	.897	.935	.905	.892	.851	.849	.768
OF05							.729
OF08							.785
OF09							.640
IS01					.789		
IS03					.894		
IS04					.751		
R01				.755			
R03				.907			
R04				.906			
MU03		.742					
MU05		.776					
MU08		.962					
MU010		.954					
RM02			.659				
RM03			.937				
RM04			.802				
RM05			.872				
TM01						.687	
TM03						.780	
TM09						.674	
TM010						.575	
A01	.588						
A02	.880						
A03	.979						
A04	.764						
A05	.751						
A07	.592						
A08	.509						
Eigen	34.2	9.4	6.1	6.7	3.9	3.5	2.9
AVE	0.55	0.75	0.68	0.74	0.66	0.50	0.52
CR	0.89	0.92	0.89	0.89	0.85	0.78	0.76
Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO)							.908
Bartlett's Test of Sphericity				Approx. Chi-Square			5390.091
				Df			378
				Sig.			.000
Goodness-of-fit Test							.000

CA: Cronbach's Alpha, AVE: Average Variance Explained, CR: Composite Reliability

The results indicated that three items of Organisational Factors contribute 2.9% of the variance; Information Sharing 3.9%; Responsiveness 6.7%; Mutual Understanding 9.4%; Relationship Management and decision-making (6.1%), and Top Management (3.5%) were generated, accounting for a total for 66.4% of the total variance in SCCD—Table 28. Under OF, 12 items were sampled but after analysis, only three items were retained for further analysis. Information sharing had seven items of which three were retained. Whereas

Responsiveness had eight items, three items were also retained. Under MU, of the 11 items, four were retained. Of the several items of RM, 4 were retained. In addition, of the 10 items of TM, four were considered for further analysis. Table 28 shows the items loading; all the items loaded with absolute values greater than 0.500. This shows that the data are sufficient to predict that the data were likely to factor well based on correlation and partial correlation between the variable constructs.

6.5.1.2 Suitability analysis

According to Tabachnick and Fidell (2007), to proceed with factor analysis KMO should be 0.70 or higher and the Bartlett's test of sphericity should be significant at $p < .05$. The seven components had a sampling adequacy—KMO of 0.908 and a significant Bartlett's Test of sphericity of 5390 as shown in Table 28.

6.5.1.3 Reliability analysis of supply chain coordination

Analysis of reliability using Cronbach's alpha shows a good fit, with a minimum of .768 on principal component seven. There were nine (2.0%) non-redundant residuals with absolute values greater than 0.05. Table 29 shows composite reliabilities (CR) and average variance extracted (AVE). The composite reliabilities ranged from .76 to .92, which is considered very good. AVE is a measure of the convergent validity of the model's constructs and should be .50 or higher (Hair *et al*., 2010). Convergent validity is defined as the extent to which a specified set of indicators for a construct converge or share in common a high proportion of variance. For this model, the AVEs ranged from .50 to .75. Therefore, all constructs exhibit convergent validity. The Fornell-Larcker (1981) criterion assesses discriminant validity between the constructs. Discriminant validity is the extent to which the indicators of a construct represent a single construct and the construct's indicators are distinct from other constructs in the model. Table 30 shows factor correlation between the formed principal components. The correlations are below 0.7. Therefore, the formed components represent a single construct and they are distinct from each other in the model.

The results further revealed that three items of organisational (OF) loaded well on factor 7 with significant loadings of .640 to .785 and Cronbach alpha of .768. Still three items of Information Sharing loaded well on component 5 with significant loadings of .751 to .894. In addition, three items of Responsiveness loaded well on factor with significant loadings of .755 to .907. The Cronbach alpha was also adequate at 0.892. Four items of MU loaded well on principal component 2 with significant loadings of .742 to .962 and Cronbach alpha of .935. Furthermore, three items loaded well on component three with significant loading of .659 to .937. Finally, four items loaded well on the principal 6 (TM), with significant loading of .575 to .780, and Alpha of .849. Seven items were extracted to explain the supply chain in relation to availability of malaria therapies. Furthermore, analysis of zero order correlation between the seven factors that loaded well on SCCD was performed. It was noted that all the seven factors significantly and positively correlated well. The results of zero order correlations are indicated in Table 30.

Table 29: Factor Correlation Matrix

Factor	A	MU	RM	R	IS	TM	OF
A	1.000						
MU	.570	1.000					
RM	.437	.506	1.000				
R	.235	.273	.248	1.000			
IS	.331	.331	.492	.394	1.000		
TM	.665	.542	.488	.261	.455	1.000	
OF	.208	.260	.299	.417	.445	.314	1.000

There are 9 (2.0%) non-redundant residuals with absolute values greater than 0.05.

Table 30: Zero order correlation—SCCD

	A	OF	IS	R	MU	RM
OF	.211**					
IS	.321**	.374**				
R	.216**	.378**	.368**			
MU	.544**	.257**	.323**	.256**		
RM	.442**	.271**	.460**	.249**	.494**	
TM	.680**	.264**	.366**	.247**	.543**	.475**

**Correlation is significant at the 0.01 level (2-tailed

6.5.1.4 Coding of the extracted items for SCCD

Under critical supply chain (SSCD), seven components were formed representing OF, Information Sharing (IS), Responsiveness (R), Mutual Understanding (MU), Relationship Management (RM) and Top Management (TM). A total of 28 variables were retained as shown in the table below.

Table 31: Summary of retained items under supply chain (Micro environment)

OF05	Issuance of local guidelines enhances ACTs availability
OF08	Accountability for ACTs enhances availability
OF09	Supervision within the hospital enhances availability of ACTs
IS01	Verbal communication during CMEs enhances ACTs' availability
IS03	Rx-solution enhances ACTs' availability
IS04	Information on stock cards has improved availability of ACTs
R01	Scheduled issuance timelines by stores to other units enhances ACTs availability
R03	Internal redistribution between units has enhanced availability of ACTs
R04	Efficient delivery timelines from Pharmacy has greatly improved availability of ACTs
MU03	Mutual trust among staff members has enhanced demand forecast for ATCs
MU08	Instructions on use of ACTs has greatly improved its availability
MU10	Communicating of policy change to patients has improved availability of ACT
RM02	Good relationships among staff has positively enhanced availability of ACTs'
RM03	Joint decision making during procurement planning has enhanced ACT availability
RM04	Good relationship of the hospital with her suppliers has improved ACTs stock levels.
RM05	Feedback loop with other units has greatly improved availability ACTs
TM01	Frequent feedback on stock status from Top Management has improved ACTs availability.
TM09	Top Management support for redistribution has enhanced availability of ACTs
TM10	supports for CME for stock management enhances ACT availability
A01	Stores timely delivers ACTs to user units
A02	ACTs can be ordered as and when needed
A03	We always get the quantities we order for
A04	ACTs issued meet the national quality standards
A05	ACTs orders are always met by the supplier
A06	ACTs stock levels have improved
A07	The rate at which ACTs run out of stock has reduced
A08	ACTs are always available for patients

6.5.2 Extraction, Suitability, Coding, and Reliability of logistics activities

6.5.2.1 Extraction

Likewise, MLA using Promax with Kaiser Normalisation was performed to reduce the number of variables under logistics activities. Basing on scree plots, an elbow is formed at seventh component (appendix 5b). Therefore, a maximum of several principal components explained logistics in relation to availability of malaria treatment. The results generated indicated that at least three items loaded well on each constructs of logistics activities with a total of six principal components. The results indicated that three factors of forecasting (5.1%), quantification (6.7%), procurement and ordering (8.4%), storage management and distribution (11.2%), dispensing 5.0(%), and availability (29.0%) were generated, accounting for 65.6.6% of the total variance in logistics activities in relation to availability of malaria therapies.

Table 32: EFA pattern matrix—Logistics

	Factor					
	1	2	3	4	5	6
CA	.897	.911	.930	.896	.914	.817
FO1					.805	
FO2					.866	
FO3					.960	
Q01				.767		
Q02				.947		
Q03				.810		
Q04				.715		
P01			.750			
P02			.876			
P04			.917			
P05			.868			
P06			.868			
SM02		.912				
SM03		.909				
SM04		.576				
SM06		.741				
SM07		.763				
SM09		.807				
D02						.763
D03						.695
D04						.678
D06						.760
A01	.671					
A02	.840					
A03	.948					
A04	.794					
A05	.772					
A07	.662					
A08	.534					
Eigen	29.0	11.2	8.4	7.0	5.1	5.0
AVE	0.57	0.63	0.74	0.66	0.77	0.53
CR	0.90	0.82	0.93	0.89	0.91	0.82
KMO						.891
Bartlett's Test of Sphericity (BTS)			Approx. Chi-Square			5653
				df		406
				Sig.		.000
Goodness-of-fit Test						.000

CA: Cronbach's alpha, AVE: Average Variance Explained, CR: Composite Reliability

6.5.2.2 Suitability of extracted items for logistics dimensions

The KMO was sufficient at .891 to predict that the data were likely to factor well based on correlation between the variable constructs. Further, all items loaded with absolute values above 50 on each of the factors of logistical activities and availability dimensions. The six components had a GOF test that was significant with chi-square value of 5653 and degrees of freedom at 406—Table 32.

6.5.2.3 Reliability of logistics items

The results further revealed that all the three items of forecasting loaded well on factor 5 with significant loadings of .799 to.961 and alpha value of .914. Four items of quantification loaded well on factor 4 with significant loadings of .768 to .948 and reliability value of .896. More so, all the five items of procurement and ordering loaded well on factor 3 with significant loadings of .747 to.915. The reliability of procurement and ordering was .930. Storage management and distribution had six items, which loaded on second component with significant loading ranging from .574 to.914, and reliability of .911. In addition, dispensing had four items loading on 7's component with Cronbach alpha of .817 (Table 32).

Table 33 shows composite reliability and convergent validity results. The composite reliabilities ranged from .82 to .93, which is considered very good. The AVEs ranged from .53 to .77. So, all constructs exhibit convergent validity. In addition, Cronbach's alpha shows a good fit. All the CR values were in the acceptable range of ≥ 0.7—Table 33. There were 14 (3.0%) non-redundant residuals with absolute values greater than 0.05 (Table 33). This shows that the data were sufficient and was likely to factor well based on correlation and partial correlation between the variable constructs. Furthermore, analysis of zero order correlation between the 6 factors that loaded well on logistics activities was performed. It was noted that apart from dispensing, all the factors significantly and positively correlated well (Table 34).

Table 33: Factor Correlation Matrix—Logistics

Factor	A	SM	P	Q	F	D
A	1.000					
SM	.341	1.000				
P	.232	.407	1.000			
D	.547	.317	.257	1.000		
F	.398	.493	.220	.426	1.000	
D	.118	.100	-.057	-.074	.034	1.000

There are 14 (3.0%) non-redundant residuals with absolute values greater than 0.05.

Table 34: Zero order correlation—Logistics

	A	F	Q	P	SM
F	.383**				
Q	.511**	.412**			
P	.208**	.202**	.243**		
SM	.343**	.471**	.314**	.374**	
D	.118*	.040	-.051	-.058	.078

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

6.5.2.4 Coding of logistics items

Variables that influence the availability of ACTs in Ugandan hospitals under logistics section are coded under this section. There were 22 items forming five principle components that were retained as shown in the table below.

Table 35: Summary of retained items under logistics activities

F01	Estimating the average monthly consumption enhances availability of ACTs
F02	Forecasting based on disease patterns enhances of ACTs availability
F03	Forecasting using information from stock cards has enhanced ACTs availability
Q01	Totalled monthly consumption enhances ACTs' availability
Q02	Quantification taking into consideration of maximum–minimum stock levels has enhanced ACT availability
Q03	Quantification using information from the dispensing logs has enhanced ACT availability
Q04	Quantification taking into consideration of malaria seasons enhances ACT availability
PO1	Identification of needs enhances ACTs' availability.
PO2	Annual procurement plans enhance ACTs' availability.
PO4	Ordering based on approved budget enhances ACTs availability
PO5	Adherence to delivery schedules by NMS enhances ACTs' availability
PO6	Requisitioning as per plan enhances ACT availability
SM02	Labelling enhances availability of ACTs
SM03	Verification of expiry dates enhances ACTs' availability
SM04	Stock cards enhances availability of ACTs
SM06	Monitoring of room temperatures improves availability of ACTs
SM07	Medicine registers enhance availability of ACTs
SM09	Observance of minimum –maximum levels has enhanced ACT availability
D02	Prior testing of blood has enhanced ACT availability
D03	Verification of prescriptions enhances availability of ACTs
D04	Clear instructions on medicine usage has enhanced availability of ACTs
D06	Verification of dispensing logs has greatly improved availability of ACTs

6.5.3 Extraction, suitability, coding and reliability of market environment dimensions

6.5.3.1 Extraction of market dimensions

Maximum likelihood analysis (MLA) using Promax with Kaiser Normalisation was further performed to reduce the number of variables at the market environment level. Upon analysis of the market environment dimensions, the results loaded on four principal components with

Eigen values greater than 1.0—which is in line with the scree plots (appendix 5d). These components can be categorised as Supply chain interdependence (SCI); Collaborative partnership for training (CP); Information sharing with suppliers (ISS); and Availability (A) of ACTs. The results indicated that four items of SCI contributed 12%, of the variance, CP was responsible for 11.6% and ISS contributed 8.9%, therefore, accounting for 56.4% of the total variance in market environment dimensions, Table 36.

Table 36: Pattern matrix for market environment

	Factor			
	1	2	3	4
CA	.908	.921	.889	.815
SCI02		.940		
SCI04		.946		
SCI05		.804		
SCI06		.680		
CP01				.621
CP02				.702
CP03				.827
CP04				.753
ISS01			.693	
ISS02			.743	
ISS04			.880	
ISS05			.923	
A01	.691			
A02	.863			
A03	.946			
A04	.765			
A05	.729			
A07	.684			
Eigen	32.0	12.0	8.9	11.6
AVE	0.56	0.72	0.66	0.53
CR	0.91	0.91	0.89	0.82
KMO				.847
BTS		Chi-Square		3337
			df	153
			Sig.	.000
Goodness-of-fit Test				.000

6.5.3.2 Suitability of extracted market environment dimensions

Under SCI, ten items were sampled—and at the end of the analysis, four items were retained for further analysis. CP had four items all of which were retained. ISS had five items of which four remained upon doing EFA. All the above retained factors were considered for further analysis. The four components had a sampling adequacy (KMO) of 847 (Table 36). The GOF test was significant with chi-square value of 253, and degrees of freedom of 87, Table 36.

6.5.3.3 Reliability of the extracted market environment dimensions

Reliability analysis showed that principal components had a Cronbach's alpha of at least 0.815. The composite reliabilities ranged between .82 and .90, which is very good. The four items of SCI loaded well on principle component 2 with significant loadings of .681 to .946 and Cronbach alpha of .921. On the contrary, four other items of CP loaded well on principle 4 with significant loadings of .624 to .819, with a reliability of .815. More so, four other items of ISS with suppliers and lower health units loaded well on factor 3 with significant loadings of .694 to .923 with a reliability of .889, Table 36.

The AVEs ranged from .53 to .72. Therefore, all constructs exhibit convergent validity. The factor correlation matrix shows the discriminant validity of the constructs; all the values are below 0.7—therefore, each component represents a single construct (Table 38). There were 11 (7.0%) non-redundant residuals with absolute values greater than 0.05. Table 36 shows the items loading; all the items loaded with absolute values greater than 0.500. This shows that the data are sufficient to predict that the data were likely to factor well based on correlation and partial correlation between the variable constructs. Furthermore, analysis of zero order correlation shows that some factors significantly and positively correlated well (Table 38).

Table 37: Factor Correlation Matrix—Market

Factor	A	SCI	ISS	CP
A	1.000			
SCI	.578	1.000		
ISS	.304	.317	1.000	
CP	-.020	.009	.002	1.000
11 (7.0%) non-redundant residuals				

Table 38: Zero Correlation Matrix—Market

	A	SCI	CP
SCI	.527**		
CP	-.008	.005	
ISO	.321**	.294**	-.010

**. Correlation is significant at the 0.01 level (2-tailed).

6.5.3.4 Coding of the extracted items

Upon doing EFA, 12 items were retained under market environment—these items formed three principal components. The item coding is shown in the following table.

Table 39: Summary of retained items under market environment

SCI02	Regular meetings with the supplier enhances ACT availability
SCI 04	Use of personal phone calls with NMS enhances ACT availability
SCI 05	Routine regional monitoring with stakeholders enhances ACT availability
SCI 06	Evaluation meetings with supplier enhances ACT availability
CP01	Joint training with NMS has enhanced ACT availability
CP02	Collaborative training with Drug Monitoring Unit has enhanced ACT availability
CP03	Refresher training with Ministry of Health has enhanced ACT availability
CP04	Collaborative training with NGOs on how to monitor drug usage and supervision has enhanced ACT availability
ISS 01	Online sharing of information enhances ACT availability
ISS 02	Regular exchanges information using hard copies of reports with other stakeholders enhances ACT availability
ISS 04	Sharing of weekly or monthly reports with other stakeholders has enhanced ACT availability
ISS 05	Holding of quarterly meetings with external stakeholders has enhanced ACT availability

6.5.4 Extraction, suitability, reliability, and coding of macro environment dimensions

6.5.4.1 Extraction of macro dimensions

From scree plot, the maximum number of principal components that can be formed under macro-environment items are six (appendix 5d). Upon analysis of the macro-environment dimensions, the results loaded on six principal components. These components can be categorised as Availability (A) of ACTs, political factors (PF), Economic (EF), Social-cultural (SC), Technological (TF) and Legal framework (LF). PF had eight sampled items, of which five items were retained for further analysis. EF had three items all of which were retained. SC had five items of which three were retained. Under TF, five items were sampled and only three were retained. For LF, four items were sampled and only three factors were retained and thereby considered for further analysis.

6.5.4.2 Suitability analysis for macro environment dimensions

The six components had a sampling adequacy on KMO of 0.855 (Table 40). The six components explain 65.5% of the total variance; the GOF test was significant with chi-square value of 181, and degrees of freedom at 130.

6.5.4.3 Reliability test for macro environment dimensions

The AVEs ranged from .50 to .78. Therefore, all constructs exhibit convergent validity—Table 40. The factor correlation matrix shows the discriminant validity of the constructs; all the values are below 0.7. Therefore, each component represents a single construct. Both composite reliability and Cronbach's Alpha show that data are reliable enough to proceed to next level (Table 40). There were seven (2%) non-redundant residuals with absolute values greater than

0.05 (Table 41). Table 40 shows the items loading and all the items loaded with absolute values greater than 0.500. This shows that the data are sufficient to predict that it is likely to factor well based on correlation and partial correlation between the variable constructs.

Table 40: EFA Pattern Matrix—Macro Environment

	Factor					
	1	2	3	4	5	6
CA	.908	.848	.914	.919	.862	.756
PF4		.631				
PF5		.882				
PF6		.755				
PF7		.674				
PF8		.686				
EF01					.861	
EF02					.991	
EF03					.571	
SC01			.809			
SC04			.872			
SC05			.965			
TF01						.690
TF03						.697
TF04						.729
LF01				.900		
LF02				.965		
LF03				.761		
A01	.671					
A02	.870					
A03	.964					
A04	.767					
A05	.733					
A07	.665					
Eigen	26.4	9.2	9.5	7.5	7.5	5.4
AVE	0.62	0.53	0.78	0.77	0.68	0.50
CR	0.82	0.85	0.91	0.91	0.86	0.75
KMO						.855
BTS				Chi-Square		4027
				Df		253
				Sig.		.000
Goodness-of-fit Test						.000

The five items of political factors loaded well on principle component 2 with significant loadings of .636 to .885 and reliability of .848. On the contrary, three items of economic dimensions loaded well on factor 5 with significant loadings of .571 to .991 and alpha of .865. More so, three other items of social cultural dimensions loaded well on factor 3 with significant loadings of .805 to .964 and Cronbach of .914. Under the technological factors, three items loaded well on factor 6 with significant loadings of .692 to .729. Finally, legal factors loaded well on factor 4 with the highest suitability index of .919. Analysis of zero order correlation between the five factors that loaded well on the macro-environment was performed most significantly and positively correlated well (Table 42).

Table 41: Factor Correlation Matrix—Macro Environment

Factor	A	PF	SC	LF	EF	TF
A	1.000					
PF	.065	1.000				
SC	.390	.097	1.000			
LF	.562	-.006	.402	1.000		
EF	.316	.037	.470	.296	1.000	
TF	.220	-.035	.318	.237	.388	1.000
7 (2%) non-redundant residuals						

Table 42: Zero correlation matrix—macro

	A	PF	EF	SC	TF
PF	.064				
EF	.317**	.028			
SC	.383**	.089	.430**		
TF	.232**	-.040	.356**	.278**	
LF	.519**	-.001	.289**	.387**	.227**
**. Correlation is significant at the 0.01 level (2-tailed).					

6.5.4.4 Coding of Macro environment factors

The table below shows the retained item under macro-environment after performing EFA and suitability indices. A total of 17 items forming five principle components were retained for further analysis.

Table 43: Summary of retained items under the macro environment environment

PF4	Political support enhances ACTs' availability
PF5	Awareness by politicians on talk shows enhances ACTs' availability
PF6	Verification of ACTs stock by politicians enhances its availability
PF7	Advocacy by politicians enhances availability of ACT
PF8	Surveillance or monitoring of ACTs stock by politician enhances its availability
EF01	Poverty within the communities enhances ACTs availability
EF02	Availability of donor funds enhances availability of ACTs
EF03	Cost sharing enhances availability of ACTs
SC01	Clicks within the community enhances ACTs' availability
SC04	Public attitude towards the lower health facilities affects availability of ACTs
SC05	Compliance to dosage enhances ACTs availability
TF01	Use of phones enhances availability of ACTs
TF03	M-track system enhances availability of ACTs
TF04	Use of RDT has enhanced availability of ACTs
LF 01	Implementing the testing and dispensing policy have enhanced availability of ACTs
LF02	Implementing the clinical guidelines have enhanced availability of ACTs
LF03	Regulating consumption has enhanced availability of ACTs

6.6 Confirmatory factor analysis (CFA)

This section analyses the hypotheses of objective one, two and three. After performing EFA to identify the underlying factors that affect ACTs availability, the parameters were subjected to confirmatory test and verify the relationship between the observed and latent variables. While carrying out CFA, hypotheses H_1, H_2, H_{3a} and H_{3b} were assessed. In order to test whether measures of the constructs were consistent with the understanding of the nature of the constructs, CFA with maximum likelihood (ML) estimation method was performed on the data set as earlier stated in Chapter 4. The summary model of fit indices to determine the good-fit of the model and acceptance or rejection of a hypothesis in this study as stated in Table 44 and 45. The CFA process and results are presented and discussed in details below.

Table 44: Thresholds of goodness-of-fit indices used in CFA

Model diagnostics	Requirement	Reference
Modification Index (MI)	≥4	(Hair *et al*., 2010)
Standardised Residuals	< │2.5│ no problem > │4.0│possible problem	(Hair *et al*., 2010)
Path Estimates (Construct to Indicator	≥ 0.5 ≥0.5; ideally ≥0.7; significant	(Hair *et al*., 2010)
Squared Multiple Correlations (SMC) or Reliability	≥0.3	(Hair *et al*., 2010)

6.6.1 CFA measurement model for critical supply chain coordination dimensions

After performing the EFA to reduce the number of variables under the variable critical supply chain coordination dimensions (objective 1), a CFA was conducted to confirm that factors that were extracted converged as manifest variables of the global latent variable. The results of the CFA indicated that three manifest variables of OF05, OF08 and OFO9 significantly loaded on the organisation factors. Three other manifest variables of IS01, IS03 and IS04 significantly loaded well on the Information Sharing of supply chain coordination. The results also indicated that three other manifest variables of R01, RO3 and R04 significantly loaded well on the Responsiveness of supply chain. For Mutual Understanding (MU), Relationship management (RM) and Top Management commitment (TM), four variables loaded significantly on each—MU03, MU05, MUO8, MU10; RM02, RM03, RM04, RM05; and TM01, TM03, TMO9, TM10 respectively (Figure 14).

Table 45: Model Fit Indices

Fit indexes	Acceptable level
chi-square- Indicates the discrepancy between hypothesised model and data; Tests the null hypothesis that the estimated covariance–variance matrix deviates from the sample variance–covariance matrix only because of sampling Error	P> 0.05 (values with non-significant *p*-value).
Normed chi-square (CMIN/DF)-Because the chi-square test is sensitive to sample size and is only meaningful if the degrees of freedom are taken into account, its value is divided by the number of degrees of freedom	< 3.00
Incremental Fit Index	≥ 0.95
Tucker-Lewis Index (TLI)	≥ 0.95
Goodness-of-fit-Index (GFI)- Comparison of the squared residuals from prediction with the actual data, not adjusted for the degrees of freedom.	≥ 0.90
Adjusted Goodness-of-fit-Index (AGFI) – Adjusted for the degrees of freedom	≥ 0.90
Comparative Fit Index (CFI)- Shows how much better the model fits, compared to a baseline model, normally the null model, adjusted for the degrees of freedom	≥ 0.95
Root Mean Square of Error of Approximation (RMEA) - Shows how well the model fits the population covariance matrix, taken the number of degrees of freedom into consideration	≤ 0.08

Source: Based on Hair *et al*., (2010)

None of the items derived from EFA were deleted in the CFA process. The 21 items comprising three or four measured variables for each of the six constructs indicated that few items were used to measure the critical supply chain coordination at micro level as supported by the item response theory (IRT). This theory postulates that the fewer the items, the better the measures as opposed to the classical testing theory (CTT), which relies on many items (Bongomin, 2016:152). This confirms the proposition that critical supply chain coordination inclusion for malaria treatment therapies can be stimulated through organisationsfactors (OF), Information sharing (IS), Responsiveness, MU, RM and TM—which acts as the rules of the game in promoting malaria treatment at micro level. Modification indices make suggestions about loosening certain model parameters in order to improve the overall model fit. As long as any decisions made based on modification indices are theoretically meaningful and do not result in an unidentified model, they can be helpful in improving model specification. Based on modification indices displayed in Table 46, covariance was drawn between e11 & e10; e4 & e7; and e5 & e6 in order to achieve further fitting model to the data (Figure 14).

Table 46: CFA fit indices—SSC

X^2	**Df**	X^2/df	RMSEA	LO90	HI90	PCLOSE	GFI	AGFI	IFI	TLI	CFI
472 P=.000	**326**	1.44	.040	.032	.048	.986	.912	.884	.972	.968	.972

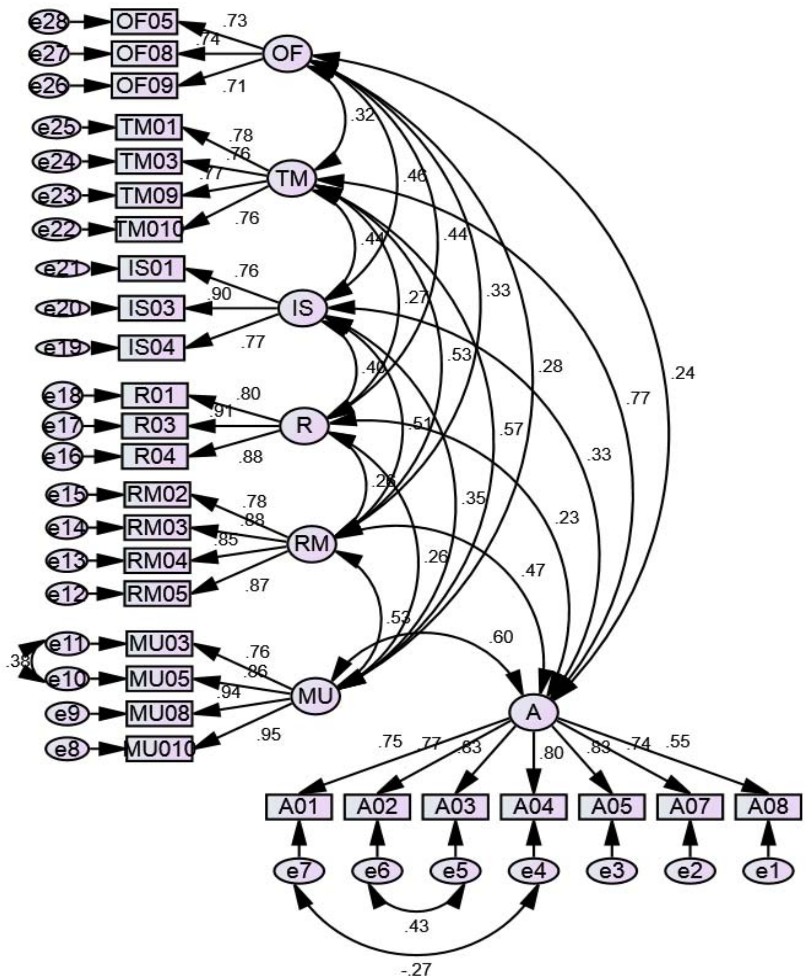


Figure 14: CFA measurement model for SCC dimensions

The results showed that the standardised parameter estimates of the initial measurement model were all significant (p<.000). The findings confirmed the validity of the final model with excellent model fit statistics between the model and the observed data. The normed chi-square (x^2) = 472 (degrees of freedom = 326, probability level = .000). The Goodness of Fit Index (GFI) was .912, above the recommended .90 while the Adjusted Goodness of Fit Index (AGFI) was calculated to be .884 slightly lower than the recommended .900. In addition, the Incremental Fit Index (IFI) was 0.972 above the recommended 0.90, while the Tucker Lewis Index (TLI) was .968 above the recommended 0.90. The Comparative Fit Index (CFI) was

0.972 further above the recommended 0.90. The results further revealed that the Root Mean Square error of estimation (RMSEA) = was significant at .040. A value of RMSEA of about 0.08 or less indicates a close fit of the model in close relation to the degrees of freedom (Table 46). The χ^2 test is significant (p-value of **.**000). Therefore, a failure to reject the null is a sign of a good model fit that is reverse testing procedure in CFA. The lower and upper boundaries at 90% confidence interval were .032 and .048, respectively. The probability of getting a sample RMSEA as large as .040 is .986. The results in Table 46 support the convergent validity of the items used to measure the study constructs.

Table 47: Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
A08	<---	A	1.000				
A07	<---	A	1.093	.121	9.003	***	
A05	<---	A	1.196	.125	9.568	***	
A04	<---	A	1.253	.133	9.387	***	
A03	<---	A	1.260	.131	9.616	***	
A02	<---	A	1.147	.124	9.234	***	
A01	<---	A	1.125	.124	9.047	***	
MU010	<---	MU	1.000				
MU08	<---	MU	1.007	.033	30.216	***	
MU05	<---	MU	.909	.039	23.261	***	
MU03	<---	MU	.807	.046	17.441	***	
RM05	<---	RM	1.000				
RM04	<---	RM	1.100	.060	18.387	***	
RM03	<---	RM	1.153	.059	19.472	***	
RM02	<---	RM	1.035	.065	16.030	***	
R04	<---	R	1.000				
R03	<---	R	1.227	.064	19.234	***	
R01	<---	R	1.037	.063	16.346	***	
IS04	<---	IS	1.000				
IS03	<---	IS	1.181	.082	14.462	***	
IS01	<---	IS	.928	.072	12.903	***	
TM010	<---	TM	1.000				
TM09	<---	TM	.905	.071	12.721	***	
TM03	<---	TM	.964	.077	12.525	***	
TM01	<---	TM	.946	.073	12.868	***	
OF09	<---	OF	1.000				
OF08	<---	OF	1.039	.108	9.662	***	
OF05	<---	OF	.961	.100	9.636	***	

Table 48: Standardised Regression Weights: (Default model)

		Estimate
Availability		
A08	ACTs are always available for patients	.547
A07	The rate at which ACTs run out of stock has reduced	.737
A05	ACTs orders are always met by the supplier	.825
A04	ACTs issued meet the national quality standards	.803
A03	We always get the quantities we order for	.834
A02	ACTs can be ordered as and when needed	.774
A01	Stores timely delivers ACTs to user units	.752
Mutual understanding		
MU010	Communicating of policy change to patients	.952
MU08	Instructions on use of ACTs	.936
MU05	Shared goals among staff has improved ACT availability	.856
MU03	Mutual trust among staff members has enhanced ACTs	.757
Relationship management		
RM05	Feedback loop with other units	.874
RM04	Good relationship of the hospital with her suppliers	.846
RM03	Joint decision making during procurement planning	.875
RM02	Good relationships among staff	.779
Responsiveness		
R04	Efficient delivery timelines from Pharmacy	.876
R03	Internal redistribution between units	.911
R01	Scheduled issuance timelines by stores to other units	.795
Internal information sharing		
IS04	Information on stock cards	.773
IS03	Use of the Rx-solution (IT tool)	.899
IS01	Verbal communication during CMEs	.760
Top management support		
TM010	Supports for Continuous Medical Education (CMEs)	.759
TM09	Top management support for redistribution	.770
TM03	Provision of transport in times of emergencies	.758
TM01	Frequent feedback on stock status from top management	.778
Organisational factors		
OF09	Supervision within the hospital	.706
OF08	Accountability for ACTs	.737
OF05	Issuance of local guidelines	.732

By using CFA, the regression weights should be 0.5 or higher with their significant *t*-values (*t*-value ≥ 1.96 at a=0.05), as recommended by Hair *et al.* (2010: 117; 708). In order to examine the strength of the linear relationship between a set of independent variables and a single dependent variable, multiple regressions were carried out. The AMOS output also displays the unstandardized and standardised regression coefficients below. Each unstandardized regression coefficient represents the amount of change in the dependent variable for each one-unit change in the variable predicting it. The regression tables display the unstandardized estimate, its standard error (abbreviated S.E.) and the estimate divided by the standard error (abbreviated C.R. for Critical Ratio). The probability value associated with the null hypothesis that the test is zero is displayed under the P column. None of the regression coefficients in this model is significantly different from zero beyond the .01 level (Table 47). Standardised estimates enabled the evaluation of the relative contributions of each predictor variable to each outcome variable. The standardised estimates for the fitted model appear in Table 48.

According to Table 46, 47, 48, and Figure 14, which are relevant to regression weights and standardised regression weights for the default model, **it can be stated that H_1 is supported** as shown in Figure 19. Based on standardised regression weights (Figure 14), the availability of malaria treatment therapies is positively more affected by followed by TM (.77), MU (.60), RM (.47), IS (.33), OF (.24) and finally by R (.23). The standardised parameter estimates of the initial measurement model (Table 48) were all significant ($p<.001$). Most importantly, the model provided an excellent model fit statistics for the construct measures. The results show that there is not much difference between the standardised and unstandardized coefficients, probably because the units were derived from the same survey measurement items.

6.6.2 CFA measurement model for logistics activities dimensions

After performing the EFA to reduce the number of variables under the logistics dimensions (objective 2), the CFA was conducted to confirm that the extracted factors converged as manifest variables of the global latent variable. The results of the CFA indicated that three manifest variables significantly loaded on both Forecastings (F) and Dispensing (D). Quantification of ACTs (Q) and Procurement and ordering of ACTs (P) had four manifest variables each while Storage management (SM) had six latent variables (see Figure 17).

Table 49: CFA fit indices—Logistics

X^2	df	X^2/df	RMSEA	LO90	HI90	PCLOSE	GFI	AGFI	IFI	TLI	CFI
545 P=.000	**135**	1.51	.043	.035	.050	.954	.938	.906	.966	.962	.966

Upon modifying the model by drawing covariance between e13 and e12; e5 and e6 (Figure 15), model fitting was achieved. The results showed that the standardised parameter estimates of the initial measurement model were all significant (p<.000). The findings confirmed the validity of the final model with excellent fit statistics between the model and the observed data.

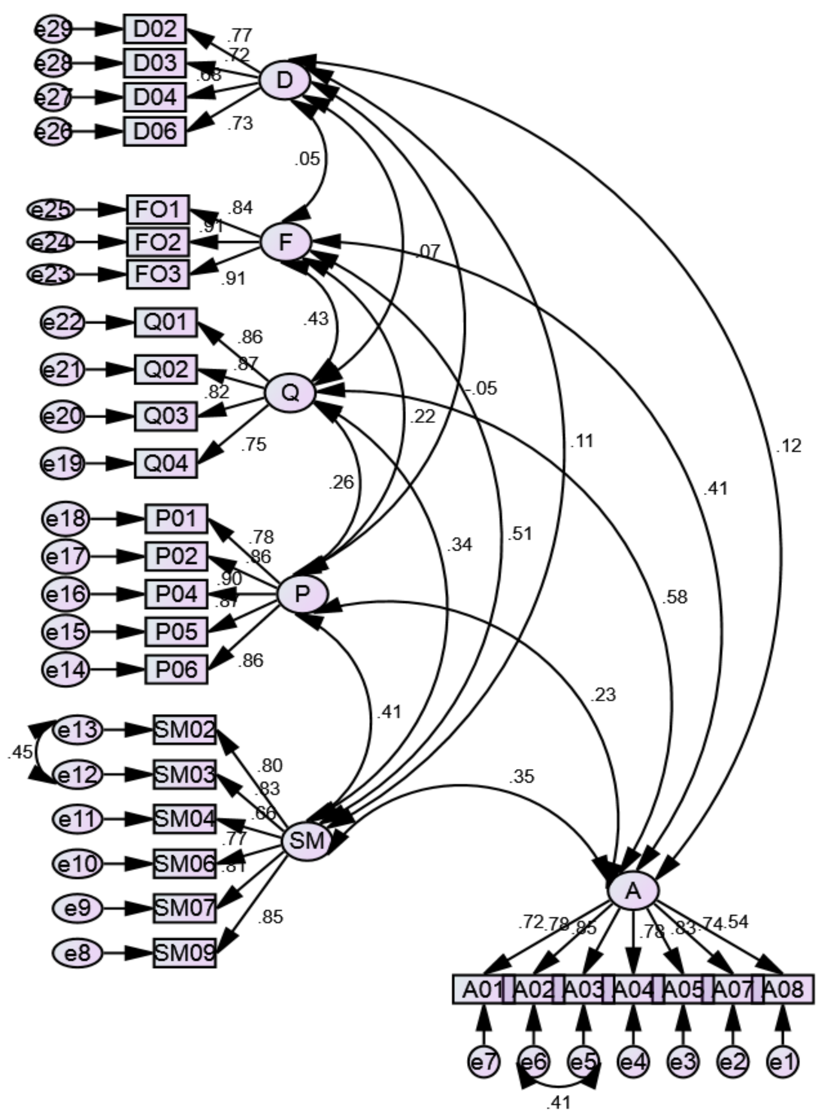


Figure 15: Measurement model for logistics activities dimensions

From Table 49, all the model fit parameters were above the recommended dimensions. Therefore, the overall model fit appears good. The $\chi 2$ test yields a value of 545 with 135 degrees of freedom and p-value of .000. Failure to reject the null is, therefore, a sign of a good model fit that is a reverse testing procedure in CFA (Blunch 2012; Byrne, 2013). Additionally, the RMSEA is .043 below the .08 recommended cut off. Both tests suggest that the model is a good fit to the data. Furthermore, the findings support the convergent validity of the items used to measure the study constructs. The results of CFA and outputs of the regression and standardised regression estimates are illustrated in Figure 15 below and Tables 50 and 51 respectively.

Table 50: Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
A08	<---	A	1.000				
A07	<---	A	1.102	.124	8.903	***	
A05	<---	A	1.210	.128	9.458	***	
A04	<---	A	1.226	.134	9.169	***	
A03	<---	A	1.284	.135	9.532	***	
A02	<---	A	1.161	.127	9.120	***	
A01	<---	A	1.086	.124	8.779	***	
SM09	<---	SM	1.000				
SM07	<---	SM	.960	.058	16.464	***	
SM06	<---	SM	.884	.059	15.058	***	
SM04	<---	SM	.780	.063	12.310	***	
SM03	<---	SM	1.016	.060	16.823	***	
SM02	<---	SM	.983	.062	15.873	***	
P06	<---	P	1.000				
P05	<---	P	1.056	.054	19.442	***	
P04	<---	P	1.039	.050	20.802	***	
P02	<---	P	1.174	.061	19.180	***	
P01	<---	P	1.030	.063	16.240	***	
Q04	<---	Q	1.000				
Q03	<---	Q	1.146	.082	14.019	***	
Q02	<---	Q	1.210	.081	14.964	***	
Q01	<---	Q	1.197	.081	14.758	***	
FO3	<---	F	1.000				
FO2	<---	F	1.001	.045	22.180	***	
FO1	<---	F	1.019	.052	19.453	***	
D06	<---	D	1.000				
D04	<---	D	.956	.095	10.050	***	
D03	<---	D	1.019	.097	10.550	***	
D02	<---	D	1.014	.092	11.033	***	

Table 51: Standardised Regression Weights: (Group number 1 - Default model)

		Estimate
Availability		
A08	ACTs are always available for patients	.545
A07	Rate of stock out	.741
A05	ACTs orders are always met by the supplier	.831
A04	ACTs issued meet the national quality standards	.782
A03	We always get the quantities we order for	.847
A02	ACTs ordered as and when needed	.780
A01	Stores timely delivers ACTs to user units	.722
Stores management		
SM09	Observance of minimum –maximum levels	.854
SM07	Maintenance of medicine registers	.814
SM06	Monitoring of room temperatures	.767
SM04	Stock cards	.664
SM03	Verification of expiry dates	.828
SM02	Labelling	.799
Procurement and ordering		
P06	Requisitioning as per plan	.859
P05	Adherence to delivery schedules by NMS	.871
P04	Ordering based on approved budget	.904
P02	Annual procurement plans	.865
P01	Identification of needs	.785
Quantification		
Q04	Quantification taking into consideration of malaria seasons	.752
Q03	Quantification using information from the dispensing logs	.821
Q02	Quantification taking into consideration of maximum–minimum stock levels	.874
Q01	Totaled monthly consumption	.862
Forecasting		
FO3	Forecasting using information from stock cards	.906
FO2	Forecasting based on disease patterns	.909
FO1	Estimating the average monthly consumption	.842
Dispensing		
D06	Verification of dispensing logs	.729
D04	Clear instructions on medicine usage	.683
D03	Verification of prescriptions	.724
D02	Prior testing of blood	.773

The standardised parameter estimates of the initial measurement model were all significant ($p<.001$) and the model provided an excellent model fit statistics for the construct measures. According to Table 49, 50, 51 and Figure 15, which are relevant to regression weights and standardised regression weights for the default model, **it can be stated that H_2 is supported** as shown in Figure 19. Based on standardised regression weights (Figure 15), the availability of malaria treatment therapies is positively affected most by Q (.58), followed by F (.41) then SM (.35), P (.23) and finally D (.12).

6.6.3 CFA measurement model for market management environment dimensions

The results of the CFA (objective 3a) indicated that all the variables significantly loaded on the global latent variable of Suppliers (SCI), Partnership training (CP), and Information sharing with donors and MoH (ISS). The results showed that the standardised parameter estimates of the initial measurement model were all significant (p<.000). The findings confirmed the validity of the final model with excellent model fit statistics between the model and the observed data.

Table 52: CFA fit indices—Market Environment

X^2	Df	X^2/df	RMSEA	LO90	HI90	PCLOSE	GFI	AGFI	IFI	TLI	CFI
242 P=.000	**127**	1.91	.057	.046	.068	.146	.930	.905	.965	.957	.965

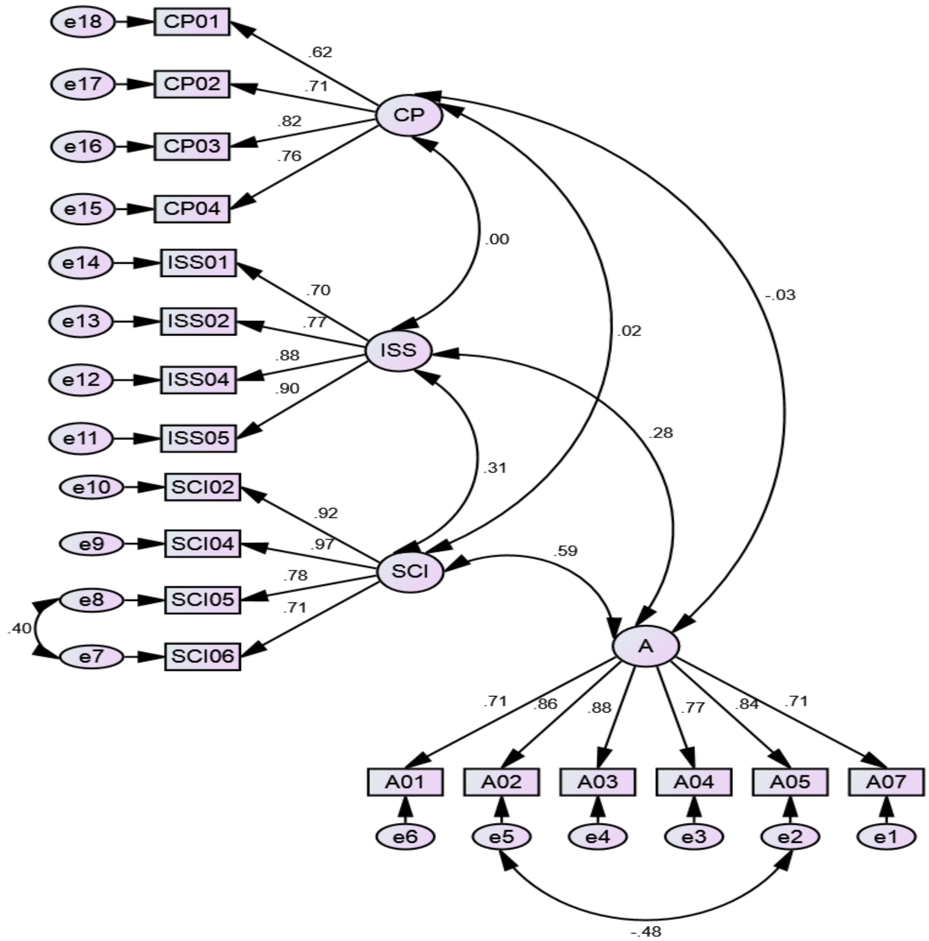


Figure 16: CFA measurement model for market environment dimensions

The normed chi-square (x^2) = 1.91 (degrees of freedom = 127, probability level = .000). The goodness of fit (GFI) was .930, above the recommended .90. The incremental fit index (IFI) was 0.965 above the recommended 0.95, while the Tucker-Lewis Index (TLI) was .957 above the recommended 0.95. The comparative fit index (CFI) was 0.965 further above the recommended 0.95 for a perfect fit. The results further revealed that the Root Mean Square error of estimation (RMSEA) = was significant at .057 (Table 52). A value of RMSEA of about 0.08 or less indicates a close fit of the model in close relation to the degrees of freedom. The lower and upper boundaries at 90% confidence interval were .046 and .068, respectively. The probability of getting a sample RMSEA as large as .057 is .146 and is significant at P=.000. The results of CFA and outputs of the regression and standardised regression estimates are illustrated in Figure 16 below and Tables 53 and 54, respectively.

Table 53: Regression Weights-Market Environment

			Estimate	S.E.	C.R.	P	Label
A07	<---	Availability	1.000				
A05	<---	Availability	1.163	.087	13.386	***	
A04	<---	Availability	1.143	.092	12.475	***	
A03	<---	Availability	1.270	.089	14.300	***	
A02	<---	Availability	1.223	.089	13.780	***	
A01	<---	Availability	1.010	.088	11.509	***	
SCI06	<---	Supply	1.000				
SCI05	<---	Supply	1.095	.066	16.608	***	
SCI04	<---	Supply	1.356	.086	15.699	***	
SCI02	<---	Supply	1.322	.087	15.246	***	
ISS05	<---	Donor	1.000				
ISS04	<---	Donor	.980	.049	20.071	***	
ISS02	<---	Donor	.815	.051	15.932	***	
ISS01	<---	Donor	.731	.052	13.950	***	
CP04	<---	Training	1.000				
CP03	<---	Training	1.023	.086	11.854	***	
CP02	<---	Training	.895	.083	10.796	***	
CP01	<---	Training	.793	.083	9.547	***	

These findings support the convergent validity of the items used to measure the study constructs. The CFA measurement result for market environment dimensions is indicated in Figure 16. The standardised parameter estimates of the initial measurement model were all significant ($p<.001$) and the model provided an excellent model fit statistics for the construct measures between the model and observed data. According to Table 52, 53, 54, and Figure 16, which are relevant to regression weights and standardised regression weights for the default model, **it can be stated that H_{3a} is supported** as shown in Figure 19. Based on standardised regression weights (Figure 16), the availability of malaria treatment therapies is affected by supply chain interdependency with suppliers (.59), followed by Information Sharing with donors, suppliers and MoH (.28), while training has no significant impact (-.03).

Table 54: Standardised Regression Weights—Market

		Estimate
	Availability	
A07	Rate of stock out	.707
A05	ACTs orders are always met by the supplier	.841
A04	ACTs issued meet the national quality standards	.767
A03	We always get the quantities we order for	.882
A02	ACTs ordered as and when needed	.865
A01	Stores timely delivers ACTs to user units	.707
	Supply chain Interdependence	
SCI06	Evaluation meetings with supplier	.712
SCI05	Routine regional monitoring with stakeholders	.785
SCI04	Use of personal phone calls with NMS	.969
SCI02	Regular meetings with the supplier	.923
	Information sharing with suppliers, MoH, Donors	
ISS05	Holding of quarterly meetings with external stakeholders	.904
ISS04	Sharing of weekly or monthly reports with other stakeholders	.884
ISS02	Regular exchanges information using hard copies	.766
ISS01	Online sharing of information	.704
	Collaborative partnerships for training	
CP04	Collaborative training with NGOs	.756
CP03	Refresher training with Ministry of Health	.817
CP02	Collaborative training with Drug Monitoring Unit	.706
CP01	Joint training with NMS	.621

6.6.4 CFA measurement model for macro-management environment dimensions

The outputs from EFA were entered into CFA to reduce the number of variables under the variable macro-environment dimensions (objective 3b). The results of the CFA indicated that all the variables from EPA were retained—none was dropped to achieve a model fit. Table 55 shows a summary of model fit indices. The results showed that the standardised parameter estimates of the initial measurement model were all significant ($p<.001$). The findings confirmed the validity of the final model with excellent model fit statistics between the model and the observed data. The normed chi-square (x^2) = 1.43 (degrees of freedom = 214, probability level = .000). The incremental fit index (IFI) was 0.976 above the recommended 0.95, while the Tucker-Lewis Index (TLI) was .972 above the recommended 0.95. The comparative fit index (CFI) was 0.976 further above the recommended 0.95. The results further revealed that the Root Mean Square error of estimation (RMSEA) was significant at .039. A value of RMSEA of about 0.08 or less would indicate a close fit of the model in close relation to the degrees of freedom. The probability of getting a sample RMSEA as large as .039 within 0.029 and 0.049 boundaries is .967. Therefore, no further modifications were made to enable model fit to the observed data. Accordingly, failure to reject the null is a sign of good model fit that is a reverse testing procedure in CFA (Blunch, 2012; Byrne, 2013).

Table 55: CFA fit indices—Macro Environment

X^2	Df	X^2/df	RMSEA	LO90	HI90	PCLOSE	GFI	AGFI	IFI	TLI	CFI
307 P=.000	**214**	1.43	.039	.029	.049	.967	.915	.901	.976	.972	.976

The CFA results are indicated in Figure 17 below together with the standardised regression estimates from the study in Tables 56 and 57.

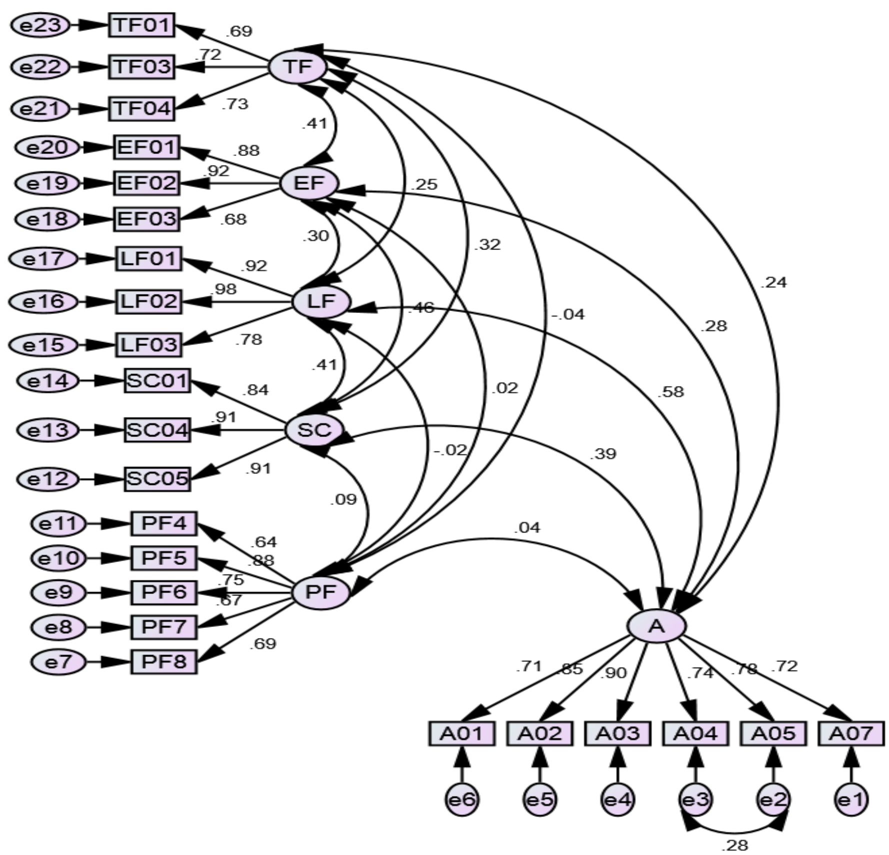


Figure 17: CFA measurement model for macro-environment dimensions

According to Table 55, 56, 57, and Figure 17, which are relevant to regression weights and standardized regression weights for the default model, **it can be stated that H_{3b} is supported** as shown in Figure 19. Based on standardised regression weights (Figure 17), the availability of malaria treatment therapies is mainly affected by legal dimensions (.58) followed by socio-cultural (.39), while political dimensions have no significant impact on the availability of ACTs.

Table 56: Regression Weights—Macro Environment

			Estimate	S.E.	C.R.	P	Label
A07	<---	A	1.000				
A05	<---	A	1.056	.083	12.742	***	
A04	<---	A	1.082	.089	12.096	***	
A03	<---	A	1.275	.086	14.749	***	
A02	<---	A	1.172	.084	13.869	***	
A01	<---	A	.997	.086	11.655	***	
PF8	<---	PF	1.000				
PF7	<---	PF	.994	.098	10.191	***	
PF6	<---	PF	1.110	.099	11.210	***	
PF5	<---	PF	1.307	.104	12.537	***	
PF4	<---	PF	.885	.091	9.678	***	
SC05	<---	SC	1.000				
SC04	<---	SC	.999	.045	22.155	***	
SC01	<---	SC	1.017	.052	19.453	***	
LF03	<---	LF	1.000				
LF02	<---	LF	1.252	.066	19.032	***	
LF01	<---	LF	1.201	.066	18.074	***	
EF03	<---	EF	1.000				
EF02	<---	EF	1.415	.109	12.987	***	
EF01	<---	EF	1.362	.106	12.887	***	
TF04	<---	TF	1.000				
TF03	<---	TF	.983	.108	9.124	***	
TF01	<---	TF	.913	.101	8.998	***	

Table 57: Standardised Regression Weights—Macro

		Estimate
	Availability	
A07	Rate of stock out	.722
A05	ACTs orders are always met by the supplier	.780
A04	ACTs issued meet the national quality standards	.742
A03	We always get the quantities we order for	.904
A02	ACTs ordered as and when needed	.846
A01	Stores timely delivers ACTs to user units	.713
	Political factors	
PF8	Surveillance or monitoring of ACTs stock by politicians	.692
PF7	Advocacy by politicians	.673
PF6	Verification of ACTs stock by politicians	.748
PF5	Awareness by politicians on talk shows	.883
PF4	Political support	.636
	Social –cultural factors	
SC05	Compliance to dosage	.907
SC04	Public attitude towards the lower health facilities	.909
SC01	Clicks within the community	.842
	Legal factors	
LF03	Regulating consumption	.783
LF02	Implementation of the clinical guidelines	.977
LF01	Implementing the testing and dispensing policy	.915
	Economic factors	
EF03	Cost sharing	.678
EF02	Availability of donor funds	.918
EF01	Poverty within the communities	.882
	Technological factors	
TF04	Use of rapid Diagnostic tools (RDT)	.729
TF03	Use of the M-track system	.720
TF01	Use of phones	.690

6.7 Analytic Hierarchy Process (AHP)

AHP was done to fulfil research objective 4 and question 4. Considering the volume of the dimensions that emerged, there was a need to know the order of importance of the parameters by answering the research questions. Although both EFA and CFA have a capability to manage and process a huge amount of data, they do not blend expert's opinion with factual evidence—therefore to solve the complex puzzle of the most influential variables, both EFA and CFA results were backed up with AHP analysis that involved expertize on the subject. This provided answers to the three research questions. The measuring variables of ACTs availability were subjected to AHP methodology to determine the most influential dimensions that need immediate attention. All the significant dimensions from CFA were presented to focus groups to rank the preference of each parameter against each other. Saaty nine-point scale was applied because it is an effective tool in solving complex decision-making, and setting priorities, while making the best decision.

6.7.1 Pair-wise comparison judgment matrices of main coordination dimensions

Table 58 and 59 show the ranking of critical supply chain (S), logistics (L), market (MKT), and macro (MA) environment dimensions—the consistency ratio was 0.03. Therefore, the results could be used to draw conclusions since CR value is less than 0.1. It implies that decision taken by experts is satisfactory for further analysis. The most influential factor was critical supply chain dimension (0.473), followed by logistics (0.336), while market environment (0.121) and macro environment (0.069) came last.

Table 58: Presentation of results: original judgments and priorities

	S	L	MKT	MA
S	1.00	1.33	5.50	6.00
L	0.75	1.00	4.80	2.88
MKT	0.18	0.21	1.00	0.40
MA	0.17	0.35	2.50	1.00

Table 59: Normalized results

S	0.4765	0.4615	0.3986	0.5837	0.473
L	0.3575	0.3462	0.3478	0.2802	0.336
MKT	0.0866	0.0721	0.0725	0.0389	0.069
MA	0.0794	0.1202	0.1812	0.0973	0.121

CR=0.03

6.7.2 Pairwise comparison of the critical supply chain coordination dimensions

To further rank the most influential parameters from the CFA model under (objective 1), supply chain, AHP was run on dimensions that loaded significantly towards availability of malaria therapies supply. Supply chain effect on the availability of ACTs was investigated with six strategic areas (Information sharing, Relationship management, Mutual Understanding, Responsiveness, Top Management, and Organisation dimensions) and their 21 sub-dimensions. Specifically, this was done through preference judgment matrices to establish the normalised weights of each item—to find the degree of consistency in the pair-wise matrices. Consistency

Ratio (CR) was calculated based on Saaty's Random index (RI) values. The results of AHP model are shown in Table 60. The step-by-step calculation of finding normalised weights and CR for strategic dimensions and sub-dimensions matrices are given in appendix 10. Upon examining the CR values, all the strategic dimensions and sub-factor had a CR ≤ 0.1—therefore data from focused was satisfactory to draw conclusions.

Table 60: Original priorities for critical supply chain coordination dimensions (SCCD)

	TM	RM	IS	MU	R	OF
TM	1.00	8.57	5.32	2.93	6.06	4.67
RM	0.12	1.00	0.28	0.20	0.46	0.27
IS	0.19	3.63	1.00	0.30	2.02	2.48
MU	0.34	5.02	3.35	1.00	4.28	4.83
R	0.17	2.19	0.49	0.23	1.00	3.00
OF	0.21	3.67	0.40	0.21	0.33	1.00

Table 61: Calculation of priorities: row averages for SCCD-Normalisation results

							Local weight
TM	0.494	0.356	0.490	0.602	0.428	0.288	**0.443**
RM	0.058	0.042	0.025	0.041	0.032	0.017	**0.036**
IS	0.093	0.151	0.092	0.061	0.143	0.152	**0.115**
MU	0.168	0.208	0.309	0.205	0.302	0.297	**0.248**
R	0.082	0.091	0.046	0.048	0.071	0.185	**0.087**
OF	0.106	0.152	0.037	0.042	0.024	0.062	**0.070**

CR=0.08

According to the results in Table 61, it is clear that more importance should be given to Top Management dimension or criterion (0.443), followed by Mutual Understanding (0.248), and Information sharing (0.115). Responsiveness, Organisation dimensions, and Relationship management followed in the same descending order. The CFA output is in agreement with the top two strategic dimensions—Top Management, and Mutual Understanding. Therefore, to improve the availability of ACTs through supply chain coordination, Top Management support, Mutual Understanding and Information Sharing are key ingredients towards the achievement of drug availability. This implies that Top Management contributes 44.3%, while Mutual Understanding and Information Sharing contribute 24.8% and 11.5% respectively in making ACTs available at local level. Furthermore, global weights for variables were calculated, Table 62. Global weights for latent variables (for example, TM01) were obtained by multiplying weight of supply chain (0.473, Table 59) with local weight of Top Management (0.443, Table 61), and then by the local weight of latent variable (Appendix 10-11).

Table 62 shows the global weightage of the strategic areas for critical supply chain coordination dimensions and it gives the global weightage of the sub-factors for the coordinated supply chain. Top Management commitment (0.213) was perceived to be most important dimension followed by the Mutual Understanding (0.0.119), Information Sharing (0.055); Responsiveness (0.042); Organisational Factors (0.034) and Relationship Management (0.017). These findings imply that to improve coordination in the supply chain, Top Management support is essential to take initiatives and implement them in the organisation. Such initiatives may involve developing mutual understanding and trust among all supply chain partners within the general hospitals. When there are mutual trust and understanding, then all members will try to synchronize operational and strategic decisions for their common goal to improve coordination in the supply chain. It will also help in sharing accurate and relevant information with each other. Among Top Management commitment sub-dimension, frequent feedback (0.086) was perceived to be most important followed by support for redistribution (0.061), support for CME (0.038), and provision of transport in times of emergency (0.028).

The second important strategic dimension was Mutual Understanding. Without Mutual Understanding among all members of the supply chain, coordination in the supply chain cannot sustain. Mutual Understanding will make members optimise supply chain goals. Among sub-factors of Mutual Understanding, shared goals among staff (0.068) were perceived to be most important sub-dimension, followed by mutual trust among chain players (0.026); communication of policy change (0.020), instructions on the use of ACTs. These findings imply that to improve ACTs availability mutual understanding built on trust, provision of timely feedback and communicating policy decisions must be enhanced. This will require creativity from top Management.

Table 62: Summary of global and local weights of for SCCD

Variable		**Local weight**	**Global weight**
Organisation factors measuring items		**0.070**	**0.034**
OF05	Issuance of local guidelines	0.349	0.012
OF08	Accountability for ACTs	0.553	0.019
OF09	Supervision within the hospital enhances	0.098	0.003
Top Management commitment		**0.443**	**0.213**
TM01	Frequent feedback on stock status from Top Management	0.402	0.086
TM03	Provision of transport in times of emergencies	0.133	0.028
TM09	Top Management support for redistribution	0.286	0.061
TM10	supports for CME (CMEs) for stock management	0.179	0.038
Responsiveness		**0.087**	**0.042**
R01	Scheduled issuance timelines by stores to other units	0.655	0.027
R03	Internal redistribution between units	0.270	0.011
R04	Efficient delivery timelines from Pharmacy	0.075	0.003
Mutual Understanding		**0.248**	**0.119**
MU03	Mutual trust among staff members	0.216	0.026
MU05	Shared goals among staff	0.568	0.068
MU08	Instructions on use of ACTs	0.050	0.006
MU10	Communicating of policy change to patients	0.166	0.020
Relationship management and Joint decision making		**0.036**	**0.017**
RM02	Good relationships among staff	0.539	0.009
RM03	Joint decision making during procurement planning	0.207	0.004
RM04	Good relationship of the hospital with her suppliers	0.098	0.002
RM05	Feedback loop with other units	0.156	0.003
Information sharing		**0.115**	**0.055**
IS01	Verbal communication during CMEs	0.428	0.024
IS03	Rx-solution	0.463	0.026
IS04	Information on stock cards	0.109	0.006

The third important dimension for coordination in the supply chain is Information Sharing among internal supply chain partners. The use of Rx solution (0.026) was most preferred, followed by verbal communication (0.024), and sharing information on stock cards (0.006). However, it was observed that in most general hospitals, IT tools are limited to stores and pharmacy sections. Responsiveness was the fourth important dimension of which scheduled issuance by stores ranked highest sub-dimension (0.027) followed by internal redistribution (0.011). The findings imply that general hospitals should enhance the flexible scheduled and where possible Top Management should allow internal redistribution whenever necessary.

Organisational dimensions or factors were the fifth influential dimension for making ACTs available in general hospitals. The most ranked sub-dimensions under this category are accounting for ACTs and issuance of local guidelines by all staff. Both organisation factors and Relationship Management scored least (0.070) and (0.036), respectively. Relationship Management did not meet the minimum criteria of consistency ratio (CR=0.341)—far above the recommended 0.1; therefore, it was dropped.

6.7.3 Pairwise comparison of logistics activities dimensions

As defined by Lai and Wong (2012), logistics is an integral part of the supply chain that involves planning, implementing, quantification, effective forwarding or reversing of goods, and services from source point to consumer point. All sectors involved in the distribution of malaria therapies, be NGO or central government, transportation and logistics share the biggest portion of operations—as agencies distribute drugs to and within the hospitals in Uganda. Therefore, improving logistics mechanism does not reduce the operation costs, but also can have a significant impact on the availability of ACTs in hospitals. In this objective 2, five global dimensions that might affect logistics of ACTs were tested. These included quantification, forecasting, dispensing, procurement, and storage. Among these, procurement and ordering had the highest weight—(0.417), followed by forecasting (0.290). Storage management and distribution of ACTs weightage was (0.159) while dispensing was at (0.098). Lastly, quantification of ACTs had a weight of 0.036 (Table 63-64). The CR value was within the allowable range (0.05).

Table 63: Original priorities for Entries for Logistics strategic dimensions

	SM	F	P	Q	D
SM	1.00	0.33	0.36	7.30	1.56
F	3.00	1.00	0.50	5.50	4.04
P	2.79	2.00	1.00	8.56	4.61
Q	0.14	0.18	0.12	1.00	0.25
D	0.64	0.25	0.22	4.00	1.00

Table 64: Normalisation of strategic dimensions of logistics

						Weight
SM	0.132	0.089	0.163	0.277	0.136	**0.160**
F	0.396	0.266	0.228	0.209	0.352	**0.288**
P	0.369	0.532	0.456	0.325	0.402	**0.417**
Q	0.018	0.048	0.053	0.038	0.022	**0.036**
D	0.085	0.066	0.099	0.152	0.087	**0.098**

CR=0.05

Table 65: Summary of global and local weights of strategic dimensions and sub-dimensions of logistics

		Local weight	Global weight
Quantification of ACTs		**0.036**	**0.012**
Q01	Totalled monthly consumption	0.200	0.002
Q02	Quantification taking into consideration of maximum–minimum stock levels	0.625	0.007
Q03	Quantification using information from the dispensing logs	0.047	0.001
Q04	Quantification taking into consideration of malaria seasons	0.128	0.002
Storage management and distribution of ACT stocks		**0.159**	**0.053**
SM02	Labelling	0.25	0.013
SM03	Verification of expiry dates	0.028	0.001
SM04	Stock cards	0.318	0.017
SM06	Monitoring of room temperatures	0.143	0.008
SM07	Medicine registers	0.097	0.005
SM09	Observance of minimum –maximum levels	0.164	0.009
Forecasting		**0.290**	**0.097**
F01	Estimating the average monthly consumption	0.697	0.067
F02	Forecasting based on disease patterns	0.077	0.007
F03	Forecasting using information from stock cards	0.225	0.022
Dispensing of ACTs		**0.098**	**0.033**
D02	Prior testing of blood	0.572	0.019
D03	Verification of prescriptions	0.253	0.008
D04	Clear instructions on medicine usage	0.079	0.003
D06	Verification of dispensing logs	0.095	0.003
Procurement and ordering of ACTs		**0.417**	**0.139**
PO1	Identification of needs	0.265	0.037
PO2	Annual procurement plans	0.159	0.022
PO4	Ordering based on approved budget	0.215	0.030
PO5	Adherence to delivery schedules by NMS	0.312	0.043
PO6	Requisitioning as per plan	0.049	0.007

Table 65 shows the global weightage of the main and sub-dimensions for logistics activities. Procurement and ordering of ACTs were perceived to be the most influential dimension (0.139). This was followed by the forecasting (0.097), storage management (0.053); dispensing (0.033), and finally quantification (0.012). These findings imply that to improve ACTs in general hospitals, in Uganda, procurement and ordering are essential based on adherence to schedules (0.043), identification of needs (0.037), and development of procurement plans since it is mandatory that all public entities develop procurement plans and implement them in the general hospitals.

Second in ranking was forecasting with a global weightage of 0.097. In Uganda's public sector, procurement of ACTs cannot take place unless an entity has determined future requirements. This is a mandatory requirement. Whereas forecast is never accurate, the dimension plays an important role in identifying the needs and estimating the average monthly consumption (0.067) using stock cards (0.022). When forecasts are accurate, then the general hospitals may avoid bullwhip effects along the supply chain. Forecasting was among the least ranked sub-dimension based on disease pattern (0.007). This may imply that general hospitals need to develop a reliable forecast, the logistics department needs to incorporate dimensions such as; budgets, consumption rate and seasonal trends. Based on such combined information, a trustworthy demand forecast can be developed.

Storage management and distribution was the third influential dimension. Among the sub-factors of storage and distribution are establishing updated stock cards (0.017); labelling (0.013), and observance of min-max levels (0.009). These findings imply that to improve ACTs availability, management should put in place mechanisms of professionally updating stock cards in a timely manner and with clear labels for ease of retrieval whenever required.

Dispensing was the fourth important dimension (0.033). Among the sub-dimension of dispensing perceived to be the most important is prior testing of blood (0.019), followed by verification of prescriptions (0.008). The others of equal importance are clear instructions on medicine usage and verification of dispensing logs (0.003). The implication is an enhancement of coordination from the outpatient department through the dispensing units. This requires joint monitoring and trust among the chain partners.

Surprisingly, quantification was the least scored as seen from the global weight (0.012). Among the sub-dimension that enhances ACTs availability is consideration of stock levels (0.007) coupled with monthly consumption and malaria seasons each at 0.002. The result can be explained by the fact that the procurement plan has to estimate the required quantities for a particular financial year.

6.7.4 Pairwise comparison of market environment dimensions

Among the strategic dimensions that might have an impact on the accessibility of ACTs in hospitals, under objective 3b, the market environment dimension was ranked least at 0.068 with a consistency ratio below 10% (Table 66 and 67). Market environment dimensions were ranked third in predicting the availability of ACTs. Market environment was measured using Information Sharing with suppliers (ISS), partnership training (CP), and SC interdependence with suppliers (SCI), and the relationship between lower health units (RH).

Table 66: Original priorities for market environment dimensions

	RH	ISS	SCI	CP
RH	1.000	0.103	0.185	0.398
ISS	9.709	1.000	2.570	7.240
SCI	5.405	0.389	1.000	8.000
CP	2.511	0.138	0.125	1.000

Table 67: Calculation of priorities: row averages for market–environment

					Weight
RH	0.0537	0.0632	0.0477	0.0239	**0.0487**
ISS	0.5213	0.6134	0.6624	0.4351	**0.5662**
SCI	0.2902	0.2387	0.2577	0.4808	**0.3059**
CP	0.1348	0.0847	0.0322	0.0601	**0.0792**

CR= 0.08

From Table 68 it can be observed that two sub-dimensions of market environment are Information Sharing with external stakeholders (0.038) and supply chain interdependence (0.021). Among the most influential subfactors is Information Sharing with external partners are online sharing of information (0.021) and regular exchange of information through hard copies (0.008). Regarding supply chain interdependence, routine monitoring and use of the personal mobile phone were most the influential dimensions affecting ACTs.

Table 68: Weights for strategic and sub-dimensions of market environment

		Local weight	Global weight
Information sharing with suppliers, MoH, Donors		**0.558**	**0.038**
ISS 01	Online sharing of information enhances ACT availability	0.547	0.021
ISS 02	Regular exchanges information using hard copies of reports	0.204	0.008
ISS 04	Sharing of weekly or monthly reports with other stakeholders	0.093	0.004
ISS 05	Holding of quarterly meetings with external stakeholders	0.156	0.006
SC interdependence with suppliers		**0.317**	**0.021**
SCI 02	Regular meetings with the supplier	0.078	0.002
SCI 04	Use of personal phone calls with NMS	0.234	0.005
SCI 05	Routine regional monitoring with stakeholders	0.552	0.012
SCI 06	Evaluation meetings with supplier	0.136	0.003

As concluded from EFA and CFA analysis, RH and CP dimensions had no significant effect on the availability of malaria therapies in hospitals—the same can be concluded from AHP analysis. Overall, of the two market environment dimensions, Information Sharing with external stakeholders was better ranked. Supply chain interdependence dimensions followed in the ranking. These two dimensions scored below 10%, with a combined effect of about 13%.

6.7.5 Pairwise comparison of the macro environment dimensions

From the study objective 3b, social-culture dimensions had the highest impact (0.478) towards the availability of ACTs in Uganda, followed by the economic dimensions (0.278). Technological dimensions influence the accessibility of malaria therapies by 0.127, while legal dimensions have a weight of 0.080 (Table 69 and 70). Surprisingly, AHP results indicate that the political dimension insignificantly influences ACTs availability in Uganda. Political dimensions scored least at 0.036.

Table 69: Original priorities for macro-environment dimensions

	LF	SC	EF	TF	PF
LF	1.00	0.14	0.20	0.50	4.00
SC	7.00	1.00	4.00	3.00	8.00
EF	5.00	0.25	1.00	4.00	7.00
TF	2.00	0.33	0.25	1.00	4.00
PF	0.25	0.13	0.14	0.25	1.00

Table 70: Normalisation results averages for macro-environment

						Weight
LF	0.066	0.077	0.036	0.057	0.167	**0.077**
SC	0.459	0.540	0.715	0.343	0.333	**0.484**
EF	0.328	0.135	0.179	0.457	0.292	**0.278**
TF	0.131	0.180	0.045	0.114	0.167	**0.126**
PF	0.016	0.068	0.026	0.029	0.042	**0.036**

CR=0.09

Table 71 shows the global weightage of both the strategic and sub dimensions areas for macro environment. Social-cultural dimension was ranked highest (0.057) followed by the economic factors (0.033), technological dimension (0.015) and least scored was legal framework (0.010). These findings imply that to improve ACTs availability, general hospitals must understand the context in which they are operating, the economic dynamics, technological factors and finally the legal framework governing the supply and distribution of ACTs. Social structures built around social networks may affect outcomes in either positively or negatively. Socially, medicines are critical inputs into healthcare, taking a significant proportion of the health budget for households and governments. Among the social culture sub-dimension, clicks within the community (0.040) is perceived to be most important subfactor followed by compliance to dosage (0.012), and public attitudes towards lower health centres (0.006). This implies that availability of medicines attracts patients to seek medical help from health facilities and in return, they become receptive to public health messages. This promotes trust and participation in health services. However, when the medicines and supplies are not available within the health facility, productivity of health workers is also affected.

Table 71: Summary of weights for sub-dimensions of macro environment

		Local weight	Global weight
Social–cultural dimensions affecting ACT availability		**0.478**	**0.057**
SC01	Clicks within the community	0.7	0.040
SC04	Public attitude towards the lower health facilities	0.097	0.006
SC05	Compliance to dosage	0.203	0.012
Legal framework and ACT availability		**0.080**	**0.010**
LF01	Implementing the testing and dispensing policy	0.333	0.0032
LF02	Implementing the clinical guidelines	0.354	0.0034
LF03	Regulating consumption	0.314	0.0030
Technological dimensions affecting ACT availability		**0.127**	**0.015**
TF01	Use of phones	0.3006	0.005
TF03	M-track system	0.6279	0.010
TF04	Use of rapid Diagnostic tools (RDT)	0.0715	0.001
Economic dimensions		**0.278**	**0.033**
EF01	Poverty within the communities	0.105	0.003
EF02	Availability of donor funds	0.297	0.010
EF03	Cost sharing	0.599	0.020

Second important strategic dimension is economic factors. Parenthetically, the health budget in Uganda is still below 15% of the total budget on health as required under the Abuja Declaration (MoH, 2015:27). Furthermore, in Uganda, ACTs are mainly subsidised by the Global Fund and implemented through the Affordable Medicines Facility-malaria (AMFm) High-level subsidies from the Global Fund are crucial in making ACTs widely available at affordable price. This implies that ACTs subsidies play a critical role in most endemic countries as seen from the global weightage (0.010). Otherwise left to unscrupulous vendors, they become prohibitively expensive in the retail drug stores from where many patients purchase them. ACTs subsidies are meant to inspire patients to demand the recommended medicines over cheaper but ineffective alternatives by reducing their prices. Better still, cost sharing was the most preferred option (0.020).

The third main dimension was technology uptake, therefore, aiding ACTs availability. This implies that technological transformation within the health sector should aim at integrating health care chains owing to the complex social change process. This may necessitate a shift in strategy, structure and control dimensions. Use of M-track is the most influential sub-dimension (0.010). The second subdimension is the use of phones (0.005) and the least ranked is the use of rapid diagnostic tools (0.001). Increasing the availability and uptake of rapid diagnostic tests (RDTs) for malaria could help reduce irrational usage of ACTs and hence improve its availability.

The fourth important dimension is legal framework. Implementing clinical guidelines (0.0034) was perceived to be most important sub-dimension, followed by implementing testing and dispensing policy (0.0032); and regulating consumption of ACTs (0.0030). These findings imply that to improving ACTs availability, strong regulatory enforcement of policies and procedures (that is, detailed guidelines for implementing policies) is required to safeguard the interests of the patients or users' policies put in place must be adhered to.

To choose the best coordination dimension from the analysis above, a hierarchy modelling the supply chain coordination dimensions for ACTs was constructed as seen in Figure 18. Each of these hierarchies was decomposed into specific items in terms of which decision alternatives could be beneficial in making ACTs available in general hospitals in Uganda.

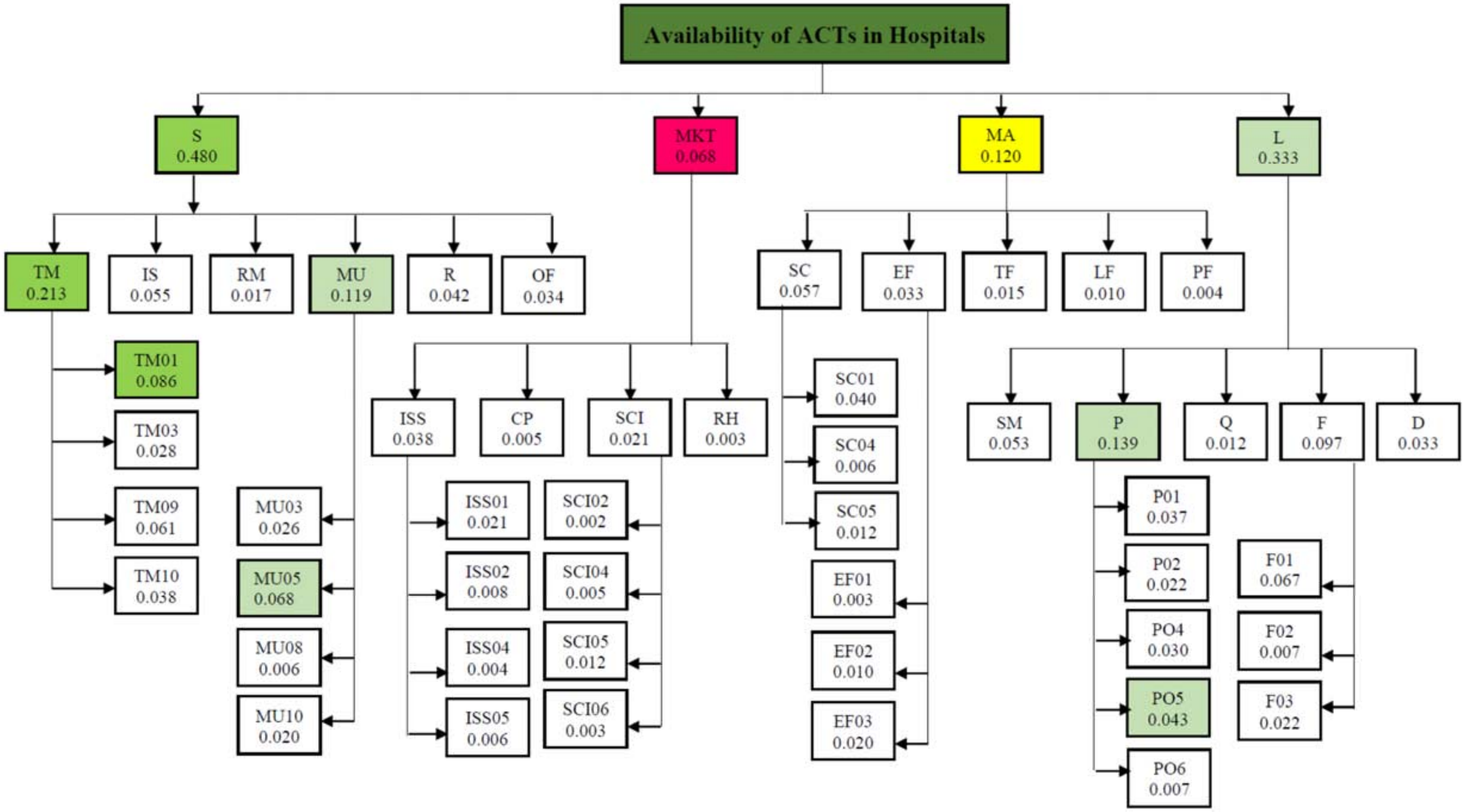


Figure 18: Hierarchy of influencing parameters

S: Supply chain, MKT: Market, MA: Macro, L: Logistics, TM: Top Management, IS: Information sharing; RM: Relationship management, MU: Mutual Understanding, R: Responsiveness, OF: Organisation factors, SC: Social–cultural, LF: Legal framework, TF: Technological, EF: Economic, PF: Political, ISS: Information sharing, SCI: SC interdependence, CP: Collaboration, RH: Relationship, SM: Storage management, P: Procurement, Q: Quantification, F: Forecasting, D: Dispensing

Most critical factors: Critical factors: Average impact: Less impact

6.8 Chapter summary

This chapter presented findings from the quantitative phase of this study based on the 140 variables of the structured study. It illustrated the demographic characteristics of the samples under study. In addition, the results of EFA and CFA, together with tests on the model and the testing of hypotheses using standardised regression weights based on the data from the main study were also presented. The first sections of the chapter analysed general information pertaining to the respondents. This was followed by normality tests before running the EFA. This study was conducted with the purpose of developing supply chain coordination framework for malaria treatment pills in general hospitals in Uganda.

Interestingly, findings supported the notion that the critical supply chain coordination dimensions; Responsiveness and Information Sharing were more salient than Top Management although the duo had a significant and positive direct effect on making malaria treatment pills available in general hospitals in Uganda. The logic may well be that Responsiveness reinforces and potentially is an antecedent to Top Management's commitment. Under the logistics activities, dimensions of dispensing and quantification had a strong positive direct effect on availability of malaria treatment pills in general hospitals in Uganda. Conversely, under the market environment, notable dimensions included supply chain interdependence with suppliers and Information Sharing with suppliers, donors and MoH, had the greatest effect on making malaria treatment pills available in general hospitals in Uganda. Finally, it was established that under the macro-environment dimensions that legal frameworks and technology had a significant and positive direct effect on making ACTs available in general hospitals in Ugnada. Based on the regression weights and standardised regression weights for the default model, it can be stated that H_1, H_2, $H_{3a,}$ and H_{3b} are supported and accepted.

Considering the model in Figure 19, the hypothesis that was derived to test the direct link between critical supply chain coordination and ACTs availability revealed significant results and therefore supported. Furthermore, hypotheses derived from the links logistics activities, management environment and ACTs availability were also supported. The framework appears to be useful for general hospitals in Uganda. Furthermore, it is applicable to supply chain members at all levels of within the hospital setting. This sort of generalisability should enhance the availability of ACTs to abate death. Under AHP section, the supply chain coordination dimensions for availing ACTs as derived from the CFA goodness of fit model were prioritised. This was done using one of the MCDA techniques. Specifically, the AHP was used to compute weights (ranks) of each parameter with respect to others under objective 4. Top Management dimension or criterion, procurement & ordering, Information Sharing with external stakeholders, and social-culture were the most critical dimensions under supply chain coordination dimensions, logistics activities dimensions, market environment dimensions, and macro environment dimensions, respectively.

CHAPTER SEVEN

SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This chapter presents the summary of findings and discusses the findings presented in the two preceding chapters. This chapter starts with a recap of the main research objective, secondary objectives, main research question and secondary questions. This is followed by a discussion of research questions and hypotheses in Section 7.3. Under 7.4, the study presents the summary and discussion of hypotheses and statistical tools used while 7.5, the summary of the main research objective is presented. Hereunder, the supply chain coordination framework for malaria treatment pills (ACTs) is subsequently presented followed by the implications of the study.

7.2 Research objectives and questions

The main aim of this study was to develop a supply chain coordination framework for malaria treatment therapies (ACTs) in General hospitals in Uganda. This main objective was further studied through several secondary objectives:

7.2.1 Research objectives

In order to achieve the main objective, the following secondary research objectives were used:

i. Examine how the critical supply chain coordination dimensions affect ACTs in the general hospitals in Uganda.
ii. Assess how logistics activities dimensions affect supply chain coordination of ACTs in general hospitals in Uganda.
iii. Critically analyse the management environment dimensions that affect supply chain coordination of ACTS in general hospitals of Uganda.
iv. To determine the most critical supply chain coordination that emerges from objective i, ii, and iii.

7.2.2 Research questions

The main research question that defined the study was: What is the appropriate supply chain coordination framework for malaria treatment therapies (ACTs) in general hospitals in Uganda?

The main question was operationalised into four secondary research questions as indicated below:

i. How do the critical supply chain coordination dimensions affect the availability of ACTs in general hospitals of Uganda?
ii. How do the logistics activities dimensions affect supply chain coordination of malaria of ACTs in general hospitals of Uganda?
iii. How do the management environment dimensions affect supply chain coordination of ACTs in general hospitals of Uganda?
iv. What is the most critical supply chain coordination that emerges from object i, ii, and iii?

The information obtained from the above questions (i, ii, iii) assisted in developing a measurement instrument (survey tool) for supply chain coordination incorporating critical supply chain coordination, logistics activities and management environment dimensions. The data from the instrument were later analysed to answer question iv.

7.3 Discussion of research questions and hypotheses

In order to achieve the main objective, three secondary research questions and hypotheses were probed as stated in section 7.2 and discussed below.

7.3.1 How do the critical supply chain coordination dimensions affect availability of ACTs?

In line with question 1 and 4 and attendant hypothesis, the following was discovered. Under this objective, the relationship between critical supply chains as a determining factor for the availability of ACTs in Uganda was assessed. CFA results support hypothesis H_1 that "The critical supply chain coordination dimensions correlate positively with ACTs availability in district general hospitals in Uganda". The main factors that influence the availability of ACTs via critical supply chain are Top Management, Mutual Understanding, and Information Sharing as summarised in the table below.

Table 72: Summary of critical supply chain dimensions

CFA results	Sub dimensions	AHP results	Sub dimensions
1. Top Management commitment	• Frequent feedback on stock status • Redistribution • Provision of transport	**1. Top Management commitment**	• Feedback on stock status • Support for CME • Support for redistribution
2. Mutual Understanding	• Communicating of policy change to patients • Clear instruction to use of ACTs	**2. Mutual Understanding**	• Shared goals among staff • Mutual trust among staff
3. Relationship management	• Joint decision making • Feedback loop	**3. Information sharing**	• Verbal communication during CMEs • Rx Solution
4. Information sharing	• Rx Solution • Use of Stock cards	**4. Responsiveness**	• Scheduled issuance by stores • Internal redistribution
5. Organisation dimensions	• Accountability for ACTs • Issuance of local guidelines	**5. Organisation dimensions**	• Accountability for ACTs • Issuance of local guidelines
6. Responsiveness	• Internal redistribution • Efficient delivery by pharmacy	**6. Relationship management**	• Good relationships among staff • Joint decision making during procurement planning

7.3.1.1 Top management commitment

The results from both CFA and AHP findings indicate that Top Management commitment was the most important dimension. Both outputs indicate that the most important sub-dimensions were the provision of feedback on stock status and transport in times of emergencies, support for redistribution and support for CME. It takes good Top Management to build great teams that can work mutually and coordinate well to achieve the objective of the supply chain in any business—be it private or government. Top Management that are afraid of making difficult decision or establish levels of performance that must be met find it hard to make supply chain a success. When Top Management gets to know the core understanding of the staff, other dimensions like Mutual Understanding and Responsiveness that affect the supply chain can easily be achieved. Building a strong supply chain to meet the demands of ACTs is an art and science that Top Management has to learn in order to make malaria therapies available in hospitals.

7.3.1.2 Mutual understanding

The second most important sub-dimension from CFA, regression, and AHP results was mutual understanding (MU). When asked to rank the presence of Mutual Understanding items, shared goals among staffs weighted highest at 0.568 followed by mutual trust among staff members (0.216). This could be because staff believe they know what they are doing based on their job descriptions and open communications. Mutual understanding is linked to appreciation of organisational strategic goals and building of trust among supply chain members as supported by Boswell (2006:1504). It is crucial that employees understand how to contribute to the organisation's strategic goals and in so doing they are likely to feel a sense of belonging (or fit), perhaps since they are better able to work in alignment with the firm's needs. The foundation on which teams are built is mutual understanding, which makes workmates trust each other; without trust, not even top management commitment can make the availability of products a success (Katsikeas, Skarmeas, & Bello, 2009).

The findings are consistent with previous studies which indicate that successful implementation of supply chain activities requires members to mutually understand each other, plan jointly and agree on the effective implementation of the required services and products (Arshinder *et al.,* 2009; Kumar, Singh, & Shankar, 2015). To achieve mutual understanding, the team members should have shared goals among themselves. Lack of shared aims can make supply chain engagements impossible and turning things around can be devastating. To improve the availability of ACTs, members of the supply chain should trust each other, develop a common vision, and design collaborative replenishing decisions. Therefore, top management should align the objective and goals with mutual interests of the team. However, shared understanding is equally important though not a sufficient condition to bring about the desired performance among supply chain actors, especially in the absence of shared goals and mutual respect among actors (Gittel, 2011). Unfortunately, extant literature on supply chain coordination implicitly assumes that supply chain members either absolutely trust each other and cooperate when sharing forecast information, or do not trust each other at all (Özer, Zheng, & Chen, 2011). Notwithstanding the aforesaid, when trust is established, joint forecasting of demand becomes possible between partners. This eases modification of orders whenever necessary and minimises frequency of stock-outs (Dudeck & Stadtler, 2005; Simatupang *et al*., 2005).

7.3.1.3 Information sharing

With trust and mutual understanding, information sharing becomes a frictionless surface in achieving availability of drugs in any hospital. It was observed that information is shared mainly through proper management of stock cards. However, in absence of ICT systems to support this, along with the automated processing of orders, rapid replenishment may remain a dream. From the survey data, Rx-solutions, and verbal communication weighted 0.463 and 0.428, respectively. The Rx Solution is Uganda's future logistics management system. The software supports best practices for quantification, supply chain-management and storage. However, the implementation of IT technologies will be hindered by poor IT infrastructure, limited IT skills within the public entities, unstable power supply (Yang, 2011), especially in rural-based general hospitals, which may hinder real-time sharing of information among external stakeholders. Through verbal communications, awareness can be improved, therefore creating knowledge sharing about the supply of ACTs. Although stock cards are considered as a good tool to improve ACTs availability, the implementing agencies should consider replacing it with the digitised system—the world has shifted to the digital age, making the use of physical cards time consuming and it becomes hard to track the levels of available drugs. Therefore, as the government is trying to improve supply chain to have malaria therapies in hospitals, digitalising the stocks should be considered as a long-term goal that will ease information sharing among hospitals.

A good information system should aim at gathering seamless data, organise it, analyse and produce timely and accurate reports to decision makers so as to evaluate the how supplies flow, account for products, reducing supply imbalances, and improve efficiency (Chen, 2013; Pinna, Carrus & Marras, 2015). Together with information technology and business practices, coordination becomes easier (Ebrahim-Khanjari, Hopp, & Iravani, 2012). Mutual exchange of information on products, processes, schedules, and capabilities helps supply chain members to develop timely, accurate, and complete delivery plans for the product, therefore improving delivery responsiveness (Flynn, *et al.,* 2010; Singh, 2011). It also improves accuracy of demand information for products and stock levels in real time and the extent of need (Mikkelsen-Lopez, Cowley, Kasale, Mbuya, Reid & de Savigny, 2013; Gittel, 2011). By so doing, the bullwhip effect, as a result of distorted information from one end of a supply chain may be reduced (Lee, *et al,* 2015).

7.3.1.4 Responsiveness

Responsiveness was ranked fourth as a factor that affects the supply of ACTs. Although its weightage was low at 0.087, the ability of any system to react to any change is paramount. Adjusting to the current needs and demands of the society is a key pillar for the survival of any business, be it public or private. As a result, responsiveness is emerging as a keyword mantra to define the ways organisations survive the tidal wave of making ACTs available to the last consumer. While studying the supply chain agile manufacturing, Gunasekaran, Lai and Edwin Cheng (2008) found Responsiveness a key driving factor. Moreover, responsiveness enables supply chain members to respond swiftly to customer requirements through identification of changes in supply and demand (Turkyilmaz, et *al*., 2015:1-2). Responsiveness to customers and markets is an indispensable requirement for all sectors (Moyano-Fuentes, Sacristán-Díaz, & Garrido-Vega, 2016). Drawing on a review of the extant literature, we argue that swiftness is a critical antecedent to responsiveness in firm performance (Chan, Ngai, & Moon, 2017). However, without supply and demand information on ACTs, the reality is far-fetched. This means supply chain actors must be integrated to create the desired visibility through some information technology tools.

7.3.1.5 Organisational factors

Under AHP, organisational factor dimensions scored second last at 0.070. The low ranking of organisational dimensions is that general hospitals like all public entities have bureaucratic systems making the top management to drive and predict the way forward, with little or no contribution from the lower level management. According to Speroff et al., 2010), bureaucratic organisational culture is less favorable to quality improvement, whereas organizations with group (teamwork) culture are better aligned for quality improvement.

As a result, some malaria therapies may expire at the main centre. Among the organisational dimensions, accountability of ACTs scored best (0.553). In the supply chain, accountability has been a significant dimension that promotes performance in any organisation. While evaluating the impact of accountability on organisational performance in the United States of America, (Han & Hong, 2016) made a similar observation. Therefore, as the government is promoting different mechanisms to make ACTs available, the leaders should be held accountable for each therapy supplied.

7.3.1.6 Relationship management and decision making

Relationship management scored least at 0.036. The reason could be because buyers tend to focus more on relationship outcomes while suppliers look to safeguard their transaction specific investments through information sharing and joint relationship effort (Nyaga, Whipple, & Lynch, 2010). Whereas joint decision-making requires trust and flow of information among the supply chain members, scholars stress the need to understand human systems and their complexities (Kohli & Jensen, 2010; Fawcett, Magnan & McCarter, 2008). Another scholar points to failure to conduct regular collaborative meetings among chain partners. The better the relationships, the higher the reporting rates, which in turn may contribute to better decision-making at the planning level (Vledder *et al*., 2015). Unfortunately, in Uganda, decision makers in the pharmaceutical sector at times 'feel lost and perplexed' in the midst of too much information prompted by the opportunities brought by information technology using internet and the computer technologies. Unfortunately, even with these technologies managers remain incapable of making effective decisions (Ohairwe, Basheka, & Zikusooka, 2015).

7.3.2 How do the Logistical Activities Dimensions affect Availability of ACTs?

This section discusses the findings of question 2 and 4 and the hypothesis test. The CFA results indicated that logistical activities promote ACTs availability, lending support to hypothesis H_2. This is consistent with Badenhorst-Weiss and Waugh's (2014:284) argument that logistical activities are an important component of service delivery in a swift, safe, flexible, and reliable manner. The most critical parameters that influence the availability of ACTs under logistics dimensions are procurement and ordering, forecasting, and storage management. Table 73 below summarises the CFA and AHP findings.

Table 73: Summary of logistics dimensions

CFA results	Sub dimensions	AHP results	Sub dimensions
1. Quantification	• Consideration of malaria seasons, • information from dispensing logs, • maximum-minimum levels and monthly consumption	**1. Procurement and ordering**	• Adherence to delivery schedules • Identification of needs • Procurement according to budget
2. Forecasting	• Stock cards • Disease patterns • Estimating monthly consumption.	**2.Forecasting**	• Average monthly consumption • Stock cards • Disease patterns
3. Store management	• Labelling, • verification of expiry dates, • updated stock cards, • monitoring temperatures, • medicine registers	**3.Storage management and distribution of ACTs**	• Use of stock cards • labelling • Mini-maximum levels • Monitoring room temperatures
4.Procurement	• Needs identification, • developing of procurement plans, • approved budgets, • adherence to delivery schedules and; • requisitioning per plan	**4.Dispensing**	• Prior testing of blood. • Verification of prescription • Verification of dispensing logs.
5.Dispensing	• Prior testing of blood	**5.Quantification of ACTs**	• Average monthly consumption

CFA results show that quantification, procurement, storage, and warehouse management had more impact on ACTs' availability in general hospitals in Uganda. On the contrary, AHP results indicate that procurement was the most influential logistics dimension.

7.3.2.1 Procurement

From the AHP results, procurement was ranked the most important logistic activity. The results are explained by the fact that public sector procurement in Uganda is regulated by the Public Procurement and Disposal of Public Assets Authority (PPDAA) and all procurements must be planned for to ensure an uninterrupted supply at all levels of the system in line with the available budget (Hakiza & Basheka, 2012:800). This is challenging because the reality is that general hospitals are not autonomous. In essence, MoH appropriates budget decisions for ACTs and other medicines on the advice by NMS. Iqbal, Geer and Dar (2016:18) have observed that procurement of medicines must be systematic and should be built on conventional scientific principles that ensure the availability of right medicines in the right quantities, at reasonable prices, and at recognised standards of quality.

The results indicate that adherence to deliveries was the most ranked sub-dimension scoring 0.417. When the general hospitals develop the procurement plans for the therapies, it is NMS's responsibility to develop and share the delivery schedules; this can solve the problem of stock-out—therefore availability of ACTs. Stover (1970:70), for instance, proposed scheduling or timetabling as a coordination dimension although it may lead to misunderstandings because people may think that their lives are managed by the standard time. However, planned processes and structures may change because of shocks in the environment and planned structures may fail to account for the eventualities in the performance of tasks. Studies on coordination in different organisational contexts have advocated the use of plans based on pre-established schedules, routines, and rules (Thompson, 1967:56).

Identification of need was the second-high sub-dimension under procurement at 0.265. This is upheld by the fact that majority of DTMC teams are cross-functional in nature with a wealth of knowledge and skills in identifying ACTs' requirements. The implication is that when the procurement strategies in a firm are operationalised by persons who have the required knowledge and skills, the desired outcomes will be realised, therefore improving ACTs availability. This sub-dimension was closely followed by budgeting (PO4: Ordering based on approved budget enhances ACTs availability—0.215). Spending within the budget helps the planners to know the regions with deficit supply so that adjustments can be made within the financial year. In Uganda, public procurement must start with planning, which is a critical and mandatory function that takes place in complex political, economic, cultural, religious, environmental, technological, and ethical environments (Hagen, 2017). However, if not well managed, it becomes a major source of conflicts, especially when the expected needs for a given financial year are neither forecasted nor coordinated. The challenge is the application of the principles of evidence-based medicine consumption and budget availability analysis, which is critical in the decision-making process in determining what and how much to procure leading to effective medicines selection.

7.3.2.2 Forecasting

Forecasting was the second most ranked parameter by the experts. This is the first activity within the healthcare logistics cycle followed by quantification. To develop a reliable forecast, the logistic department needs to incorporate dimensions like seasonal trends, resource envelop, consumption rate; based on such combined information, a trustworthy demand forecast can be developed. However, extreme care must be followed since no forecast is accurate; it is based on someone's experience and knowledge because any change in the governing pillar of the society (political, social and economic) can drastically affect the forecast. Conversely, Kasapoglu (2016:3); (MoH Report, 2011) and Kamuzora (2011:5) assert that the challenge with medicine forecasting is relying on inaccurate dispense-to-user data from previous months from the health facilities, poor planning, and forecasting the future needs of a facility.

When asked to weigh the preference of forecasting sub-dimensions, estimating the average monthly consumption was ranked number 1, at 0.697. The implication is that coordinating the availability of malaria therapies at different centres in the country, monthly estimates are key in developing the country's yearly consumption. Monthly consumptions are able to show the seasonal trend for each medicine, including ACTs. To have correct monthly consumptions, stock cards are fundamental since many hospitals lack centralised IT systems for inventory counting. Forecasting using stock cards weighted 0.225. A similar observation was made in Cabo Delgado, Mozambique (Hasselback *et al.*, 2014). Forecasting based on disease pattern was the least loaded item under forecasting at 0.077. From the focused group discussion, this is attributed to the fact that malaria cases have the same pattern with almost insignificant variation. However, Kasapoglu (2016:3) argues that there is no superior forecasting technique since most of them are prone to errors and the forecasting technique cannot be generalised for all the hospitals or individual departments. Nonetheless, policy makers should encourage monthly stock taking with stock cards for this will improve the ACTs availability in hospitals. Even in the presence of best procurement and forecasting team, poor store management makes the availability of ACTs difficult. However, there needs to be a coherent approach, providing an opportunity to engage with all stakeholders, to reduce wastage (Perumal-Pillay & Suleman, 2017:7). Furthermore, the products selected should support the diagnosis and treatment of the most prevalent diseases, be safe and effective, meet basic standards of quality, demonstrate a favourable cost-benefit ratio in terms of total treatment cost, and have adequate scientific evidence of performance in a variety of medical settings (Ministry of Health and Social Welfare of Liberia, 2010: 2).

7.3.2.3 Storage of ACTs

A store is a place where incoming materials (medicine) are kept until they are needed. The store should have enough buffers to cater for the demand between ordering and receiving the order—the ideal stock level for every medicine must be maintained at a level that each hospital can get the necessary quantity without tying excess capital. When stores are managed well, any drastic change in demand can easily be absorbed. Medicines have expiry dates and keeping them in the store has a cost attached to it; therefore, the overall goal of a store should be to minimise stocks while keeping short life-span medicine in balance. Under storage management, stock cards were ranked number one item (0.318) in improving the availability of ACTs in hospitals. A store card is like a communication gadget for any store manager. For countries like Uganda that are still using the traditional way of counting stock, cards are extremely important in monitoring the in-flows and outflows. It is important that pharmaceuticals in pharmacy premises are stored well till they reach the consumer. The loss of potency during storage may influence the efficacy and safety of pharmaceuticals. Pharmaceutical products require controlled storage and transit conditions in order to ensure that their quality is not compromised. Storage is an important aspect of the total drug control system. Proper environmental control that is right humidity, light, temperature, ventilation, conditions of sanitation, and segregation must be maintained wherever drugs and supplies are stored in the premises (Shafaat, *et al.*, 2013; Iqbal *et al.*, 2017: 81). Therefore, the Hospital Stores Manager must establish efficient inventory system policies for normal operating conditions that also ensure the hospital's ability to meet emergency demand conditions (Schöpperle, 2013).

Labelling of drugs improves stock card usability (weight: 0.250). Most people working in the stores are not aware of the medical names given to different malaria therapies; therefore, labelling the medicine with universal codes that can be understood by everyone is key to monitor drug levels in stores. With well-documented stock cards and labelling, the store manager can easily observe the minimum stock of every therapy, observing the least level can improve ACTs availability by 0.164 under storage management dimension. The findings are consistent with Khurana, *et al*., (2013:9); Kritchanchai and Meesamut (2015:19) and Kritchanchai and Suwandechochai (2010:211) who theoretically suggest that inventory techniques are critical in enhancing product availability and quality. However, manual systems are tedious and time-consuming. Among the sub-dimensions that scored above 10% was monitoring the room temperatures of the stores, with a score of 0.143. This sub-dimension (temperature) was dropped because it did not meet the criteria. Unfortunately, in a study conducted by MoH in FY 2012/13 on the physical condition of medicine stores in all public hospitals, most hospitals lack appropriate infrastructure, thereby compromising the quality of medical supplies.

7.3.3 How do the market environment dimensions affect ACTs availability in general hospitals?

This section discusses the findings of question 3a and 4 and attendant hypothesis in line with market environment. The results of CFA support the hypothesis H_{3a}, “The market management dimensions correlate positively with ACTs’ availability in District general hospitals in Uganda”. This suggests that market environment dimensions promote ACTs availability. From AHP analysis, the most influential parameters that affect the availability of ACTs include; Information Sharing with external stakeholders, and supply chain interdependence. Table 74 below summarises the major factors that influence ACTs availability in relation to market environment.

Table 74: Summary of market environment dimensions

CFA results	Sub dimensions	AHP results	Sub dimensions
1. Supply chain interdependence (SCI)	• Regular regional monitoring • Use of personal phones	**1. Information sharing with external stakeholders (donors & MoH and NMS).**	• holding a quarterly meeting with external stakeholders
2. Information sharing with donors & MoH (ISS).	• Quarterly meetings • Sharing of weekly or quarterly reports	**2. Supply chain interdependence (SCI)**	• regular communication with suppliers

The market environment had two sub-dimensions. CFA outputs show that there was a direct relationship between market environment dimensions (supply chain interdependence and Information Sharing with external stakeholder) and ACTs availability in general hospitals in Uganda.

7.3.3.1 Information sharing

AHP results indicate that Information Sharing (holding a quarterly meeting with external stakeholders) was the best-ranked parameter. This is followed by supply chain interdependence, of which regular communication with suppliers was most the most preferred sub-dimension. The strong impact is attributed to a strong culture of coordination in this sector, where integration and networking is supported and reinforced by government bodies funded by international donors to reduce the incidence of unavailability if the UHC is to be achieved in the near future.

Watsierah and Ouma (2014) assert that within the market environment, many actors and organisations have to interact with one another (suppliers, manufacturers, wholesalers, and retailers), proactively coordinating through regular meetings, and developing educational plans. Furthermore, Asamoah, *et al*., (2011) proposed the need for a well-built coordination framework to tackle ACTs complex partnerships and subnational programmes – hence the rationale for sharing critical information between the general hospitals and external stakeholders. Adequate attention is required since issues regarding delivery of services or products are best answered through coordination of employees, resources, and ideas from different stakeholders.

However, at the national level, the existing logistics management information system (LMIS) in Uganda is predominantly paper-based (USAID, 2011). To a lesser extent, computerised inventory management systems have been introduced in about one-third of the hospitals. While NMS is fully computerised, there is currently no linkage between the health facility logistics systems and the central warehouses. This scenario inhibits availability, analysis and sharing of pharmaceutical information between users at all levels. Information Sharing is an important dimension for coordination and integration of the processes or activities along the supply chain. Singh (2013) points that in order to fulfil customer requirements in the supply chain, it is vital to manage the flow of information associated with the movement of products (goods or services) to the final customer. In addition, general hospitals share information probably not mainly because of trust, commitment or reciprocate reasons, but more importantly because stakeholders provide important and critical resources for which there are few alternative sources of supply. The other sub dimensions–collaborative partnerships and relationship between lower health units were dropped.

In Uganda, hospitals that are informed of the changes in supply related issues are more likely to have medicines in stock than those that are not informed by the suppliers. Or else contingency measures have to be put in place to cater for the gaps created by the change, especially those hospitals with no such notifications who are usually taken unawares. Most importantly, sharing information in advance by NMS mitigates gaps during planning for any probable delays that may occur in the supply chain. With increasing demand for good governance, transparency, and accountability from development partners, regular information sharing has become more relevant than ever before. Therefore, it is important that hospitals, MoH, Districts, and NMS enhance their level of information sharing in order enhance the effectiveness of the supply chain as they endeavour to make ACTs available to the patients.

7.3.4 How do the macro-environment dimensions affect ACTs availability?

This section discusses question and hypotheses 3b and 4 for macro-environment. Under macro-environment, the availability of ACTs was accessed via political, legal, economic, socio-cultural, and technological factors. The macro-environment dimensions show how ACTs availability is influenced at country or region level and how the population of a given location react towards the system. According to hypothesis results, H_{3b} was accepted "The macro environment dimensions correlate positively with ACTs' availability in District general hospitals in Uganda". AHP shows that socio-cultural dimensions, economic and technological factors influence the availability of ACTs more. Table 75 summarises the most influential factors of macro environment.

Table 75: Summary of macro-environment dimensions

CFA results	Sub dimensions	AHP results	Sub dimensions
1. Legal	• Clinical guidelines • Testing policy	**1. Social - cultural**	• Clicks within the community • Compliance with dosage
2. Social - Cultural	• Compliance with dosage • Social clicks	**2. Economic**	• Cost sharing • donor funds
3.Economic	• Cost sharing • Donor funds	**3. Technological**	• M-track • Use of phones
4.Technological	• Use of RDTs • M-track	**4. Legal**	• Implementing clinical guidelines • Implementing testing and dispensing policy • Regulating consumption

7.3.4.1 Political dimension

From both CFA and AHP results, political dimensions had the least impact on ACTs' availability. This is explained by the fact that politicians politicise the ACTs for their own political expediency and in turn affect the conceptualisation, design, operationalisation, and assessment of supply chains. At the time of data collection, the medical practitioners were on a sit down strike demanding for better working conditions and better pay. Therefore, the respondents could not express their views about politics directly. However, results show a bias against politicians whom the experts claimed to be interfering in the hospitals' operations for political capital. Overall, as defined by Park *et al*., (2017), a politician is a person who has the capacity to influence others and make them act in the desired way. However, the politicisation of drug supply can lead to conflicting objectives and lack of coordination among participating parties. While there is considerable involvement of different stakeholders, there is a need for political will to drive the process of coordinating the supply chain for successful implementation and integration of the processes. Despite the finding, politically medicine attracts a high level of political interest owing to its high economic value, the large public and private investment and its impact on the health and well-being of society. Consequently, many pharmaceutical issues are high on the political agenda of society, being the subject of intense political and trade discussions in forums such as the World Health Assembly, the World Trade

Organisation, as well as in bilateral and multilateral trade negotiations (Ministry of Medical Services & Ministry of Public Health and Sanitation, 2010:11).

7.3.4.2 Social-cultural dimension

AHP results indicate that among the macro factors, the socio-cultural dimension was the most influential dimension impacting ACTs availability. This may have either a positive connotation in terms of seeking medical attention or negative connotation (wanting to be issued with ACTs even when not sick). This is linked to the society's basic values, preference, and behaviour affecting the accessibility of malaria therapies. Gender, age bracket, clubs, and location that shape someone's beliefs and values can influence the preferences. Failure to understand these dimensions can lead to a blunder in malaria therapies supply. The perspective of a group to which someone subscribes influences their present and future decisions in using ACTs—a change in one situation causes a different impact. Social networks create trust or confidence that others will do the "right" thing (Granovetter, 2005:33). The resultant effect is the formation of closely-knit cliques, connected to each other through their weak rather than strong ties. Such ties determine the extent of information diffusion in large-scale social structures. Cohen, Cox, Dickens, Maloney, Lam, and Fink, (2015:1) assert that in most malaria-endemic countries such as Uganda, presumptive treatment for malaria is based on symptoms rather than a rapid diagnostic blood test (RDTs).

Impact of clicks on the availability of ACTs scored highly (0.700) compared to other parameters that measured socio-cultural dimensions. In Uganda, there is a culture of seeking medical attention after having serious bouts of malaria—this is rooted in the culture of using herbal medicines. In Uganda, more than 60% of the population depend on herbal medicines—for every 400 people, there is a herbalist (Kamatenesi-Mugisha & Oryem-Origa, 2005); comparing this to western countries (1:20,000), the odds favour traditional medicine usage. The flooding of Asian drugs on the market further escalates this situation. In addition, regardless of their availability, herbs are too cheap compared to the ACTs. Therefore, as people continue to associate themselves with such norms and clicks that do not encourage malaria treatments from recognised hospitals, the situation will continue to be worse—even if the stores are full of ACTs. There is a direct link between poverty and malaria (Gallup & Sachs, 2001). Malaria therapies are special products because of their peculiar supply and demand.

Therefore, in some countries, the importation and distribution are heavily regulated to ensure affordability and consumer safety.

7.3.4.3 Economic dimension

Expert groups ranked donor funding and cost sharing as the best ways to solve the problem, with the later weighing 0.599. Unavailability of ACTs is a general problem for many drug supply chains in countries with limited financial support from donors. With the decline in funding, developing countries have seen a decline in ACTs. This could probably explain why experts perceived cost sharing as the best option to embrace in improving health systems in developing countries. This can be attributed to the fact that cost-sharing can raise extra burden to the poor. In Uganda, medicines are one of the most expensive items for an average Ugandan. Some ACTs are expensive and not affordable to poor people, but if the community has some insurance, the impact can be distributed across, resulting in ACTs availability (Konde-Lule, Gitta, Lindfors, Okuonzi, Onama & Forsberg, 2010: 5). Parenthetically, the health budget in most sub-Saharan African countries is still below 15% of the total budget on health as required under the Abuja Declaration (MoH, 2015:27). During the last decade, significant sums of money have been invested in global initiatives (GHIs) to address global health issues such as malaria in developing countries (Vledder, *et al.*, 2015:2; World Health Organisation, 2009:2137).

However, unavailability of ACTs is still a reality in many drug supply chains in countries with limited financial support from donors (Lalvani, Yadav, Curtis, & Bernstein, 2010:17; Bate, Hess & Mooney, 2010:20). As a result, developing countries have seen a decline in the funding of malaria drugs, resulting in ACT shortage (Tumwine, *et al.,* 2010: 560; WHO, 2013: ix). However, Government must be conscious because pro-poor spending in health is critical to the attainment of national health goals.

7.3.4.4 Technology dimension

The expert groups ranked the technological dimension third in order of preference. From CFA results, technology influences the availability of ACTs at a magnitude of 0.24. This is attributed to the fact that technology has become the driving engine for any business or service— with a click of a few buttons, stocks at hand can be known in just seconds. The effect of technology has been more immense in the medical sector from medical research, manufacturing to the last consumer. Albeit the use of RDT scored least (0.072) among the technological items, diagnosing malaria has never been easy and accurate like it is today. RDT allows the technician to examine the patient without invasive procedures. However, Cohen, *et al*., (2015:1) assert that in most malaria-endemic countries such as Uganda, presumptive treatment for malaria is based on symptoms rather than a rapid diagnostic blood test (RDTs). Therefore, coordinating the testing of blood samples and monitoring prescription can go a long way ensuring ACTs.

Under technology, the use of M-tracking systems and mobile phones were ranked highly at 0.628 and 0.301 respectively. With the help of mobile phones and M-tracking, the central distribution office can easily know the areas with fewer stocks, in addition to the stock rate consumption—hence, planning for the stock-out in advance. Moreover, M-tracking does not only help the planners, but also the consumers. The users can easily know which malaria therapies are available at the health centre before travelling there. The rapid development of M-tracking in Uganda supports this theory of adoption of mobile ICT or multimedia technologies integrated with wireless health care delivery systems, referred to as m-Health. The tool enables the dissemination of information to consumers and providers of these health services through the use of mobile ICT applications such as SMS, which is used when sending health reminders on their cell phones. In support Dowling (2011) suggests that technological transformation within the health sector should aim at integrating health care chains owing to the complex social change process. This may necessitate a shift in strategy, structure and control dimensions

Unfortunately, governments and development partners are challenged with lack of information to improve the availability of ACT and malaria diagnostics kits called Rapid Diagnostic Tests (RDTs) owing to lack of information technology. Although the application of IT health technology comes with challenges like lack of cultural norms, the implementation of m-health services can ease the accessibility of ACTs and reduce the cost of operations.

At the national level, the existing logistics management information system (LMIS) in Uganda is predominantly paper-based. To a lesser extent, computerised inventory management systems have been introduced in about one-third of the hospitals. While NMS is fully computerised, there is currently no linkage between the health facility logistics systems and the central warehouses. This scenario inhibits access, analysis and sharing of pharmaceutical information between users at all levels. Lack of information technology systems affects supply chain cross-functional and cross organisational coordination (Meijboom, Schmidt-Bakx, & Westert, 2011; Pule, 2014:136), increasing inventory costs and putting hospitals at risk of not meeting patients' requirements timely (Lillrank, *et al*., 2011).

7.3.4.5 Legal dimension

The impact of the legal dimension on the availability of ACTs can be seen from the CFA results; the legal mechanism had the highest regression weight toward the availability of ACTs at 0.78 compared to all the other macro dimensions while the AHP results it was ranked fourth. Under the legal dimension, establishing proper clinical guidelines had the highest impact of 0.73. The pharmaceutical sector involves manufacturers, importers, exporters, wholesalers and retailers, who provide medicines for healthcare. When properly regulated, the sector can contribute to the improved availability of essential medicines among which are ACTs. Because

However, most often pharmaceutical systems do not always guarantee rational decision-making that primarily benefits the consumer. Therefore, strong regulatory enforcement of policies and procedures (that is, detailed guidelines for implementing policies) is required to safeguard the interests of the patients or users (Iqbal, *et al*., 2017:83). This implies that hospital administration and health workers through appropriate committees or Drugs Therapeutic Committees (DTC) must have the will to make appropriate decisions. According to MoH (2015:9), policies such as Uganda Clinical Guidelines (UCG) and Essential Medicines and Health Supplies List of Uganda (EMHSLU), which were updated in 2012, should guide the logistics activities such as selection, procurement and prescription. These are expected to guide the condition of use of ACTs and other drugs, reduce wastage and make them available.

7.3.5 What is the most critical supply chain coordination that emerges from object i, ii, and iii?

Following the findings from the exploration phase of the study, three hypotheses were formulated in order to establish dimensions that either positively or negatively influence the availability of ACTs. According to EFA and CFA, critical supply chain coordination dimensions, logistics activities and macro-environment dimensions have a significant positive influence on the availability of ACTs in general hospitals in Uganda. Table 76 below summarises the findings of the research questions and hypothesises as observed in CFA and ANOVA test.

Table 76: Summary of research questions and hypotheses

<table>
<tr><th>Model</th><th>Research questions</th><th>Hypothesis</th><th>Remarks</th></tr>
<tr><td>Model 1</td><td>How do the critical supply chain coordination dimensions affect the availability of ACTs in general hospitals of Uganda?</td><td>H1: The critical supply chain coordination dimensions correlate positively with ACTs availability in district general hospitals in Uganda</td><td>Accepted</td></tr>
<tr><td>Model 2</td><td>How do the logistics activities dimensions affect supply chain coordination of malaria of ACTs in general hospitals of Uganda?</td><td>H2: The logistics activities dimensions correlate positively with ACTs availability in District general hospitals in Uganda</td><td>Accepted</td></tr>
<tr><td>Model 3a</td><td rowspan="2">How do the management environment dimensions affect supply chain coordination of ACTs in general hospitals of Uganda?</td><td>H3a: The market management dimensions correlate positively with ACTs' availability in District general hospitals in Uganda.</td><td>Accepted</td></tr>
<tr><td>Model 3b</td><td>H3b: The macro environment dimensions correlate positively with ACTs' availability in District general hospitals in Uganda.</td><td>Accepted</td></tr>
</table>

7.3.5.1.1 Summary and discussion of Statistical techniques used

In order to test the hypotheses, different statistical techniques were used to achieve the four research objectives of this study. The table below shows the objectives, statistical techniques and the contribution of each statistical technique in achieving the research questions and objectives and the main aim of the study.

Table 77: Statistical techniques used to achieve objectives

Objectives	Statistical techniques	Contributions of statistical techniques to achieving objectives
i, ii, iii	EFA	EFA helped to establish the suitability and validity of data and factors for analysis. The data and factors for this study were found suitable and valid for analysis. Reliability analysis was used to test the reliability of the data and factors for further analysis. The data and factors for this study were found to be reliable for further analysis.
i, ii, iii	CFA	CFA statistics helped to describe the level of agreement regarding the factors that positively and negatively influence the availability of ACTs. CFA helped to reveal how people responsible for ACTs availability agree or disagree towards the major factors that affect malaria therapies' availability. CFA with principles of SEM were employed to examine the hypothesised relationships and the adequacy of the structural model. CFA is a collection of multivariate statistical techniques that is used to test hypotheses represented by path models. Hypothesis test helped to establish significance of the relationships between the positive and negative factors that influence ACTs availability.
iv	AHP	AHP helped to answer the research questions that establish deep understanding of research objectives based on expert's opinion with factual evidence. AHP helped to rank the most influential factors that affect the availability of ACTs.

EFA and CFA with principles of SEM were employed to examine the hypothesised relationships and the adequacy of the structural model. CFA is a collection of multivariate statistical techniques that is used to test hypotheses represented by path models. A path model is either a simple regression or multiple regression involving multiple independent and dependent variables (Tabachnick & Fidell, 2007:676), often referred to as observed variables, indicators or manifest variables. CFA involved model identification followed by model testing and modification if whenever the proposed model failed to produce acceptable fit. According to Tabachnick and Fidell (2007: 720), all indices led to similar conclusions, although CFI and RMSEA were the most frequently reported fit indices.

7.4 Summary of the study and main research objective

The study aimed at developing a supply chain coordination framework for ACTs in general hospitals in Uganda. In order to achieve this, the study was subdivided into seven chapters. Each chapter briefly elaborates on the importance of what was done and how it informs the study.

7.4.1 Summary of the chapters

7.4.1.1 Chapter 1

This chapter set the pace at presenting the general synopsis of the topic being investigated and justified why the topic was studied. To put the study into practical context, the problem was contextualised. Within this chapter, the main objective of developing a supply chain coordination framework was stated, together with the secondary objectives, main question and secondary questions. These secondary objectives and questions answer the main objective of the study. A brief explanation of the main study constructs, problem statement, and the significance of the study were done to set the pace of the study. Hypotheses were then derived for further guidance and testing in Chapter 6.

7.4.1.2 Chapter 2

In this chapter, it was imperative to discuss further the supply chain management concept so that the reader appreciates the key terms used in the study. This was followed by discussing the global medicine supply and distribution chain and the Uganda health sector medicine chain. Here within, the role of supply chain management, and emerging challenges are discussed without losing focus of the study objectives and questions. The theoretical review and conceptualisation of coordination framework was important because it was then that the relevant knowledge gaps in supply chain coordination were identified. Coordination theories were relevant to the study in explaining the phenomenon under investigation.

7.4.1.3 Chapter 3

The aim of this chapter was to review the existing coordination frameworks, constructs and the models that have been used to explain supply chain coordination taking into consideration of the micro-, market-and macro-environment. This chapter subsequently laid the foundation for the study because it identifies the gaps that exist from extant literature.

7.4.1.4 Chapter 4

The chapter discusses the methodology and the research design undertaken to achieve the objectives of this study. The chapter begins with justifications to the chosen methodology, followed by a description of the research design. The research design includes details of the chosen study population and sample of each of the two phases, the design and creation of the data collection instruments and methods for data collection. The subsequent section explains the testing of the validity and reliability of the instruments. Finally, the treatment of data and statistical analysis procedures for scale purification and model testing are detailed.

7.4.1.5 Chapter 5

In order to achieve the main study objective and the secondary objectives, this followed the methodology in Chapter 4. This led to exploring of the research questions using in-depth case studies. The strategy gave practical insights into the critical coordination dimensions, logistics activities and management environment (market and macro) dimensions that support the development of the current level of variables under the study. This phase concluded with the development of a questionnaire that was used in the quantitative phase.

7.4.1.6 Chapter 6

Under this chapter, the questionnaire developed in the previous chapter was used to carry out a survey. Specifically, this chapter was aimed at validating the results presented in Chapter 5 using the survey. The findings are arrived at by testing the correlation between the variables by first using an EFA followed by a CFA. Furthermore, in order to prioritise the key supply chain coordination dimensions, AHP approach was used. The technique provided a framework to cope with multiple criteria situations involving intuitive, rational, quantitative and qualitative aspects. AHP provided a practical approach in identifying the most influential criteria that makes ACTs available in general hospitals in Uganda.

7.4.1.7 Chapter 7

In the last chapter, a summary of findings and discussion of the findings were made. Thereafter, implications and a coordination framework are presented. Finally, the chapter ends with the presentation of the limitations encountered in the study and suggestions for future research were also made.

7.4.2 Answering the main research objective

From the secondary objectives, the main research objective is answered. A summary of the findings are postulated below.

Critical supply chain coordination dimensions: The main factors that influence the availability of ACTs via critical supply chain are Top Management, Mutual Understanding, and Information Sharing, Responsiveness, followed by Organisational Factors and Relationship Management as summarized in the Table 72.

Logistics activities dimensions: The most critical parameters that influence the availability of ACTs under logistics dimensions are procurement and ordering, forecasting, and storage management, dispensing and lastly quantification as shown in Table 73.

Management environment – market dimensions: From Table 74, the most influential market environment dimensions that affect the availability of ACTs include; Information Sharing with external stakeholders, and supply chain interdependence.

Management environment – macro dimensions: Results from the macro-environment shows that socio-cultural dimensions, economic, technological, and legal dimensions influence the availability of ACTs more as illustrated in Table 75. The political dimensions scored least and therefore were dropped.

In determining the most critical supply chain coordination dimensions that emerge from objective i, ii, and iii, the main research objective of this study, a supply chain coordination framework for making ACTs available in general hospitals in Uganda is adopted for this study as illustrated in Figure 19.

A supply chain coordination framework for malaria treatment therapies in general hospitals in Uganda

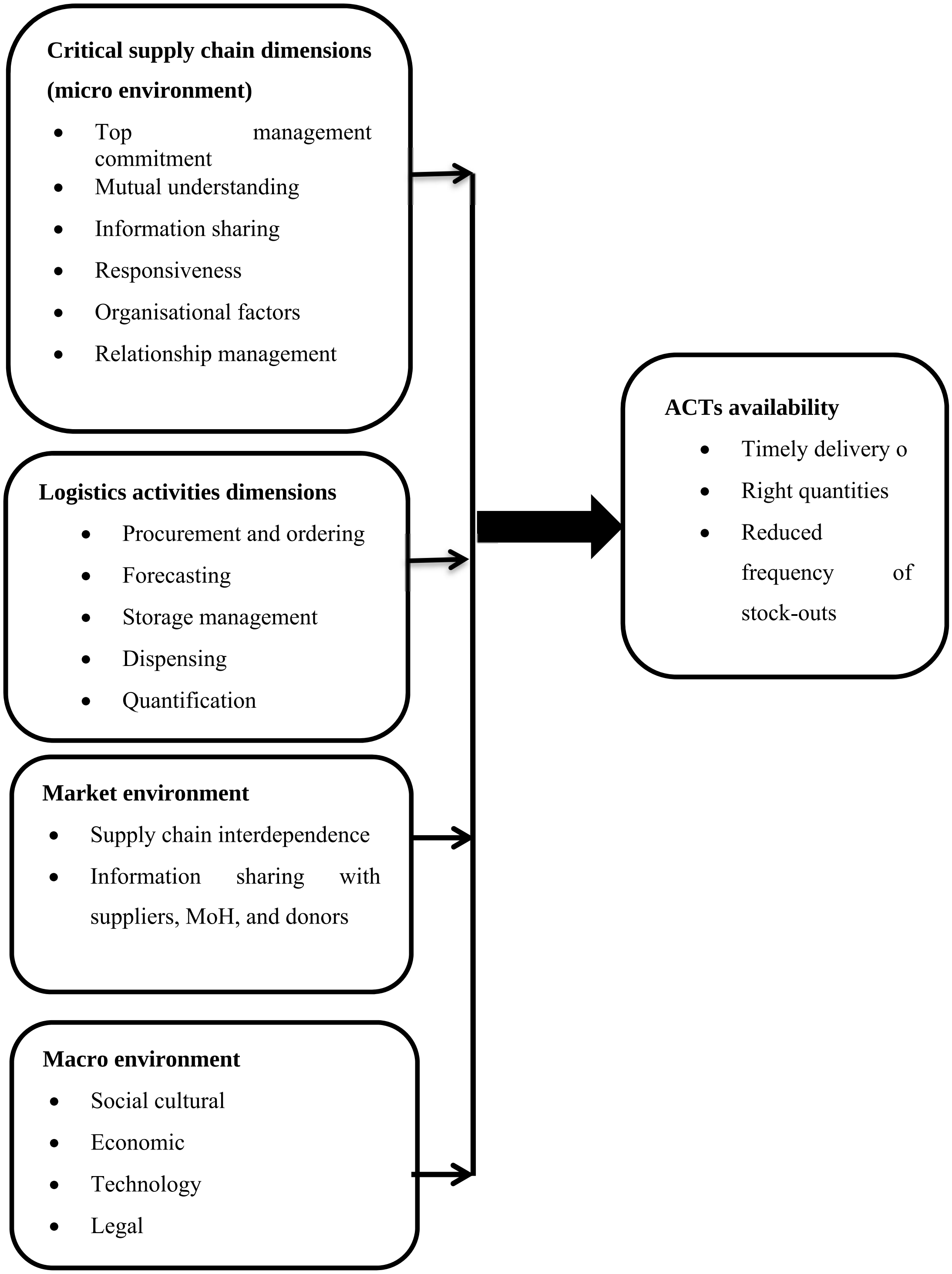


Figure 19: A supply chain coordination framework for malaria treatment therapies in general hospitals in Uganda

7.5 Contributions and implications

This section discusses the theoretical, policy and managerial contributions and implications. The aim of this study was to develop a model for Ugandan hospitals towards the accessibility of malaria therapies. To achieve this aim, this study established methods used by Ugandan hospitals enforce ACTs availability, which play a critical role in the adoption of malaria therapies.

7.5.1 Managerial implications

From these findings, top management should focus more on developing efficient feedback systems such as regular meetings in the short time. These will improve ACTs supply and distribution. Top Management should enhance the policy of redistribution of ACTs internally and externally, other than having stocks at one centre that people cannot access. Albeit provision of transport in times of emergencies scored least, for long-term planning, NMS should draft easier ways of making deliveries during emergencies from the regional centres. Owing to unavailability of real-time point of consumption data, bullwhip effects may occur along the hospital supply chains. Therefore, findings of the study imply that for proper coordination in the supply chain, top management should try to ensure that supply and distribution information is available to all users and suppliers. It will help in managing service delivery to the last consumer, inventory and product quality. Moreover, a higher level of top management commitment to invest in IT and IT adoption in general hospitals will enhance a higher level of inter-organisational relationship (indicated by trust, commitment and shared vision). This arrangement would not only have a major impact on cost cutting but it would also allow DTMC to focus more effort in working with clinical quality value analysis teams that help to support product selection. With these technologies, managers will be capable of making timely effective decisions.

By so doing, mutual understanding will be fostered therefore optimising the supply chain goal. Without mutual understanding among all members of the supply chain, coordination in the supply chain cannot be sustained. These findings imply that to improve mutual understanding, members of the supply chain should trust each other, share the vision and goal and collaboratively procure and forecast. Therefore, MoH and other stakeholders could explore investing in cheaper IT tools such as mobile phones and the Rx-solution or the m-health solution used in other developing countries.

Consistent with previous studies that advocate for use of managing supply chain interdependence with suppliers and information sharing with external stakeholders, general hospitals in conjunction with district leadership should think innovatively about how to collaborate with NMS, donors and other lower health units in determining accepted standards for actions. This will help to improve the process of availing ACTs, especially to the poor who greatly rely on general hospitals for treatment of malaria. This requires undertaking a deliberate effort in sensitising supply chain partners on the importance of coordinating the supply chain procurement, forecasting storage management and where possible, enhance internal transfer or redistribution.

While political dimensions were ranked lowest, the general hospitals should not disregard this component since politicians by law appropriate national expenditures and approve grants. Management should instead lobby the politicians and where possible hold dialogue to appreciate their supervisory role. Politicians should be restrained from directly interfering with dispensing ACTs but they should instead be supportive through public awareness on radio talk shows and clarifying on issues regarding ACTs.

There is need to integrate supply chain actors through the implementation of m-health services to ease the availability of ACTs and reduce the cost of operations. Management should lobby for modems and Internet bundles to facilitate the sustainability of Internet since m-tracking and Rx solution need Internet support to run. This will in turn help inform officials as to which health facilities are at risk of stock-out of ACTs.

7.5.2 Theoretical contribution and implication

A number of emergent themes and propositions on supply chain coordination dimensions affecting ACT availability are presented. Specifically, the study incorporates the market and macro perspective into the coordination framework for ACTs. To consolidate the argument, the study supplies an analysis of coordination frameworks and classifies each framework by comparing it with the management environment. The study clearly addresses the question of how market and macro-dimensions influence the distribution of ACTs drugs in Africa. It is from the findings that the study pinpoints the market and macro-environment implications in developing countries. Incorporating the market and macro environment augments the assessment of existing coordination frameworks. The extensions contribute to both the body of knowledge and supply chain practices in the medical industry. As regards knowledge contribution, the study provides a conceptual extension of the framework to assist with better assessment of medical drug coordination. In practice, as mentioned above, this may reduce medical drug stock-outs, improve drug availability and might lead to the possible combat of the malaria death rate through better supply chain management in the medical sector. From the discussion, there is need to broaden the theoretical domain basing it not only micro critical supply chain coordination but focusing on a holistic orientation, including the market and macro-environment dimensions. The implication for leadership in the medical field is the need to take a leading role in providing a working climate that promotes interdependence of actors internally, in the market and the larger economy.

7.5.2 Policy implications

7.5.2.1 Strengthening the health supply chain

This necessitates strengthening all elements in the health systems: building the necessary government and public policy infrastructure, human capacity and information systems. At the market environment, there is a need for a well-built coordination framework to tackle ACTs complex partnerships and subnational programmes. This may require amending the National Medicine Policy to cater for supply chain coordination at the hospital level. Better still emphasis should be put on building supply chain interdependencies with suppliers and platforms for information sharing among external stakeholders. This requires joint partnerships with donors, MoH and NMS. From the macro-environment perspective, Government should rethink of measures to restore the policy of cost sharing or better still introduce community insurance. This will require engaging leadership at both national and local government levels to promote such programmes.

7.5.2.2 Information technology adoption

Government initiatives through the National Information Technology Authority–Uganda (NITA-U) charged with improving IT adoption across Uganda, should slowly phase out manual systems in general hospitals. This will require a deliberate policy of providing computers to all general hospitals and intense training of staff and sensitisation in the area of IT adoption. Government through the rural electrification programmes and other sister agencies provide stable power supply, especially in rural based general hospitals so as to facilitate real time sharing of information among external stakeholders.

The assumption is that, when reliable data is provided, then valuable information will be obtained and used to make effective supply and distribution decisions by managers at the different levels of management. Given the fact that, medicine supply chain is handled by people at different levels of operation, the information needed should be provided in different formats using different information management systems. Initiatives such as the Health Management Information System (HMIS) supported by development partners in conjunction with the MoH and other stakeholders may foster integration, networking and Information Sharing on a routine basis to monitor the availability of ACTs. Whereas by design the IT system may not be specific to ACTs only, managers at the health Unit level and the Health Unit Management Committee will be able to plan and coordinate health care services in their catchment area.

7.5.2.3 Strengthening the legal framework of testing and dispensing of ACTs

The regulatory agency (MoH) should ensure the implementation of adequate standards for testing and treatment of malaria. In addition, as malaria is evolving, new medicines are developed. Therefore, MoH should always review and develop the standard guidelines frequently to address the trends in disease burden and control strategies. This requires systematic adjustments in the National Medicine Policy (2015), to include supply chain coordination. Besides, Government through MoH should enact the medicine supply chain coordination policy to provide management of essential medicines and where possible revise the general hospitals structure to cater for supply chain managers, who will work together with the DTMC and guide the forecasting, quantification, procurement, storage, and distribution of medicines in general. In addition, depending on the type of disease, Standard Treatment Guidelines (STGs) should be developed and reviewed as and when the need arises, to address trends in disease burden and control strategies.

7.5.2.4 Relationship management and decision making

While Relationship Management and decision-making neither scored highly under CFA nor AHP, general hospitals should strive to develop long-term relationships and effective integration with their suppliers. Such kinds of initiatives will help in taking collaborative decisions, thereby reducing any distortion of information flow across the supply chain.

7.5.3 Methodological contribution and implications

This study explored key dimensions from expert focus groups to the development of an instrument that could be used for future studies. Through this methodological approach, the current study has developed supply chain coordination measures consisting of different constructs originating from several variables to explain clearly ACTs availability in general hospitals in Uganda. The study used exploratory sequential mixed methods to develop an instrument and then later validating it while investigating the existing problem. Both qualitative and quantitative procedures were adopted to understand theoretical perspectives of the study. The qualitative approach (focus group discussions) excerpts enabled the understanding of the supply chain coordination dimensions in the availability of ACTs. The quantitative approach allowed the discovery of reality through statistical analysis of relationships between the independent and dependent variables. Therefore, the research design provided appropriate procedures for an inquiry into the existing phenomenon under study. The use of a mixture technique (EFA, CFA and AHP) enhanced and refined the results.

Finally, this study provides a direction for further research based on the empirical and theoretical concepts used. The reliability of items and construct/content validity of the measurement items were purified based on EFA and CFA, therefore confirming their usefulness in measuring the different variables under study. Therefore, this study provides evidence on the use of these measurement items in future scholarly studies.

7.6 Limitations of the study

The novelty of the subject in the health sector and the lack of data in this area was a challenge. Another major limitation of the study was the sensitivity of the topic since the newspapers in Uganda are awash with arrests of health officers owing to pilferage of the medicines from public health facilities. At the time of the survey data collection, medical doctors were on a nationwide strike owing to lack of medicines and other medical supplies and poor remuneration. This situation may have added to social desirability bias, with respondents' answers reflecting what they believed the interviewer would find acceptable.

This study was limited by research design. It was a cross-sectional study ignoring the importance of a longitudinal design, which can be useful in investigating the characteristics of supply chain coordination mechanisms over time-based on the study variables. This meant that certain behaviour and characteristics observable in the sample over time were not considered. This could be an area for further investigation in future research. Furthermore, since this study was cross-sectional, it could neither discuss nor come up with conclusions on the causality of critical supply chain coordination dimensions, logistical activities, management environment dimensions, and availability of ACTs. Therefore, it was difficult to claim that critical supply chain coordination dimensions, logistical activities dimensions and management environment dimensions can cause changes in the level of ACTs over a long period of time.

In addition, although the sample was large enough, it could not be generalised because the study focused only on the public general hospitals, therefore leaving out other equally important private hospitals. A study involving other general hospitals in Uganda, irrespective of the region, is necessary in future. Besides, this study limits itself to public general hospitals in Uganda with a major focus on DTMC members only. It does not include other players within the health care system such as NMS, MoH, development partners, and local governments where the general hospitals are located. Future research can be done among other stakeholders in different tiers.

This study's research design, data collection and interpretation processes may also have had limitations. Both the qualitative and quantitative research methods have limitations. However, a mixed method approach opens the space for triangulation between methods and sources of data to reinforce the validity, reliability and quality of the study. It also ensures complementarity of explanations in responding to the study problem. The cross-sectional survey also has inherent weaknesses. For example, some coordination factors can well be explained using longitudinal studies. However, given the time and cost limitations of the study programme, the method was adequate.

Lastly, critical coordination dimensions, logistical elements and management environment factors explained the availability of ACTs in Uganda to a tune of 66.7%, 65.7%, and 65.0%, respectively. Therefore, model may not have exhausted all the possible dimensions that could possibly explain availability of ACTs since factors in the business environment that affect supply chain coordination for malaria pills may change quickly.

7.7 Areas for future research

Therefore, future studies can examine other factors at several levels from NMS, general hospitals, regional referral hospitals and the national referral hospitals. Furthermore, future studies could examine how the coordination dimensions mentioned above could be employed at both conceptual and at methodical level at the different health care levels. A longitudinal study may be carried out to test the impact of IT developed software on the supply and distribution of ACTs.

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APPENDICES

Appendix 1 Focus group discussion guide

Dear Sir/madam,

PhD student request for interview

Thank you for taking time to participate in this research. This an interview session within a focus group discussion and is part of a bigger study by Ms Pross Oluka, a PhD student of Business Management at the University of South Africa.

The purpose of this study is to assess Uganda's medical and drug distribution system in order to determine appropriate coordination mechanisms to improve delivery of artemisinin-based combination therapies (ACTs) in the Health care system in Uganda. You have been procedurally selected as members of the DTMC to provide the study with your in-depth understanding of ACTs in your hospital.

It is anticipated that different understanding may arise from the discussions. I encourage you to express your views and insights accordingly. We are here to ask questions, listen and make sure everyone gets a chance to share their perspective.

This discussion should no more than 90 minutes and you may withdraw at any point in time without any consequences of any kind. The discussion will be tape recorded for accuracy of information and validity purposes. We shall be taking notes to help us remember what you say but no source, individual or institution, will be identified or reported without written and express permission from the originator. For your confidentiality and by use of pseudonyms, you will be protected from all forms of identification at both personal and at institutional level. We request you to be comfortable and honest in sharing your ideas with us.

I will be honoured to receive your help and would be extremely grateful if you could let me know by replying this letter confirming participation in this discussion. The details of suitable time and venue for the discussion can be agreed upon later on.

Thank you for your time. I look forward to hearing from you

Pros Nagitta Oluka (Mrs)
PhD student – Department of Operations Management, School of Public & Operations Management, University of South Africa (Unisa)
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Background information

The following questions are designed to understand the biographical details of the informants more specifically their name, position in the hospital; and for how long have you have served in that position.

Educational and Employment background

1. Kindly tell us your age and position in this hospital.
2. How long have you worked in this position, and within this hospital?
3. What is the highest level of education you have received? Preferably, that informants list all degrees they earned, and their field of study of each degree.
4. How would you describe your major responsibilities at this hospital?

Basic information about ACTs, the hospitals and health care system in Uganda

The following questions are designed to understand the about ACTS, the hospitals and health care system in Uganda.

1. Describe how you understand the healthcare system in Uganda? Its structure, systems and general processes.
2. Describe you general understanding of artemisinin-based combination therapies (ACTs) used in the hospitals in Uganda

Supply chain (SC) coordination within the micro-environment

The following questions are designed to understand the current supply and distribution .mechanisms of ACTs in general hospitals described here as the micro level SC environment

2. Tell us your roles and responsibilities in the ACTs supply and distribution system of this hospital
3. How effective are these institutional structures to ensuring availability of ACTs
4. In your view, is the current ACT supply and distribution system of this hospital effective?
    a. Describe the reasons for your response above…
5. In your view, does the current ACT supply chain coordination mechanisms promote timeliness and reduce frequency of stock-outs?

a. Give reasons to support your response in the question above

6. What are the institutional and structural issues that exist in the supply and distribution of ACTs?
7. How would you describe the supervision system that currently exists for drugs in this hospital? How has this fostered quality and availability of ACTs?
8. In your view, is Top Management of this hospital committed to ensuring that ACTs are available and well utilised?
   b. Are they committed to the goal?
   c. Do they invest time and resources for this activity?
   d. Are they ready to adapt to new innovations and ideas that ensure ACTs are available and well utilized
   e. Do they invest in training of employees
9. What is the level of understanding among SC members of the aims of effective ACTs management?
   a. Is there a common or Mutual Understanding among members of expectations?
   b. Is there shared vision and goals among members of supply chain
   c. What is there level of trust among themselves (confidence that others will do the "right" thing)n
10. What role does effective information flow among SC members play in efficient ACTs management?
    a. What specific Information Technology (IT) tools and techniques used?
    b. What sort of Information Sharing/exchange and SC linkages occurs with regard to management of drugs Inventory?
11. In terms of Relationship Management and decision-making, why are better relationships with NMS important for the hospital?
    a. What is the nature of the relationships between NMS and this hospital or other similar hospitals?
    b. What is the nature of the relationships between patients and this hospital in terms of ACTs use?
    c. Can you describe the quality and nature of integration amongst all the SC players you earlier explained?
12. How do specific organisationsfactors (such as structure, culture, level of integration etc.) influence the quality of coordination among members internal SCs of ACTs?
13. Describe the level of Responsiveness, in terms of flexibility, delivery on time, service reliability, the level of adaptability with process change within internal SCs of ACTs?

Logistics activities and availability of ACTS

2. Using examples, describe how are ACTs are sourced and order for this hospital from the supplier to the final patient?
3. How would you describe the management of ACTs stock?
4. What forecasting method is used to predict future demand?
5. How do you quantify the demand of ACTs?
6. How do you store ACTs?
7. What are the logistical demands for ACTs for this hospital?
8. How would you describe the method used to ensure timely ordering for ACTs in this hospital?
9. How are these drugs dispensed to the public?
10. What is the current lead time of ACTs from the point of origin (NMS) to the hospital?
11. How would you describe the signing powers of ACTs? Who is responsible or accountable for ACTs distribution? Linked to ordering and sourcing

Supply chain (SC) coordination within the market environment

The following questions are designed to understand the market environment in which actors in the ACTs supply chains operate, and how their decisions are shaped by the features of this type of environment.

1. How do you manage the supply chain inter dependences between all stakeholders e.g. national stores and other suppliers?
2. How would you describe the decision making process in the supply and distribution of ACTs with NMS?
3. Do you have any collaborative partnership for joint training with your suppliers and district local government?
4. How do you share Information about schedules between general hospitals and NMS?
5. And how does the practice affect ACTs availability?
6. Are there any public private partnerships between your hospital and private pharmacies?
7. What is the relationship between lower health units and ACT availability**?**

Supply chain (SC) coordination within the macro environment

The following questions are designed to understand the macro environment in which actors in the ACTs supply chains operate, and how their decisions are shaped by the features of this type of environment.

2. What is the regulatory framework governing the procurement of ACTs?
   Interaction and sharing mechanisms among stakeholders
3. How many times to you meet with your partners or other stakeholders to discuss challenges in stock-outs?
4. What information do you share with donors, MoH other stakeholder? Is there any disclosure clause attached or associated with supply and distribution of ACTs?
5. How is this information shared?
6. When you do meet? What information do you consider when making decisions in your respective organisations?
7. How do the political, economic, social-culture, technological and legal environments affect malaria treatment pills?
8. How do you analyse the SWOT (analysing their strengths and weaknesses for developing strategies to improve coordination in supply chain)
   a. Macro issues…

Finally...

As we wind up, can you suggest recommendations for developing appropriate ACT coordination in general Hospitals of Uganda?

Thank you for your participation

Appendix 2: Sample size table

Krejcie and Morgan (1970) sample size determination.

TABLE 1

Table for Determining Sample Size from a Given Population

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size.
S is sample size.

Appendix 3: Permission letters

UNISA university of south africa

24 April 2017

Ref #: 2017_CEMS_ESTTL_005

DEPARTMENT OF ENTREPRENEURSHIP, SUPPLY CHAIN, TRANSPORT, TOURISM AND LOGISTICS MANAGEMENT RESEARCH ETHICS REVIEW COMMITTEE

This is to certify that the application for ethics clearance submitted by
Ms Oluka Pross Nagitta (student number 58551603, nagittaoluka@gmail.com)
Developing a supply chain coordination framework for malaria treatment pills in General Hospitals in Uganda
received Ethics Approval

The application for ethics clearance for the above mentioned research was reviewed by the Department of Entrepreneurship, Supply Chain, Transport, Tourism and Logistics Management Research Ethics Review Committee in April 2017 in compliance with the Unisa Policy on Research Ethics. Ethical Clearance for the project is granted. You may proceed with the research project.

The research ethics principles outlined by the Unisa Policy on Research Ethics must be adhered to throughout the project. Please be advised that the committee needs to be informed should any part of the research methodology as outlined in the Ethics application (Ref #2017_CEMS_ESTTL_005) change in any way or in case of adverse events. This certificate is valid for the duration of the project. The ESTTL Research Ethics Review Committee wishes you all the best with this research undertaking.

Kind regards,

Poole

Mrs C Poole
Chairperson

ff
Executive Dean: CEMS

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

THE REPUBLIC OF UGANDA

APAC DISTRICT LOCAL GOVERNMENT

In any correspondence on
this matter please quote Ref:

APAC HOSPITAL,
P. O. Box 11,

APAC.

24th October 2017
Mrs. Oluka Pross Nagitta,
C/o Uganda Mnagement Institute
P. O. Box, 20131
Kampala.

RE: PERMISSION TO CONDUCT FOCUS GROUP DISCUSSIONS.

Following consultations with our supervisors, I hereby wish to inform you that, permission has been granted to hold focus group discussions, with the staff of Apac General Hospital Drug Therapeutic Management Committee, regarding your PhD project entitled: ***"Supply Chain Coordination Mechanisms of Artemisin - based Combination Therapies (ACTs) in General Hospitals in Uganda".***

We believe that participation in this study will be voluntary and we hope that the rights, privacy, confidentiality and anonymity of participants and the institution/facility at large will be upheld. We also wish that at an appropriate time we shall be privileged to share the findings of the project with you.

I wish you success in your endeavour.

Yours sincerely,

MEDICAL SUPERINTENDENT
24 OCT 2017
APAC HOSPITAL
P.O. BOX 11 APAC

Dr, Sabiiti Fanuel Abwooli

(Medical Superintendent Apac General Hospital)

Iganga District Local Government

THE REPUBLIC OF UGANDA

Medical Superintendent's Office
Iganga Hospital
P.O. Box 245
IGANGA
Tel. 0772642809
e-mail:hospiganga@yahoo.com
Website-igangahospital.or.ug

Ref: 10/2

Date: 26th October, 2017

Mrs. Oluka Pross Nagitta,
C/o Uganda Management Institute,
P.O. Box 20131,
KAMPALA.

RE: PERMISSION TO CONDUCT FOCUS GROUP DISCUSSIONS

I hereby wish to inform you that permission has been granted to hold focus group discussions with the staff of the Drug Therapeutic Committee regarding your PhD project entitled ***"Supply Chain Coordination Mechanisms of Artemisin – based Combination Therapies (ACTs) in General Hospitals in Uganda".***

We believe that participation in this study will be voluntary and we hope that the rights, privacy, confidentiality and anonymity of participants and the institution at large will be upheld.

I wish you success in your endeavour.

Yours sincerely,

For:
MEDICAL SUPERINTENDENT
IGANGA HOSPITAL

Dr. Waako James
MEDICAL SUPERINTENDENT

Iganga District Local Government

THE REPUBLIC OF UGANDA

Medical Superintendent's Office
Iganga Hospital
P.O. Box 245
IGANGA
Tel. 0772642809
e-mail:hospiganga@yahoo.com
Website-igangahospital.or.ug

Ref: 10/2

Date: 26th October, 2017

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I wish you success in your endeavour.

Yours sincerely,

For:
MEDICAL SUPERINTENDENT
IGANGA HOSPITAL

Dr. Waako James
MEDICAL SUPERINTENDENT

THE REPUBLIC OF UGANDA

APAC DISTRICT LOCAL GOVERNMENT

In any correspondence on
this matter please quote Ref:

APAC HOSPITAL,
P. O. Box 11,

APAC.

24th October 2017
Mrs. Oluka Pross Nagitta,
C/o Uganda Mnagement Institute
P. O. Box, 20131
Kampala.

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I wish you success in your endeavour.

Yours sincerely,

MEDICAL SUPERINTENDENT
24 OCT 2017
APAC HOSPITAL
P.O. BOX 11 APAC

Dr, Sabiiti Fanuel Abwooli

(Medical Superintendent Apac General Hospital)

TORORO DISTRICT LOCAL GOVERNMENT
TORORO GENERAL HOSPITAL

MS. Direct Line: 0774122456
Email: tororohospital@gmail.com.
In any correspondence on this subject
Please quote

P.O. BOX 1,
Tororo.

24th October 2017.

Mrs. Oluka Pross Nagitta,
C/o Uganda Management Institute
P. O. Box, 20131
Kampala.

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We believe that participation in this study will be voluntary and we hope that the rights, privacy, confidentiality and anonymity of participants and the institution at large will be upheld.

I wish you success in your endeavour.

Yours sincerely,

TORORO GENERAL HOSPITAL
24 OCT 2017
P.O. BOX 1, TORORO

Ojwang James
For: Medical Superintendent

A HEALTHY AND PRODUCTIVE POPULATION THAT CONTRIBUTES TO SOCI- ECONOMIC DEVELOPMNENT.

Cleophas Amanyire

KIRYANDONGO GENERAL HOSPITAL

KIRYANDONGO DISTRICT LOCAL GOVERNMENT

P.O.BOX 128, KIGUMBA UGANDA

THE REPUBLIC OF UGANDA

In any correspondence on this
Subject please quote
Ref…..

24th August 2017.

Mrs. Oluka Pross Nagitta,
C/o Uganda Management Institute,
P. O. Box, 20131,
Kampala, (U).

Dear Madam,

RE: PERMISSION TO CONDUCT FOCUS GROUP DISCUSSIONS

I hereby wish inform you that permission has been granted to hold focus group discussions with the staff of the Drug Therapeutic Management Committee regarding your PhD project entitled: *"Supply Chain Coordination Mechanisms of Artemisin - based Combination Therapies (ACTs) in General Hospitals in Uganda."*

We believe that participation in this study will be voluntary and we hope that the rights, privacy, confidentiality and anonymity of participants and the institution at large will be upheld. I wish you success in your endeavour.

Yours sincerely,

Dr. Kisembo Godfrey
Medical Superintendent

MEDICAL SUPERINTENDENT
Kiryandongo Hospital
24 AUG 2017
P. O. Box 128, Kigumba

Telephone: General Lines: 256 – 417 – 712260
Permanent Secretary's Office: 256 – 417 – 712221
Fax: 256 – 41 – 231584
340887

E-mail: ps@health.go.ug
Website: www.health.go.ug

IN ANY CORRESPONDENCE ON
THIS SUBJECT PLEASE QUOTE NO. ADM 100/244/13

THE REPUBLIC OF UGANDA

Ministry of Health
P. O. Box 7272
Plot 6, Lourdel Road,
Wandegeya
KAMPALA
UGANDA

14th November 2016

Mrs. Oluka Pross Nagitta
Uganda Management Institute
P.O Box 20131
KAMPALA

PERMISSION TO CONDUCT RESEARCH IN SELECTED GENERAL HOSPITALS

Reference is made to your letter dated 14th November 2016 requesting to conduct a research study with some selected general hospitals in Uganda.

This is therefore to inform you that your request to carry out your PhD research project on Developing a Supply Chain Coordination Framework for Malaria Treatment Pills (ACTS) in General Hospitals in Uganda has been granted.

You will liaise with Directors of the Hospitals of your choice for purposes of your study.

I wish you the best in your research.

David Katabarwa
For: PERMANENT SECRETARY

For Permanent Secretary
MINISTRY OF HEALTH
16 NOV 2015
P. O. BOX 7272 KAMPALA

Appendix 4: Questionnaire

QUESTIONNAIRE

Dear Respondents

I am carrying out a PhD study on "*developing a supply chain coordination framework for malaria treatment therapies (Artemisinin-based Combination Therapies [ACTs]) in general hospitals in Uganda*". You have been chosen as a key respondent in this study and you are kindly requested to spare some of your valuable time and give the required responses in order to ensure that this questionnaire is filled-in and answered appropriately. All information provided will be treated with utmost confidentiality and used specifically for academic purposes.

Oluka Pross Nagitta (0700733659)
(PhD Candidate)

SECTION A **BACKGROUND INFORMATION**

A) Organisationscharacteristics:

1. Location of your hospital in Uganda

Central Region	Northern Region	Eastern region	Southern Region	Western region
1	2	3	4	5

B) Employee's characteristics:

1. Gender

Male	Female
1	2

2. Age bracket

Below 20 years	20-29 years	30-39 years	40-49 years	50 years and above
1	2	3	4	5

3. Highest level of education attained

Certificate	Diploma	Degree	Masters	PhD
1	2	3	5	6

4. Have you attained professional training in supply chain management?

Yes	No
1	2

5. Position in your organization

Senior manager	Middle manager	Supervisor	Officer
1	2	3	4

6. Length of time you have worked for the organization

Less than 1 year	1-3 years	4-6 years	7-9 years	10 years and above
1	2	3	4	5

SECTION B: SUPPLY CHAIN COORDINATION FACTORS AT THE MICRO (HOSPITAL) LEVEL

ACTS-

Please circle the most appropriate option on the right-hand side of the questions concerning supply chain coordination at the micro (health facility) level; strongly agree (5), Agree (4), Not sure (3), Disagree (2) and Strongly Disagree (1)

1) Organisation factors (OF)							
		Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
OF01	The hospital has early warning systems when suppliers are unable to supply ACTs.	5	4	3	2	1
OF02	The institutional structures support regular monitoring of ACTs distribution.	5	4	3	2	1
OF03	The Drug Therapeutic Committee has enhanced	5	4	3	2	1

	availability ACTs.					
OF04	Regular meetings foster ACTs availability.	5	4	3	2	1
OF05	Issuance of local guidelines enhances ACTs availability.	5	4	3	2	1
OF06	Centralised distribution by Pharmacist enhances availability of ACTs.	5	4	3	2	1
OF07	Delegation enhances the swift ordering of ACTs.	5	4	3	2	1
OF08	Accountability for ACTs enhances availability.	5	4	3	2	1
OF09	Supervision within the hospital enhances availability of ACTs.	5	4	3	2	1
OF10	Lobbying of funds enhances ACTs availability.	5	4	3	2	1
OF11	Spot checks foster ACTs availability.	5	4	3	2	1
OF 12	Pharmacist's guidance on the process of dispensing medicine enhances availability.	5	4	3	2	1
Information sharing						
IS01	Verbal communication during CMEs enhances ACTs availability.	5	4	3	2	1
IS02	Electronic drug management system enhances ACTs availability.	5	4	3	2	1
IS03	Rx-solution enhances ACTs availability.	5	4	3	2	1
IS04	Information on stock cards has improved availability of ACTs.	5	4	3	2	1
IS05	Sharing of stock status enhances availability of ACTs.	5	4	3	2	1
IS06	Timely information pinned on notice boards has improved availability ACTs.	5	4	3	2	1
IS07	Use of hardcopy reports regarding ACTs has improved availability of ACTs.	5	4	3	2	1
Responsiveness						
R01	Scheduled issuance timelines by stores to other units enhances ACTs availability.	5	4	3	2	1
R02	Flexible ordering system improves availability of ACTs.	5	4	3	2	1
R03	Internal redistribution between units has enhanced availability of ACTs.	5	4	3	2	1
R04	Efficient delivery timelines from Pharmacy has greatly improved availability of ACTs.	5	4	3	2	1
R05	Supplier schedule has greatly improved availability of	5	4	3	2	1

	ACTs.					
R06	Internal transfers have improved availability of ACTs.	5	4	3	2	1
R07	Placement of emergency orders has greatly improved ACTs availability.	5	4	3	2	1
R08	Ease of calling the supplier has enhanced availability of ACTs.	5	4	3	2	1
Mutual Understanding						
MU01	Staff awareness of the demands of their job description enhances ACTs availability.	5	4	3	2	1
MU02	Staff coherence enhances ACTs availability.	5	4	3	2	1
MU03	Mutual trust among staff members has enhanced demand forecast for ACTs.	5	4	3	2	1
MU04	Shared vision has led to improved availability of ACTs.	5	4	3	2	1
MU05	Shared goals among staff have improved ACT availability.	5	4	3	2	1
MU06	Understanding of the new policy change in usage of ACTs has enhanced ACT availability.	5	4	3	2	1
MU07	Staff knowledge of the procedures has enhanced ACTs' availability.	5	4	3	2	1
MU08	Instructions on use of ACTs have greatly improved its availability.	5	4	3	2	1
MU09	General understanding of the pull systems enhances ACTs' availability	5	4	3	2	1
MU10	Communicating of policy change to patients has improved availability of ACT.	5	4	3	2	1
MU11	Development of work plans enhances ACT availability.	5	4	3	2	1
Relationship management and Joint decision making						
RM01	Interdepartmental cooperation during redistribution has led to improved ATCs availability.	5	4	3	2	1
RM02	Good relationships among staff has positively enhanced availability of ACTs	5	4	3	2	1
RM03	Joint decision making during procurement planning has enhanced ACT availability.	5	4	3	2	1
RM04	Good relationship of the hospital with her suppliers has improved ACTs stock levels.	5	4	3	2	1

RM05	Feedback loop with other units has greatly improved availability ACTs.	5	4	3	2	1
RM06	Interdepartmental involvement in procurement planning has greatly improved availability of ACTs.	5	4	3	2	1
RM07	Meeting of orders per schedule enhances relationships.	5	4	3	2	1
Top Management commitment						
TM01	Frequent feedback on stock status from Top Management has improved ACTs availability.	5	4	3	2	1
TM02	Support for online ordering has enhanced ACTs availability.	5	4	3	2	1
TM03	Provision of transport in times of emergencies has enhanced ACTs' availability	5	4	3	2	1
TM04	Top Management issuance of guidelines enhances availability of ACTs.	5	4	3	2	1
TM05	Frequent communication whenever there is stock-outs enhances availability of ACTs.	5	4	3	2	1
TM06	Top Management support for hands on training enhances ACTs availability.	5	4	3	2	1
TM07	Top Management support for strategic planning enhances availability of ACTs.	5	4	3	2	1
TM08	Top Management investment in monitoring of ACTs enhances availability of ACTs.	5	4	3	2	1
TM09	Top Management support for redistribution has enhanced availability of ACTs.	5	4	3	2	1
TM10	supports for Continuous Medical Education (CMEs) for stock management enhances ACT availability.	5	4	3	2	1

SECTION C: LOGISTICS ACTIVITIES AFFECTING AVAILABILITY OF ACTs

Please use the following scale to indicate the extent of your agreement with each statement below on logistical factors within supply chain of ACTs. Rate as follows: *(1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree, and (5) Strongly agree*

	2) LOGISTICS FACTORS (LOG)	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Forecasting						
F01	Estimating the average monthly consumption enhances availability of ACTs.	5	4	3	2	1
F02	Forecasting based on disease patterns enhances of ACTs availability.	5	4	3	2	1
F03	Forecasting using information from stock cards has enhanced ACTs availability.	5	4	3	2	1
Quantification of ACTs						
Q01	Totalled monthly consumption enhances ACTs availability.	5	4	3	2	1
Q02	Quantification taking into consideration of maximum–minimum stock levels has enhanced ACTs availability.	5	4	3	2	1
Q03	Quantification using information from the dispensing logs has enhanced ACTs availability.	5	4	3	2	1
Q04	Quantification taking into consideration of malaria seasons enhances ACTs availability.	5	4	3	2	1
Q05	Quantification taking into consideration of peak times enhances ACTs availability.	5	4	3	2	1
	Procurement and ordering of ACTs					
PO1	Identification of needs enhances ACTs availability.	5	4	3	2	1
PO2	Annual procurement plans enhance ACTs availability.	5	4	3	2	1
PO3	Team involvement during procurement planning enhances ACTs availability	5	4	3	2	1
PO4	Ordering based on approved budget enhances ACTs availability.	5	4	3	2	1
PO5	Adherence to delivery schedules by NMS enhances ACTs availability.	5	4	3	2	1
PO6	Requisitioning as per plan enhances ACT availability.	5	4	3	2	1
PO7	Observance of lead-time has enhanced ACT availability.	5	4	3	2	1
Storage management and distribution of ACT stocks						

SM01	Team verification before storage enhances availability of ACTs.	5	4	3	2	1
SM02	Labelling enhances availability of ACTs.	5	4	3	2	1
SM03	Verification of expiry dates enhances ACTs' availability.	5	4	3	2	1
SM04	Stock cards enhance availability of ACTs.	5	4	3	2	1
SM05	Storage equipment (shelves or pallets) improves availability of ACTs.	5	4	3	2	1
SM06	Monitoring of room temperatures improves availability of ACTs.	5	4	3	2	1
SM07	Medicine registers enhance availability of ACTs.	5	4	3	2	1
SM08	Enforcing of the Drug Management Policy has enhanced availability of ACTs.	5	4	3	2	1
SM09	Observance of minimum –maximum levels has enhanced ACTs availability	5	4	3	2	1
SM10	Authorised distribution by specific personnel has enhanced ACTs' availability.	5	4	3	2	1
Dispensing of ACTs						
D01	First in first out or last in last out policy has enhanced ACTs availability.	5	4	3	2	1
D02	Prior testing of blood has enhanced ACT availability.					
D03	Verification of prescriptions enhances availability of ACTs.	5	4	3	2	1
D04	Clear instructions on medicine usage have enhanced availability of ACTs.	5	4	3	2	1
D05	Authorised signatures have greatly improved ACTs availability.	5	4	3	2	1
D06	Verification of dispensing logs has greatly improved availability of ACTs.	5	4	3	2	1

SECTION D: MARKET AND MACRO FACTORS AFFECTING AVAILABILITY OF ACTS

Please tick the number that best reflects your agreement with the following statements concerning supply chain coordination at market level.

Rate as follows: *(1) strongly disagree, (2) disagree, (3) Neutral, (4) agree, and (5) strongly agree*

Di) MARKET/MESO FACTORS (MKT)						
		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
SC interdependence with suppliers						
SCI01	Regular communication with supplier (NMS) enhances ACTs availability.	5	4	3	2	1
SCI02	Regular meetings with the supplier enhance ACTs availability.	5	4	3	2	1

SCI 03	Use of e-mails with to the supplier enhances availability of ACTs.	5	4	3	2	1
SCI 04	Use of personal phone calls with NMS enhances ACTs availability.	5	4	3	2	1
SCI 05	Routine regional monitoring with stakeholders enhances ACTs availability.	5	4	3	2	1
SCI 06	Evaluation meetings with supplier enhance ACTs availability.	5	4	3	2	1
SCI 07	Use of M-TACK with other external stakeholders has improved ACTs availability.	5	4	3	2	1
SCI 08	Use of the Rx tool with the supplier has enhanced ACTs availability.	5	4	3	2	1
SCI 09	Sharing of schedules with the supplier has enhanced ACTs availability.	5	4	3	2	1
SCI 10	Regular correspondence with the supplier's representative has enhanced ACTs availability.	5	4	3	2	1
Collaborative partnerships for training						
CP01	Joint training with NMS has enhanced ACTs availability.	5	4	3	2	1
CP02	Collaborative training with Drug Monitoring Unit has enhanced ACTs availability.	5	4	3	2	1
CP03	Refresher training with Ministry of Health has enhanced ACTs availability.	5	4	3	2	1
CP04	Collaborative training with NGOs on how to monitor drug usage and supervision has enhanced ACTs availability.	5	4	3	2	1
Information sharing with suppliers, MoH, Donors						
ISS 01	Online sharing of information enhances ACTs availability.	5	4	3	2	1
ISS 02	Regular exchanges information using hard copies of reports with other stakeholders enhances ACTs availability.	5	4	3	2	1
ISS 03	Use of IT tools (M-Track) as a means of communicating with stakeholders has enhanced ACTs availability.	5	4	3	2	1
ISS 04	Sharing of weekly or monthly reports with other stakeholders has enhanced ACTs availability.	5	4	3	2	1
ISS 05	Holding of quarterly meetings with external stakeholders has enhanced ACTs availability.					
Relationship between lower health units						
RHU01	The hospital's relationship with lower health units has enhanced ACTs availability through redistribution.	5	4	3	2	1
RHU02	District Health Officer's support for redistribution enhances ACTs availability.	5	4	3	2	1

D ii) MACRO FACTORS AFFECTING AVAILABILITY OF ACTS

Please use the following scale to indicate the extent of your agreement or disagreement regarding the supply chain coordination at macro factors affecting ACT availability.

Rate as follows: (1) *strongly disagree, (2) Disagree, (3) Neutral, (4) Agree, and (5) strongly Agree*

D ii). MACRO FACTORS (MAC)						
		Strongly agree	Agree	Not sure	Disagree	Strongly disagree
Political factors affecting ACT availability						
PF1	Politicization of ACTs has enhanced its availability.					
PF2	Political publicity enhances availability of ACTs.	5	4	3	2	1
PF3	Politicians' interference enhances ACTs availability.	5	4	3	2	1
PF4	Political support enhances ACTs availability.	5	4	3	2	1
PF5	Awareness by politicians on talk shows enhances ACTs availability.	5	4	3	2	1
PF6	Verification of ACTs stock by politicians enhances its availability.	5	4	3	2	1
PF7	Advocacy by politicians enhances availability of ACTs.	5	4	3	2	1
PF8	Surveillance or monitoring of ACTs stock by politician enhances its availability.	5	4	3	2	1
Economic factors						
EF01	Poverty within the communities enhances ACTs availability.	5	4	3	2	1
EF02	Availability of donor funds enhances availability of ACTs.	5	4	3	2	1
EF03	Cost sharing enhances availability of ACTs.	5	4	3	2	1
Social –cultural factors affecting ACT availability						
SC01	Clicks within the community enhance ACTs availability.	5	4	3	2	1
SC02	Culture of self-medication enhances ACTs availability.	5	4	3	2	1
SC03	Belief of keeping ACTs by households enhances ACTs availability.	5	4	3	2	1
SC04	Public attitude towards the lower health facilities affects availability of ACTs.	5	4	3	2	1
SC05	Compliance to dosage enhances ACTs availability.	5	4	3	2	1
Technological factors affecting ACT availability						
TF01	Use of phones enhances availability of ACTs.	5	4	3	2	1
TF02	Use of toll free lines enhances ACTs availability.	5	4	3	2	1
TF03	M-track system enhances availability of ACTs.	5	4	3	2	1
TF04	Use of rapid Diagnostic tools (RDT) has enhanced availability of ACTs.	5	4	3	2	1
TF05	Use of Internet has enhanced ACTs availability.	5	4	3	2	1
Legal framework and ACT availability						
LF 01	Implementing the testing and dispensing policy have enhanced availability of ACTs.	5	4	3	2	1

LF02	Implementing the clinical guidelines have enhanced availability of ACTs.	5	4	3	2	1
LF03	Regulating consumption has enhanced availability of ACTs.	5	4	3	2	1
LF04	Pull policy change has enhanced ACTs availability.	5	4	3	2	1

DEPENDENT VARIABLE

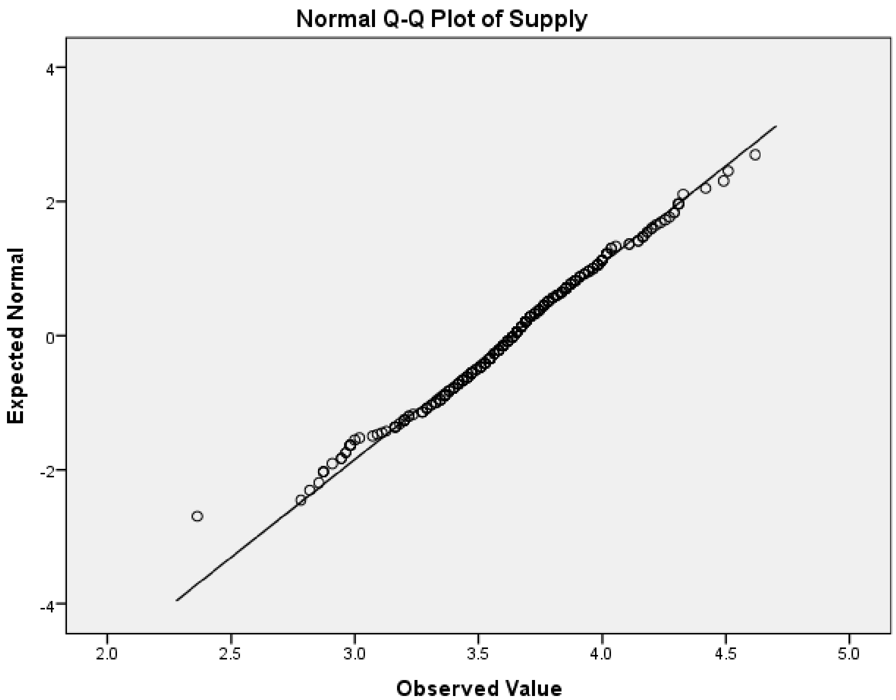
Please use the following scale to indicate the extent of your agreement or disagreement regarding the availability of ACTs. Rate as follows: (1) *strongly disagree, (2) Disagree, (3) Neutral, (4) Agree, and (5) strongly Agree*

Availability						
A01	Stores timely deliver ACTs to user units.	5	4	3	2	1
A02	ACTs can be ordered as and when needed.	5	4	3	2	1
A03	We always get the quantities we order for.	5	4	3	2	1
A04	ACTs issued meet the national quality standards.	5	4	3	2	1
A05	ACTs orders are always met by the supplier.	5	4	3	2	1
A06	ACTs stock levels have improved.	5	4	3	2	1
A07	The rate at which ACTs run out of stock has reduced.	5	4	3	2	1
A08	ACTs are always available for patients.	5	4	3	2	1

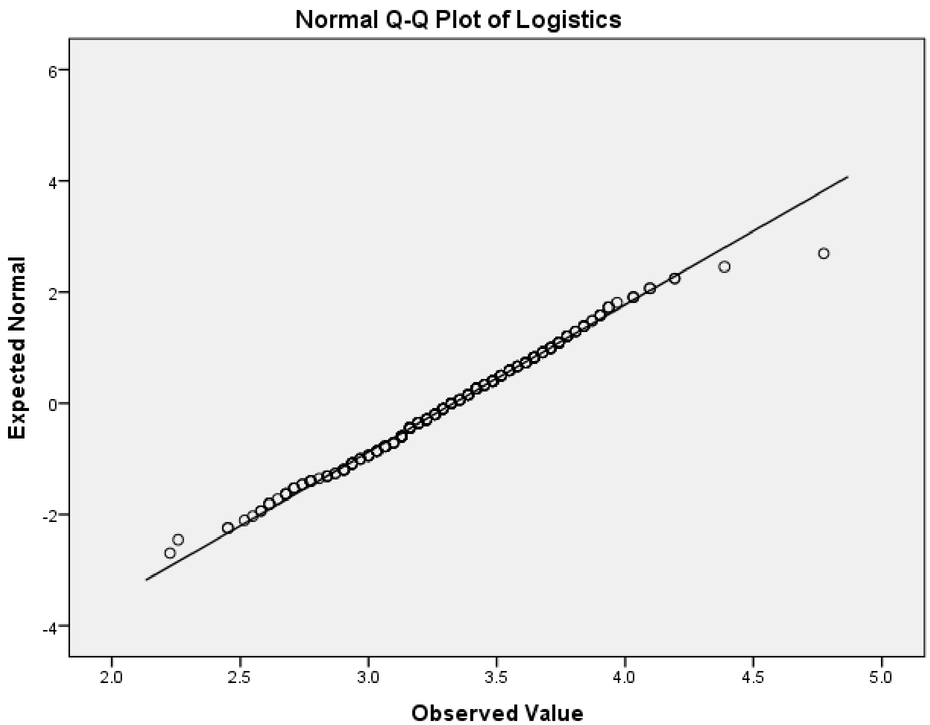
Appendix: 5 – Test of Normality

5a - Normal plots

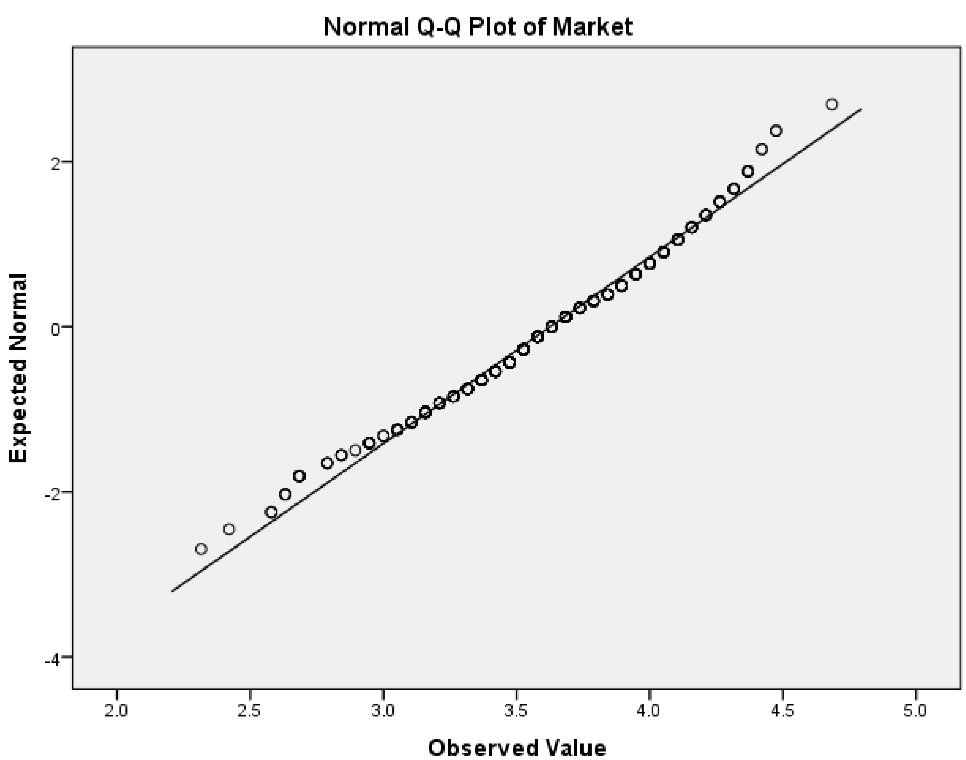
Critical supply chain Management



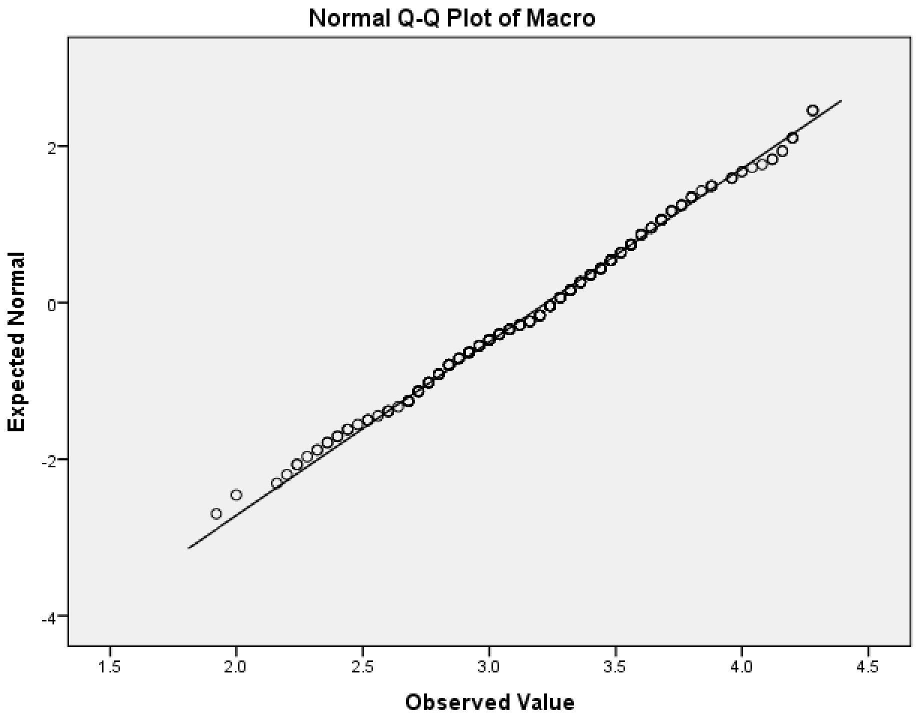
Logistics activities



Market environment

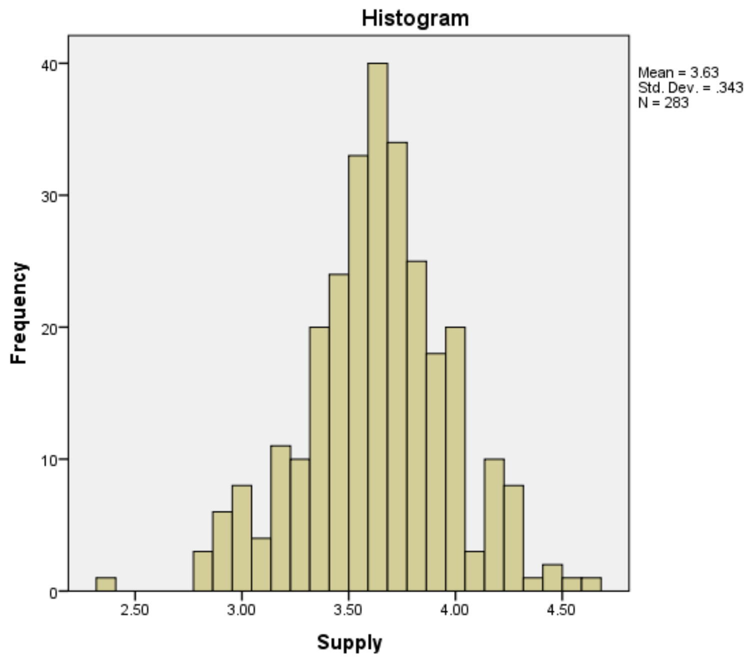


Macro environment

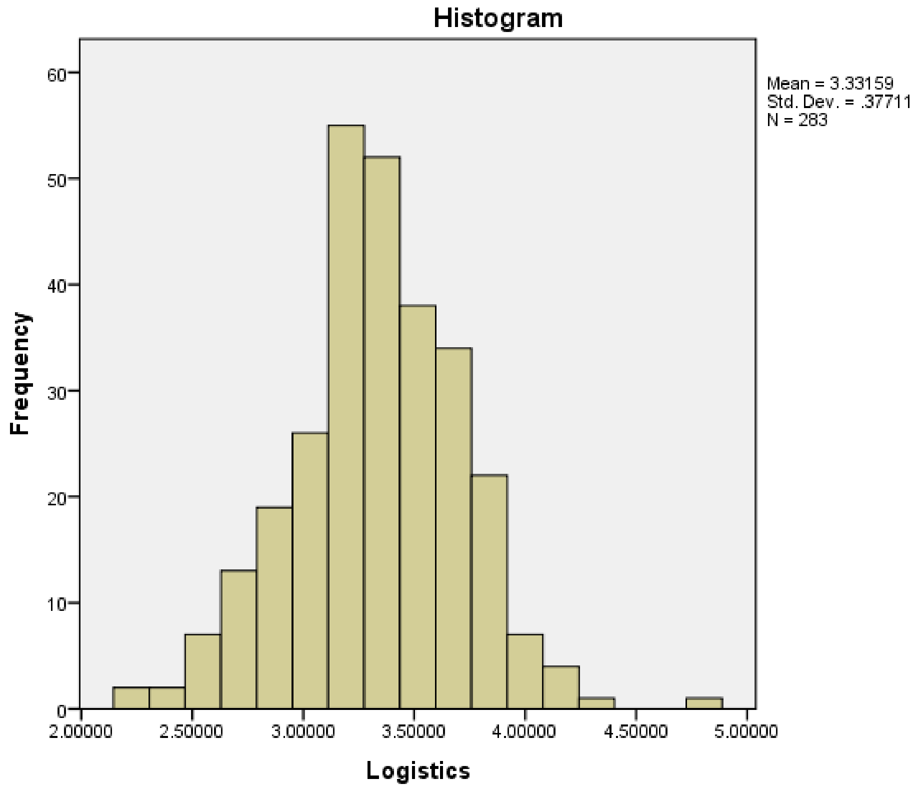


Appendix 5b) Histogram

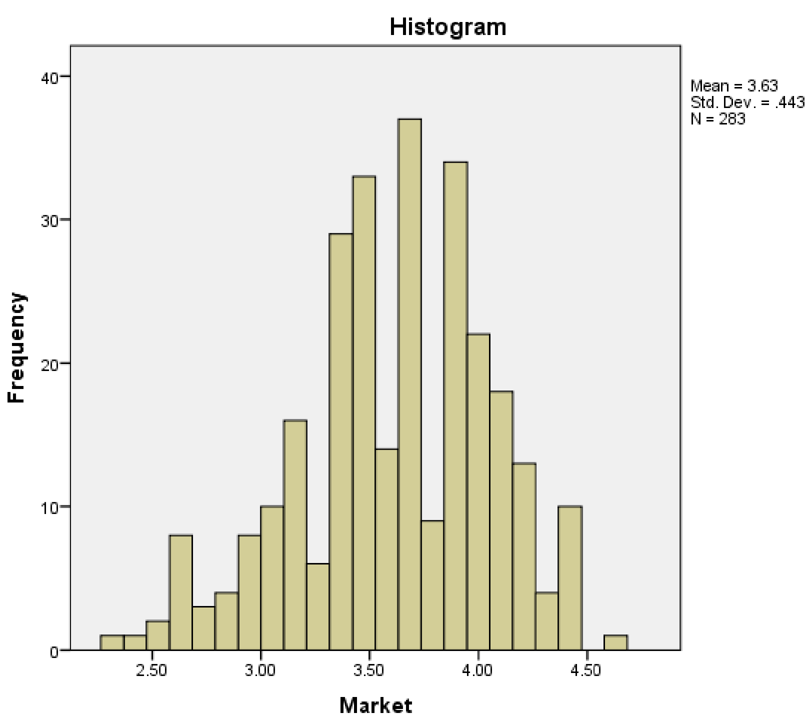
Critical supply chain coordination



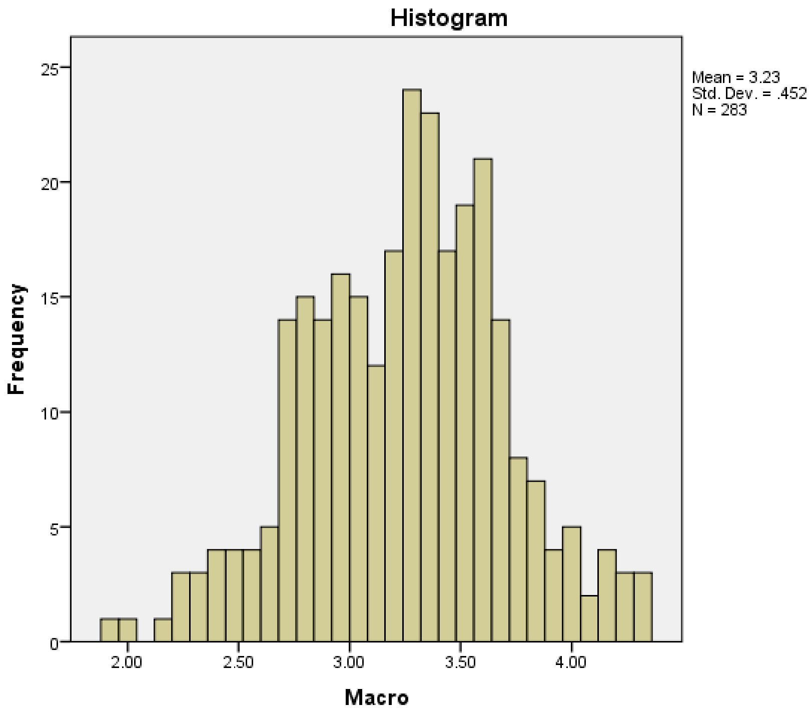
Logistics activities



Market Environment dimensions

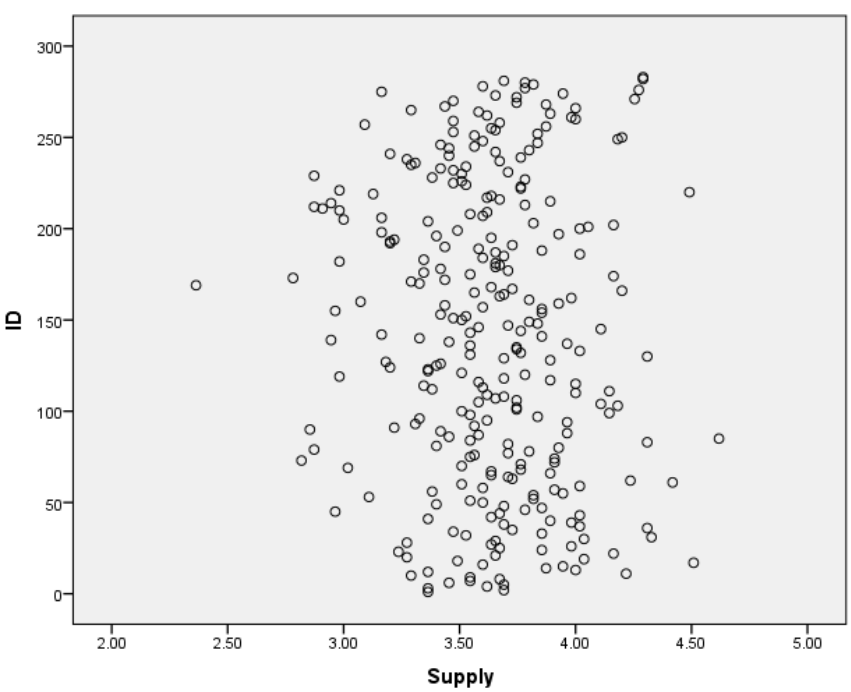


Macro environment dimensions

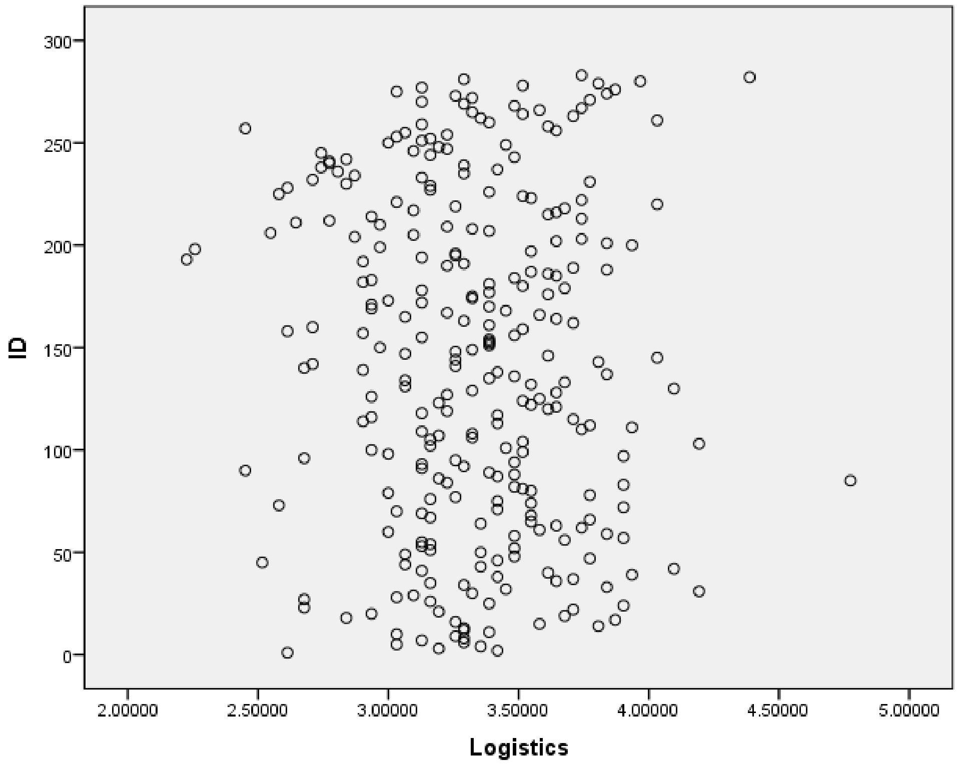


Appendix 5c) Scatter plots

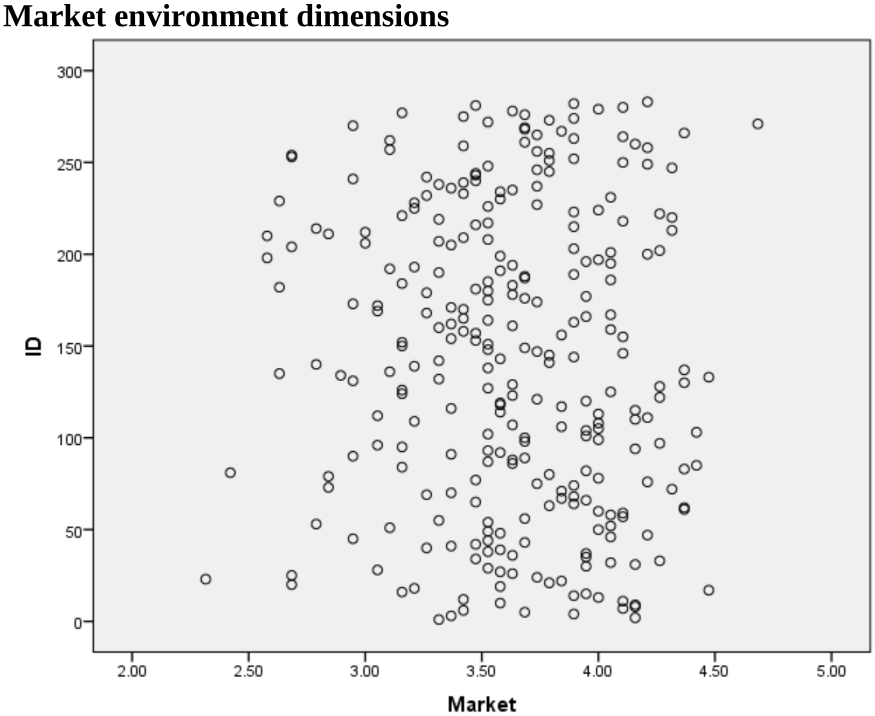
Critical supply chain coordination dimensions



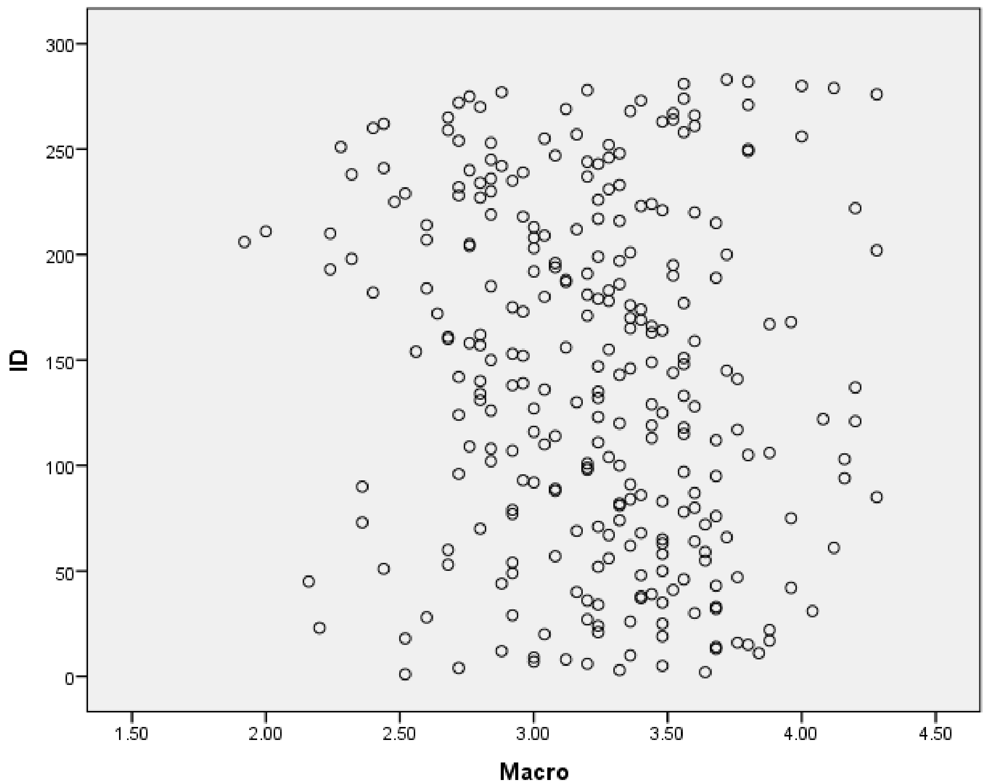
Logistics activities dimensions



Market environment dimensions

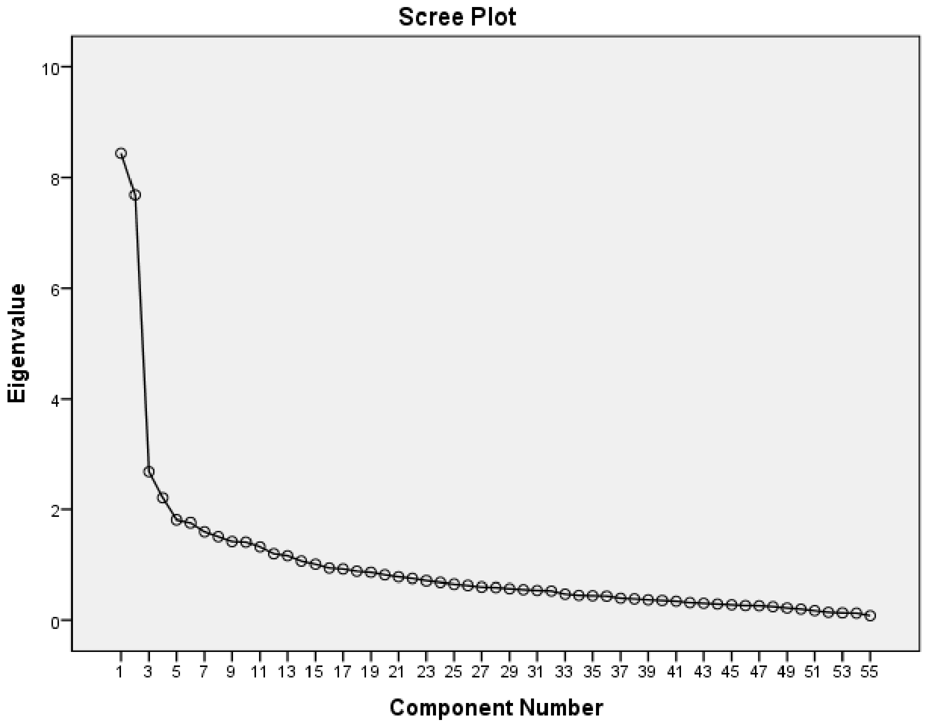


Macro environment dimensions

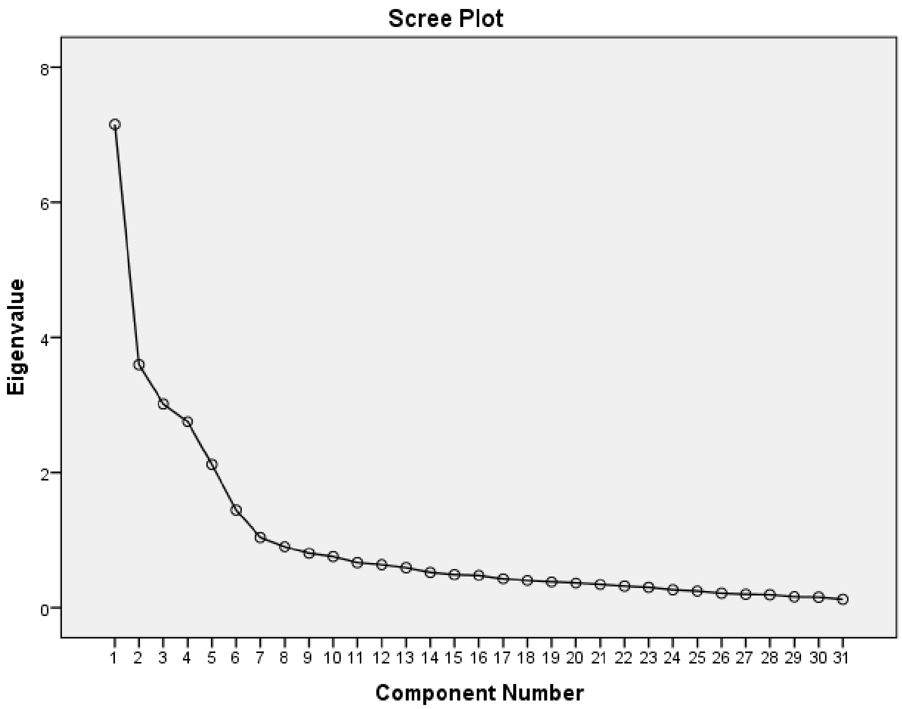


Appendix 6: Scree plots

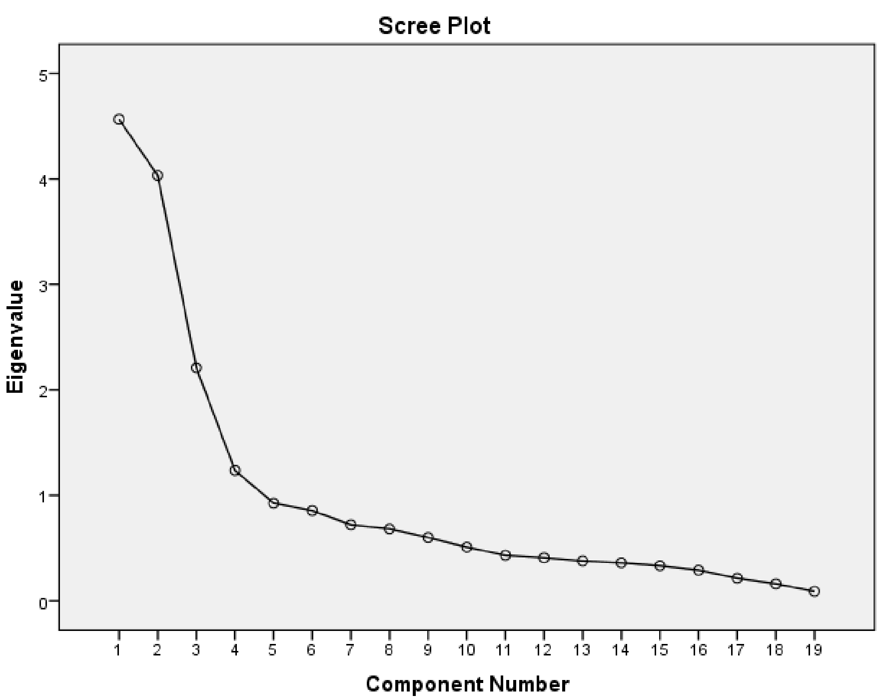
6a) Critical supply chain coordination dimensions



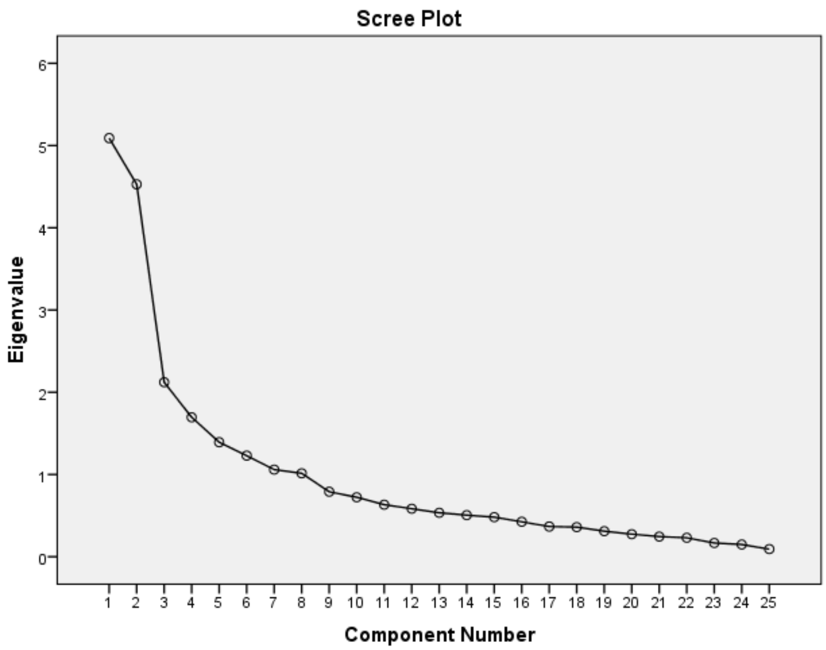
6b) Logistics activities dimensions



6c) Market environment dimensions



6d) Macro environment dimensions


Scree Plot
Eigenvalue
Component Number
0
1
2
3
4
5
6
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

Appendix 7: Skewness and kurtosis

		OF01	OF02	OF03	OF04	OF05	OF06	OF07	OF08	OF09	OF010	OF011	OF012	IS01	IS02	IS03	IS04	IS05	IS06	IS07
N	Valid	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean		4.04	3.81	4.00	3.66	3.25	3.94	3.78	2.57	2.71	4.28	3.43	3.63	2.76	3.99	2.87	2.72	3.61	4.08	3.93
Skewness		-1.150	-.980	-.807	-.689	-.410	-1.043	-.826	.450	.240	-1.249	-.430	-.700	.272	-.967	.089	.308	-.423	-1.088	-.786
Kurtosis		1.212	.148	.055	-.070	-.804	.874	.251	-.407	-.978	2.464	-1.031	-.077	-.466	.494	-.815	-.409	-.750	.994	.186

		R01	R02	R03	R04	R05	R06	R07	R08	MU01	MU02	MU03	MU04	MU05	MU06	MU07	MU08	MU09	MU010	MU011
N	Valid	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean		2.40	2.42	2.33	2.20	3.87	4.05	4.03	3.93	3.66	3.83	4.05	3.51	4.01	3.69	4.01	3.99	3.88	3.99	3.80
Skewness		.898	.894	.783	.912	-.863	-1.066	-1.123	-.895	-.744	-.872	-.699	-.409	-.758	-.654	-1.018	-.597	-.907	-.578	-.534
Kurtosis		.354	.297	.149	.869	.419	1.441	1.075	.386	-.164	.480	.850	-.680	1.404	.235	.763	.862	.390	.976	-.133

		RM01	RM02	RM03	RM04	RM05	RM06	RM07	TM01	TM02	TM03	TM04	TM05	TM06	TM07	TM08	TM09	TM010	FO1	FO2	FO3	Q01
N	Valid	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean		4.04	3.47	3.47	3.53	3.73	3.96	3.96	3.99	3.72	3.86	3.97	3.78	3.81	4.05	3.77	4.11	3.91	3.40	3.65	3.71	3.99
Skewness		-1.004	-.340	-.442	-.609	-.928	-.798	-.593	-.858	-.664	-.577	-.905	-.722	-.950	-1.309	-.687	-.785	-.807	-.249	-.549	-.530	-.578
Kurtosis		1.114	-.329	-.175	.299	1.281	.371	.053	2.066	-.266	.801	.801	.192	.926	2.122	.083	2.307	1.617	-.480	.006	.059	.976

		Q02	Q03	Q04	Q05	P01	P02	P03	P04	P05	P06	P07	SM01	SM02	SM03	SM04	SM05	SM06	SM07	SM08	SM09	SM10
N	Valid	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean		4.05	4.08	4.12	3.99	2.40	2.33	3.84	2.20	2.22	2.23	3.91	4.24	3.01	3.02	2.91	3.88	2.72	3.06	4.01	2.87	4.00
Skewness		-.555	-.935	-.353	-.871	.898	.783	-.733	.912	.793	.901	-.813	-1.321	-.138	-.135	.069	-.708	.308	-.203	-.962	.089	-1.009
Kurtosis		.848	2.316	-.104	.446	.354	.149	-.333	.869	.380	.888	.051	1.898	-1.006	-.936	-.681	-.073	-.409	-.847	.785	-.815	1.362

		D01	D02	D03	D04	D05	D06	SCI01	SCI02	SCI03	SCI04	SCI05	SCI06	SCI07	SCI08	SCI09	SCI010	CP01	CP02	CP03	CP04
N	Valid	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean		4.03	3.26	2.57	2.71	4.18	2.69	4.03	3.99	3.73	3.99	4.05	4.08	3.79	3.97	3.76	3.82	3.59	3.54	3.57	3.54
Skewness		-.815	-.388	.473	.240	-1.311	.258	-1.057	-.597	-.732	-.578	-.555	-.935	-.867	-1.186	-.797	-.739	-.708	-.502	-.711	-.614
Kurtosis		.277	-.800	-.401	-.978	1.784	-.855	.626	.862	.028	.976	.848	2.316	.665	1.962	.390	.464	-.102	-.405	.041	-.336

		ISS01	ISS02	ISS03	ISS04	ISS05	RHU01	RHU02	PF1	PF2	PF3	PF4	PF5	PF6	PF7	PF8	EF01	EF02
N	Valid	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean		2.72	3.06	3.64	3.01	3.02	3.84	4.04	3.23	3.11	2.98	3.17	3.17	3.06	3.12	3.06	3.01	3.02
Skewness		.308	-.203	-.707	-.138	-.135	-.869	-.939	-.168	-.132	.036	-.214	-.180	-.182	-.238	-.027	-.138	-.135
Kurtosis		-.409	-.847	-.063	-1.006	-.936	.904	.887	-.995	-.916	-1.134	-.720	-.916	-.905	-.936	-.924	-1.006	-.936

		EF03	SC01	SC02	SC03	SC04	SC05	TF01	TF02	TF03	TF04	TF05	LF01	LF02	LF03	LF04
N	Valid	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean		2.91	3.40	3.05	2.79	3.65	3.71	2.68	3.25	2.57	2.71	3.90	3.99	3.99	4.05	3.10
Skewness		.069	-.249	-.067	.185	-.549	-.530	.219	-.410	.450	.240	-.845	-.597	-.578	-.555	-.010
Kurtosis		-.681	-.480	-1.268	-1.147	.006	.059	-.911	-.804	-.407	-.978	-.103	.862	.976	.848	-1.126

		A01	A02	A03	A04	A05	A06	A07	A08
N	Valid	283	283	283	283	283	283	283	283
	Missing	0	0	0	0	0	0	0	0
Mean		3.76	3.86	3.86	3.72	3.73	3.91	3.81	3.23
Skewness		-.788	-.767	-.514	-.636	-.606	-.689	-.386	.012
Kurtosis		1.330	1.296	.444	.581	.641	.592	.302	-.510

Appendix 8: Anova regression

a. Critical supply chain coordination

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.716[a]	.512	.502	.43596

a. Predictors: (Constant), AVTM, AVR, AVOF, AVRM, AVIS, AVMU

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	55.064	6	9.177	48.286	.000[b]
	Residual	52.458	276	.190		
	Total	107.522	282			

a. Dependent Variable: AVAV

b. Predictors: (Constant), AVTM, AVR, AVOF, AVRM, AVIS, AVMU

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.332	.203		1.635	.103
	AVOF	-.013	.036	-.017	-.356	.722
	AVIS	.023	.041	.029	.567	.571
	AVR	.007	.035	.009	.191	.849
	AVMU	.204	.050	.218	4.090	.000
	AVRM	.061	.042	.078	1.468	.143
	AVTM	.579	.059	.516	9.742	.000

a. Dependent Variable: AVAV

b. Logistics

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.574[a]	.330	.318	.51001

a. Predictors: (Constant), AVD, AVF, AVP, AVQ, AVSM

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	35.471	5	7.094	27.274	.000[b]
	Residual	72.051	277	.260		
	Total	107.522	282			

a. Dependent Variable: AVAV

b. Predictors: (Constant), AVD, AVF, AVP, AVQ, AVSM

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.019	.242		4.207	.000
	AVF	.108	.044	.143	2.434	.016
	AVQ	.412	.055	.411	7.434	.000
	AVP	.032	.042	.041	.760	.448
	AVSM	.098	.048	.121	2.040	.042
	AVD	.097	.038	.126	2.539	.012

a. Dependent Variable: AVAV

c. Market

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.555[a]	.308	.300	.51655

a. Predictors: (Constant), AVISO, AVCP, AVSCI

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33.077	3	11.026	41.321	.000[b]
	Residual	74.445	279	.267		
	Total	107.522	282			

a. Dependent Variable: AVAV

b. Predictors: (Constant), AVISO, AVCP, AVSCI

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.492	.239		6.239	.000
	AVSCI	.454	.050	.473	9.082	.000
	AVCP	-.006	.035	-.009	-.179	.858
	AVISO	.139	.040	.182	3.483	.001

a. Dependent Variable: AVAV

d. Macro

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.570[a]	.325	.313	.51178

a. Predictors: (Constant), AVLF, AVPF, AVTF, AVEF, AVSC

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	34.970	5	6.994	26.703	.000[b]
	Residual	72.552	277	.262		
	Total	107.522	282			

a. Dependent Variable: AVAV

b. Predictors: (Constant), AVLF, AVPF, AVTF, AVEF, AVSC

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.290	.227		5.683	.000
	AVPF	.033	.033	.050	1.004	.316
	AVEF	.081	.043	.108	1.892	.050
	AVSC	.117	.044	.155	2.669	.008
	AVTF	.043	.040	.058	1.077	.282
	AVLF	.385	.051	.414	7.615	.000

a. Dependent Variable: AVAV

Appendix 9: Cross tabulation

a. **Region and Information sharing Cross tabulation**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Total
Central Region	2	24	8	13	0	47
	4.3%	51.1%	17.0%	27.7%	0.0%	100.0%
Northern Region	1	24	28	20	1	74
	1.4%	32.4%	37.8%	27.0%	1.4%	100.0%
Eastern region	4	28	33	17	2	84
	4.8%	33.3%	39.3%	20.2%	2.4%	100.0%
Western region	4	23	25	24	2	78
	5.1%	29.5%	32.1%	30.8%	2.6%	100.0%
Total	11	99	94	74	5	283
	3.9%	35.0%	33.2%	26.1%	1.8%	100.0%

b. **Position in your organisationsand Top Management**

		Disagree	Neutral	Agree	Strongly agree	Total
Position	Senior manager	3	3	20	6	32
		9.4%	9.4%	62.5%	18.8%	100.0%
	Middle manager	3	6	36	15	60
		5.0%	10.0%	60.0%	25.0%	100.0%
	Supervisor	0	4	40	5	49
		0.0%	8.2%	81.6%	10.2%	100.0%
	Officer	5	15	100	20	140
		3.6%	10.7%	71.4%	14.3%	100.0%
	5	0	0	2	0	2
		0.0%	0.0%	100.0%	0.0%	100.0%
Total		11	28	198	46	283
		3.9%	9.9%	70.0%	16.3%	100.0%

c. **Age bracket Information sharing Cross tabulation**

		Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Total
Age bracket	20-29	3	16	30	17	1	67
		4.5%	23.9%	44.8%	25.4%	1.5%	100.0%
	30-39	3	45	31	22	1	102
		2.9%	44.1%	30.4%	21.6%	1.0%	100.0%
	40-49	5	26	25	18	2	76
		6.6%	34.2%	32.9%	23.7%	2.6%	100.0%
	>50	0	12	8	17	1	38
		0.0%	31.6%	21.1%	44.7%	2.6%	100.0%
Total		11	99	94	74	5	283
		3.9%	35.0%	33.2%	26.1%	1.8%	100.0%

d. **Gender and Mutual Understanding Cross tabulation**

		Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Total
Gender	Male	0	2	22	77	33	134
		0.0%	1.5%	16.4%	57.5%	24.6%	100.0%
	Female	1	4	26	89	28	148
		0.7%	2.7%	17.6%	60.1%	18.9%	100.0%
Total		1	6	49	166	61	283
		0.4%	2.1%	17.3%	58.7%	21.6%	100.0%

e. **Training in Supply Chain and Quantification Cross tabulation**

		Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Total
Training in Supply Chain	Yes	0	1	15	45	22	83
		0.0%	1.2%	18.1%	54.2%	26.5%	100.0%
	No	1	2	29	115	49	196
		0.5%	1.0%	14.8%	58.7%	25.0%	100.0%
	4	0	1	2	0	1	4
		0.0%	25.0%	50.0%	0.0%	25.0%	100.0%
Total		1	4	46	160	72	283
		0.4%	1.4%	16.3%	56.5%	25.4%	100.0%

Appendix 10: AHP Questionnaire

Dear Respondents

I am carrying out a PhD study on "*developing a supply chain coordination framework for malaria treatment therapies (Artemisinin-based Combination Therapies [ACTs]) in general hospitals in Uganda*". Thank you for the participation in the first study—your response was of great help. In furtherance of the study, Multi Criteria Decision Making Tool was employed. The tool is applied in ranking the best alternative or identifying the most influential parameter in making ACTs available in Ugandan hospitals. There are four sections within which there are sub criteria which you are required to rank the magnitude of each factor under the four categories—Critical Supply chain dimensions, Logistics activities, Market, and Macro environment dimensions. Participation in the study is voluntary and involves the five members of Top Management but who at the same time are members of the Drugs Therapeutic Management Committee who make decision regarding forecasting, quantification, procurement, storage and dispensing. All information provided will be treated with utmost confidentiality and used specifically for academic purposes—thank you once again.

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1. SUPPLY CHAIN COORDINATION FACTORS AT THE MICRO (HOSPITAL) LEVEL

Rank the preference of each item against each other; for example, Top Management is more influential than Mutual Understanding in developing a supply chain coordination framework for availing malaria treatment therapies, ACTs—then circle the magnitude from 1 (yellow) to 9 (green). Otherwise, circle from 1 (yellow) to 9 (red).

Key: Top Management commitment (**TM**); Relationship management and Joint decision making (**RM**); Mutual Understanding (**MU**); Information sharing (**IS**); Organisational factors (**OF**)

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
TM	9	7	5	3	1	3	5	7	9	**RM**
TM	9	7	5	3	1	3	5	7	9	**MU**
TM	9	7	5	3	1	3	5	7	9	**IS**
TM	9	7	5	3	1	3	5	7	9	**R**
TM	9	7	5	3	1	3	5	7	9	**OF**
RM	9	7	5	3	1	3	5	7	9	**MU**
RM	9	7	5	3	1	3	5	7	9	**IS**
RM	9	7	5	3	1	3	5	7	9	**R**
RM	9	7	5	3	1	3	5	7	9	**OF**
MU	9	7	5	3	1	3	5	7	9	**IS**
MU	9	7	5	3	1	3	5	7	9	**R**
MU	9	7	5	3	1	3	5	7	9	**OF**
IS	9	7	5	3	1	3	5	7	9	**R**
IS	9	7	5	3	1	3	5	7	9	**OF**
R	9	7	5	3	1	3	5	7	9	**OF**

In addition, please rank the preference of the following items under the different CRITICAL SUPPLY CHAIN determining factor

Organisation factors (OF) measuring items

OF05 Issuance of local guidelines enhances ACTs availability

OF08 Accountability for ACTs enhances availability

OF09 Supervision within the hospital enhances availability of ACTs

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
OF05	9	7	5	3	1	3	5	7	9	OF05
OF05	9	7	5	3	1	3	5	7	9	OF08
OF08	9	7	5	3	1	3	5	7	9	OF09

Top Management commitment

TM01 Frequent feedback on stock status from Top Management has improved ACTs availability.

TM03 Provision of transport in times of emergencies has enhanced ACTs' availability

TM09 Top Management support for redistribution has enhanced availability of ACTs

TM10 supports for CME (CMEs) for stock management enhances ACT availability

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
TM01	9	7	5	3	1	3	5	7	9	TM03
TM01	9	7	5	3	1	3	5	7	9	TM09
TM01	9	7	5	3	1	3	5	7	9	TM10
TM03	9	7	5	3	1	3	5	7	9	TM9
TMO3	9	7	5	3	1	3	5	7	9	TM10
TM09	9	7	5	3	1	3	5	7	9	TM10

Information sharing

IS01 Verbal communication during CMEs enhances ACTs' availability

IS03 Rx-solution enhances ACTs availability

IS04 Information on stock cards has improved availability of ACTs

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
IS01	9	7	5	3	1	3	5	7	9	IS03
IS01	9	7	5	3	1	3	5	7	9	IS04
IS03	9	7	5	3	1	3	5	7	9	IS04

Responsiveness

R01 Scheduled issuance timelines by stores to other units

R03 Internal redistribution between units has enhanced availability of ACTs

R04 Efficient delivery timelines from Pharmacy has greatly improved availability of ACTs

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
R01	9	7	5	3	1	3	5	7	9	R03
R01	9	7	5	3	1	3	5	7	9	IS04
R03	9	7	5	3	1	3	5	7	9	IS04

Mutual Understanding

MU03 Mutual trust among staff members has enhanced demand forecast for ATCs

MU05 Shared goals among staff has improved ACT availability

MU08 Instructions on use of ACTs has greatly improved its availability

MU10 Communicating of policy change to patients has improved availability of ACT

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
MU03	9	7	5	3	1	3	5	7	9	MU05
MU03	9	7	5	3	1	3	5	7	9	MU08
MU03	9	7	5	3	1	3	5	7	9	MU10
MU05	9	7	5	3	1	3	5	7	9	MU08
MU05	9	7	5	3	1	3	5	7	9	MU10
MU08	9	7	5	3	1	3	5	7	9	MU10

Relationship management and Joint decision making

RM02 Good relationships among staff has positively enhanced availability of ACTs

RM03 Joint decision making during procurement planning has enhanced ACT availability

RM04 Good relationship of the hospital with her suppliers has improved ACTs stock levels.

RM05 Feedback loop with other units has greatly improved availability ACTs

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
RM02	9	7	5	3	1	3	5	7	9	RM03
RM02	9	7	5	3	1	3	5	7	9	RM04
RM02	9	7	5	3	1	3	5	7	9	RM05
RM03	9	7	5	3	1	3	5	7	9	RM04
RM03	9	7	5	3	1	3	5	7	9	RM05
RM04	9	7	5	3	1	3	5	7	9	RM05

2. LOGISTICS ACTIVITIES AFFECTING AVAILABILITY OF ACTS

Rank the preference of each item against each other; for example, Forecasting is more important than Quantification in developing a supply chain coordination framework for availing malaria treatment therapies, ACTs—then circle the magnitude from 1 (yellow) to 9 (green). Otherwise, circle from 1 (yellow) to 9 (red).

Key: Dispensing of ACTs (**D**); Storage management and distribution of ACT stocks (**SM**); Procurement and ordering of ACTs (**P**); Quantification of ACTs (**Q**); Forecasting (**F**)

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
D	9	7	5	3	1	3	5	7	9	**SM**
D	9	7	5	3	1	3	5	7	9	**P**
D	9	7	5	3	1	3	5	7	9	**Q**
D	9	7	5	3	1	3	5	7	9	**F**
SM	9	7	5	3	1	3	5	7	9	**P**
SM	9	7	5	3	1	3	5	7	9	**Q**
SM	9	7	5	3	1	3	5	7	9	**F**
P	9	7	5	3	1	3	5	7	9	**Q**
P	9	7	5	3	1	3	5	7	9	**F**
Q	9	7	5	3	1	3	5	7	9	**F**

The following are items that measure the different factors under LOGISTICS that affect the availability of ACTs, please rank the preference towards each other.

Quantification of ACTs

Q01 Totalled monthly consumption enhances ACTs availability

Q02 Quantification taking into consideration of maximum–minimum stock levels has enhanced ACT availability

Q03 Quantification using information from the dispensing logs has enhanced ACT availability

Q04 Quantification taking into consideration of malaria seasons enhances ACT availability

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
Q01	9	7	5	3	1	3	5	7	9	Q02
Q01	9	7	5	3	1	3	5	7	9	Q03
Q01	9	7	5	3	1	3	5	7	9	Q04
Q02	9	7	5	3	1	3	5	7	9	Q03
Q02	9	7	5	3	1	3	5	7	9	Q04
Q03	9	7	5	3	1	3	5	7	9	Q04

Storage management and distribution of ACT stocks

SM02 Labelling enhances availability of ACTs

SM03 Verification of expiry dates enhances ACTs' availability

SM04 Stock cards enhances availability of ACTs

SM06 Monitoring of room temperatures improves availability of ACTs

SM07 Medicine registers enhance availability of ACTs

SM09 Observance of minimum –maximum levels has enhanced ACT availability

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
SM02	9	7	5	3	1	3	5	7	9	SM03
SM02	9	7	5	3	1	3	5	7	9	SM04
SM02	9	7	5	3	1	3	5	7	9	SM06
SM02	9	7	5	3	1	3	5	7	9	SM07
SM02	9	7	5	3	1	3	5	7	9	SM09
SM03	9	7	5	3	1	3	5	7	9	SM04
SM03	9	7	5	3	1	3	5	7	9	SM06

SM03	9	7	5	3	1	3	5	7	9	SM07
SM03	9	7	5	3	1	3	5	7	9	SM09
SM04	9	7	5	3	1	3	5	7	9	SM06
SM04	9	7	5	3	1	3	5	7	9	SM07
SM04	9	7	5	3	1	3	5	7	9	SM09
SM06	9	7	5	3	1	3	5	7	9	SM07
SM06	9	7	5	3	1	3	5	7	9	SM09
SM07	9	7	5	3	1	3	5	7	9	SM09

Forecasting

F01 Estimating the average monthly consumption enhances availability of ACTs

F02 Forecasting based on disease patterns enhances of ACTs availability

F03 Forecasting using information from stock cards has enhanced ACTs availability

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
F01	9	7	5	3	1	3	5	7	9	F02
F01	9	7	5	3	1	3	5	7	9	F03
F02	9	7	5	3	1	3	5	7	9	F03

Dispensing of ACTs

D02 Prior testing of blood has enhanced ACT availability

D03 Verification of prescriptions enhances availability of ACTs

D04 Clear instructions on medicine usage has enhanced availability of ACTs

D06 Verification of dispensing logs has greatly improved availability of ACTs

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
D02	9	7	5	3	1	3	5	7	9	D03
D02	9	7	5	3	1	3	5	7	9	D04
D02	9	7	5	3	1	3	5	7	9	D06
D03	9	7	5	3	1	3	5	7	9	D04
D03	9	7	5	3	1	3	5	7	9	D06
D04	9	7	5	3	1	3	5	7	9	D06

Procurement and ordering of ACTs

PO1 Identification of needs enhances ACTs availability.

PO2 Annual procurement plans enhance ACTs availability.

PO4 Ordering based on approved budget enhances ACTs availability

PO5 Adherence to delivery schedules by NMS enhances ACTs availability

PO6 Requisitioning as per plan enhances ACT availability

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
PO1	9	7	5	3	1	3	5	7	9	PO2
PO1	9	7	5	3	1	3	5	7	9	PO4
PO1	9	7	5	3	1	3	5	7	9	PO5
PO1	9	7	5	3	1	3	5	7	9	PO6
PO2	9	7	5	3	1	3	5	7	9	PO4
PO2	9	7	5	3	1	3	5	7	9	PO5
PO2	9	7	5	3	1	3	5	7	9	PO6
PO4	9	7	5	3	1	3	5	7	9	PO5
PO4	9	7	5	3	1	3	5	7	9	PO6
PO5	9	7	5	3	1	3	5	7	9	PO6

3. MARKET FACTORS AFFECTING AVAILABILITY OF ACTS

Key: Relationship between lower health units (**RH**); Information sharing with suppliers, MoH, Donors (**ISS**); Collaborative partnerships for training (**CP**); SC interdependence with suppliers (**SCI**)

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
RH	9	7	5	3	1	3	5	7	9	**ISS**
RH	9	7	5	3	1	3	5	7	9	**CP**
RH	9	7	5	3	1	3	5	7	9	**SCI**
ISS	9	7	5	3	1	3	5	7	9	**CP**
ISS	9	7	5	3	1	3	5	7	9	**SCI**
CP	9	7	5	3	1	3	5	7	9	**SCI**

The following are items that measure the different factors that affect the availability of ACTs under MARKET ENVIRONMENT, please rank the preference towards each other.

Information sharing with suppliers, MoH, Donors

ISS 01 Online sharing of information enhances ACT availability

ISS 02 Regular exchanges information using hard copies of reports with other stakeholders enhances ACT availability

ISS 04 Sharing of weekly or monthly reports with other stakeholders has enhanced ACT availability

ISS 05 Holding of quarterly meetings with external stakeholders has enhanced ACT availability

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
ISS 01	9	7	5	3	1	3	5	7	9	ISS 02
ISS 01	9	7	5	3	1	3	5	7	9	ISS 04
ISS 01	9	7	5	3	1	3	5	7	9	ISS 05
ISS 02	9	7	5	3	1	3	5	7	9	ISS 04
ISS 02	9	7	5	3	1	3	5	7	9	ISS 05
ISS 04	9	7	5	3	1	3	5	7	9	ISS 05

SC interdependence with suppliers

SCI 02 Regular meetings with the supplier enhances ACT availability

SCI 04 Use of personal phone calls with NMS enhances ACT availability

SCI 05 Routine regional monitoring with stakeholders enhances ACT availability

SCI 06 Evaluation meetings with supplier enhances ACT availability

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
SCI 02	9	7	5	3	1	3	5	7	9	SCI 04
SCI 02	9	7	5	3	1	3	5	7	9	SCI 05
SCI 02	9	7	5	3	1	3	5	7	9	SCI 06
SCI 04	9	7	5	3	1	3	5	7	9	SCI 05
SCI 04	9	7	5	3	1	3	5	7	9	SCI 06
SCI 05	9	7	5	3	1	3	5	7	9	SCI 06

4. MACRO FACTORS AFFECTING AVAILABILITY OF ACTS

Rank the preference of each item against each other; for example, social-culture factors influence the availability of ACTs more than political factors—then circle the magnitude from 1 (yellow) to 9 (green). Otherwise, circle from 1 (yellow) to 9 (red).

Key: Legal framework and ACT availability (**LF**); Technological factors affecting ACT availability (**TF**); Social –cultural factors affecting ACT availability (**SC**); Economic factors (**EF**); Political factors affecting ACT availability (**PF**)

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
LF	9	7	5	3	1	3	5	7	9	**TF**
LF	9	7	5	3	1	3	5	7	9	**SC**
LF	9	7	5	3	1	3	5	7	9	**EF**
LF	9	7	5	3	1	3	5	7	9	**PF**
TF	9	7	5	3	1	3	5	7	9	**SC**
TF	9	7	5	3	1	3	5	7	9	**EF**
TF	9	7	5	3	1	3	5	7	9	**PF**

SC	9	7	5	3	1	3	5	7	9	**EF**
SC	9	7	5	3	1	3	5	7	9	**PF**
EF	9	7	5	3	1	3	5	7	9	**PF**

The following are items that measure the different factors that affect the availability of ACTs under MACRO ENVIRONMENT, please rank the preference towards each other.

Social –cultural factors affecting ACT availability

SC01 Clicks within the community enhances ACTs' availability

SC04 Public attitude towards the lower health facilities affects availability of ACTs

SC05 Compliance to dosage enhances ACTs availability

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
SC01	9	7	5	3	1	3	5	7	9	SC04
SC01	9	7	5	3	1	3	5	7	9	SC05
SC04	9	7	5	3	1	3	5	7	9	SC05

Legal framework and ACT availability

LF01 Implementing the testing and dispensing policy have enhanced availability of ACTs

LF02 Implementing the clinical guidelines have enhanced availability of ACTs

LF03 Regulating consumption has enhanced availability of ACTs

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
LF01	9	7	5	3	1	3	5	7	9	LF02
LF01	9	7	5	3	1	3	5	7	9	LF03
LF02	9	7	5	3	1	3	5	7	9	LF03

Technological factors affecting ACT availability

TF01 Use of phones enhances availability of ACTs

TF03 M-track system enhances availability of ACTs

TF04 Use of rapid Diagnostic tools (RDT) has enhanced availability of ACTs

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	

TF01	9	7	5	3	1	3	5	7	9	TF03
TF01	9	7	5	3	1	3	5	7	9	TF04
TF03	9	7	5	3	1	3	5	7	9	TF04

Economic factors

EF01 Poverty within the communities enhances ACTs availability

EF02 Availability of donor funds enhances availability of ACTs

EF03 Cost sharing enhances availability of ACTs

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
EF01	9	7	5	3	1	3	5	7	9	EF02
EF01	9	7	5	3	1	3	5	7	9	EF03
EF02	9	7	5	3	1	3	5	7	9	EF03

5. RANKING OF LEVEL TWO FACTORS

Key: Supply chain (S); Logistics (L); Macro level (MC); Market environment (M)

	Extreme importance	Demonstrated Importance	Strong Importance	Moderate importance	Equal importance	Moderate importance	Strong important	Demonstrated importance	Extreme importance	
S	9	7	5	3	1	3	5	7	9	**L**
S	9	7	5	3	1	3	5	7	9	**MC**
S	9	7	5	3	1	3	5	7	9	**M**
L	9	7	5	3	1	3	5	7	9	**MC**
L	9	7	5	3	1	3	5	7	9	**M**
MC	9	7	5	3	1	3	5	7	9	**M**

End—thank you for the participation

Appendix 11: AHP Results

A - Supply chain coordination dimensions

Organisation factors

Results				Normalisation				Average		Consistency	No	3
	OF5	OF08	OF09		OF5	OF08	OF09				Average Consistency	3,029
OF5	1,000	0,744	3,040	OF5	0,374	0,393	0,281	0,349	35%	3,028	Consistency ındex	0,014
OF08	1,345	1,000	6,785	OF08	0,503	0,529	0,627	0,553	55%	3,050	Random ındex	0,580
OF09	0,329	0,147	1,000	OF09	0,123	0,078	0,092	0,098	10%	3,009	Consistency ratio	0,025
Sum	2,674	1,891	10,825		1,000	1,000	1,000			9,086		

Top Management commitment

Results					Normalisation					Average		Consistency	No	4
	TM01	TM03	TM09	TM10		TM01	TM03	TM09	TM10				Average Consistency	4,195
TM01	1,000	2,750	2,078	1,862	TM01	0,420	0,383	0,516	0,290	0,402	40%	4,214	Consistency ındex	0,065
TM03	0,364	1,000	0,619	0,552	TM03	0,153	0,139	0,154	0,086	0,133	13%	4,175	Random ındex	0,900
TM09	0,481	1,616	1,000	3,000	TM09	0,202	0,225	0,248	0,468	0,286	29%	4,310	Consistency ratio	0,072
TM10	0,537	1,812	0,333	1,000	TM10	0,225	0,252	0,083	0,156	0,179	18%	4,082		
Sum	2,382	7,178	4,031	6,414		1,000	1,000	1,000	1,000			16,781		

Information sharing

Results				Normalisation				Average		Consistency	No	3
	IS01	IS03	IS04		IS01	IS03	IS04				Average consıstency	3,051
IS01	1,000	0,737	5,000	IS01	0,391	0,364	0,529	0,428	43%	3,071	Consistency ındex	0,025
IS03	1,357	1,000	3,457	IS03	0,531	0,493	0,366	0,463	46%	3,066	Random ındex	0,580
IS04	0,200	0,289	1,000	IS04	0,078	0,143	0,106	0,109	11%	3,016	Consistency ratio	0,044
Sum	2,557	2,026	9,457		1,000	1,000	1,000			9,153		

Responsiveness

Results				Normalisation				Average		Consistency	No	3
	R01	R03	R04		R01	R03	R04				Average consıstency	3,048
R01	1,000	3,073	7,198	R01	0,683	0,715	0,567	0,655	66%	3,091	Consistency ındex	0,024
R03	0,325	1,000	4,500	R03	0,222	0,233	0,354	0,270	27%	3,043	Random ındex	0,580
R04	0,139	0,222	1,000	R04	0,095	0,052	0,079	0,075	8%	3,010	Consistency ratio	0,041
Sum	1,464	4,295	12,698		1	1	1			9,144		

Mutual Understanding

Results					Normalisation					Average		Consistency	No	4
	MU03	MU05	MU08	MU10		MU03	MU05	MU08	MU10				Average consistency	4,178
MU03	1,000	0,450	5,320	0,797	MU03	0,214	0,260	0,291	0,098	0,216	22%	4,026	Consistency ındex	0,059
MU05	2,222	1,000	8,730	6,000	MU05	0,476	0,578	0,478	0,740	0,568	57%	4,368	Random ındex	0,900
MU08	0,188	0,115	1,000	0,310	MU08	0,040	0,066	0,055	0,038	0,050	5%	4,153	Consistency ratio	0,066
MU10	1,255	0,167	3,226	1,000	MU10	0,269	0,096	0,177	0,123	0,166	17%	4,166		
Sum	4,665	1,731	18,276	8,107		1,000	1,000	1,000	1,000	1,000	100%	16,712		

Relationship management and Joint decision-making

Results					Normalisation					Average		Consistency	No	4
	RM02	RM03	RM04	RM05		RM02	RM03	RM04	RM05				Average Consistency	4,922
RM02	1,000	6,540	5,940	2,070	RM02	0,554	0,729	0,608	0,264	0,539	54%	5,193	Consistency ındex	0,307
RM03	0,153	1,000	0,838	4,280	RM03	0,085	0,112	0,086	0,545	0,207	21%	5,032	Random ındex	0,900
RM04	0,168	1,194	1,000	0,501	RM04	0,093	0,133	0,102	0,064	0,098	10%	5,237	Consistency ratio	0,342
RM05	0,483	0,234	1,995	1,000	RM05	0,268	0,026	0,204	0,127	0,156	16%	4,226		
Sum	1,804	8,967	9,773	7,851		1,000	1,000	1,000	1,000			19,688		

B - Logistics activities

Forecasting

Results				Normalisation				Average		Consistency	No	3
	F01	F02	F03		F01	F02	F03				Average Consistency	3,097
F01	1,000	7,000	4,400	F01	0,730	0,583	0,779	0,697	70%	3,198	Consistency ındex	0,048
F02	0,143	1,000	0,250	F02	0,104	0,083	0,044	0,077	8%	3,018	Random ındex	0,580
F03	0,227	4,000	1,000	F03	0,166	0,333	0,177	0,225	23%	3,075	Consistency ratio	0,084
Sum	1,370	12,000	5,650		1,000	1,000	1,000			9,291		

Quantification

Results					Normalisation					Average		Consistency	No	4
	Q01	Q02	Q03	Q04		Q01	Q02	Q03	Q04				Average Consistency	4,133
Q01	1,000	0,234	5,000	2,000	Q01	0,167	0,155	0,263	0,216	0,200	20%	4,173	Consistency ındex	0,044
Q02	4,274	1,000	9,000	6,000	Q02	0,715	0,661	0,474	0,649	0,625	62%	4,273	Random ındex	0,900
Q03	0,200	0,111	1,000	0,250	Q03	0,033	0,073	0,053	0,027	0,047	5%	4,033	Consistency ratio	0,049
Q04	0,500	0,167	4,000	1,000	Q04	0,084	0,110	0,211	0,108	0,128	13%	4,051		
Sum	5,974	1,512	19,000	9,250		1,000	1,000	1,000	1,000			16,530		

Dispensing

Results					Normalisation					Average		Consistency	No	4
	D02	D03	D04	D06		D02	D03	D04	D06				Average consıstency	4,161
D02	1,000	3,700	6,000	5,000	D02	0,611	0,698	0,448	0,532	0,572	57%	4,304	Consistency ındex	0,054
D03	0,270	1,000	5,400	2,400	D03	0,165	0,189	0,403	0,255	0,253	25%	4,212	Random ındex	0,900
D04	0,167	0,185	1,000	1,000	D04	0,102	0,035	0,075	0,106	0,079	8%	3,992	Consistency ratio	0,060
D06	0,200	0,417	1,000	1,000	D06	0,122	0,079	0,075	0,106	0,095	10%	4,136		
Sum	1,637	5,302	13,400	9,400		1,000	1,000	1,000	1,000			16,643		

Procurement and ordering of ACTs

Results						Normalisation						Average		Consistency	No	5
	PO1	PO2	PO4	PO5	PO6		PO1	PO2	PO4	PO5	PO6				Average consıstency	5,401
PO1	1,000	3,330	0,566	0,718	6,620	PO1	0,217	0,411	0,114	0,248	0,335	0,265	26%	5,515	Consistency ındex	0,100
PO2	0,300	1,000	1,500	0,355	3,560	PO2	0,065	0,124	0,301	0,123	0,180	0,159	16%	5,334	Random ındex	1,120
PO4	1,767	0,667	1,000	0,600	4,020	PO4	0,383	0,082	0,201	0,208	0,203	0,215	22%	5,443	Consistency ratio	0,089
PO5	1,393	2,817	1,667	1,000	4,580	PO5	0,302	0,348	0,335	0,346	0,232	0,312	31%	5,474		
PO6	0,151	0,281	0,249	0,218	1,000	PO6	0,033	0,035	0,050	0,076	0,051	0,049	5%	5,238		
Sum	4,611	8,094	4,981	2,891	19,780		1,000	1,000	1,000	1,000	1,000			27,003		

Results							Normalisation							Average		Consistency	No	6
	SM02	SM03	SM04	SM06	SM07	SM09		SM02	SM03	SM04	SM06	SM07	SM09				AC	6,592
SM02	1,000	7,160	0,806	3,100	4,500	0,850	SM02	0,244	0,194	0,274	0,361	0,279	0,147	0,250	25%	6,899	CI	0,118
SM03	0,140	1,000	0,140	0,157	0,102	0,183	SM03	0,034	0,027	0,048	0,018	0,006	0,032	0,028	3%	6,156	RI	1,240
SM04	1,241	7,143	1,000	3,130	5,850	2,000	SM04	0,302	0,193	0,341	0,364	0,363	0,346	0,318	32%	6,814	CR	0,095
SM06	0,323	6,354	0,319	1,000	3,000	1,140	SM06	0,079	0,172	0,109	0,116	0,186	0,197	0,143	14%	6,832		
SM07	0,222	9,804	0,171	0,333	1,000	0,600	SM07	0,054	0,265	0,058	0,039	0,062	0,104	0,097	10%	6,415		
SM09	1,176	5,479	0,500	0,877	1,667	1,000	SM09	0,287	0,148	0,170	0,102	0,103	0,173	0,164	16%	6,434		
Sum	4,102	36,940	2,936	8,598	16,119	5,773		1,000	1,000	1,000	1,000	1,000	1,000			39,551		

Storage management and distribution of ACT stocks

C - Market environment

Information sharing with suppliers, MoH, Donors

Results					Normalisation					Average		Consistency	No	4
	ISS 01	ISS 02	ISS 04	ISS 05		ISS 01	ISS 02	ISS 04	ISS 05				Average Consistency	4,081
ISS 01	1,000	3,550	6,500	2,500	ISS 01	0,545	0,633	0,589	0,420	0,547	55%	4,146	Consistency ındex	0,027
ISS 02	0,282	1,000	2,000	1,800	ISS 02	0,153	0,178	0,181	0,303	0,204	20%	4,048	Random ındex	0,900
ISS 04	0,154	0,500	1,000	0,650	ISS 04	0,084	0,089	0,091	0,109	0,093	9%	4,085	Consistency ratio	0,030
ISS 05	0,400	0,556	1,538	1,000	ISS 05	0,218	0,099	0,139	0,168	0,156	16%	4,045		
Sum	1,836	5,606	11,038	5,950		1,000	1,000	1,000	1,000			16,324		

SC interdependence with suppliers

Results					Normalisation					Average		Consistency	No	4
	SCI 02	SCI 04	SCI 05	SCI 06		SCI 02	SCI 04	SCI 05	SCI 06				Average Consistency	4,091
SCI 02	1,000	0,275	0,199	0,456	SCI 02	0,084	0,054	0,115	0,059	0,078	8%	4,032	Consistency ındex	0,030
SCI 04	3,630	1,000	0,299	2,023	SCI 04	0,307	0,195	0,172	0,261	0,234	23%	4,097	Random ındex	0,900
SCI 05	5,015	3,349	1,000	4,278	SCI 05	0,424	0,654	0,577	0,551	0,552	55%	4,187	Consistency ratio	0,034
SCI 06	2,193	0,494	0,234	1,000	SCI 06	0,185	0,097	0,135	0,129	0,136	14%	4,047		
Sum	11,838	5,119	1,732	7,758		1,000	1,000	1,000	1,000			16,362		

D - Macro environment

Social –cultural factors affecting ACT availability

Results				Normalisation				Average		Consistency	No	3
	SC01	SC04	SC05		SC01	SC04	SC05				Average Consistency	3,022
SC01	1,000	8,500	3,000	SC01	0,689	0,751	0,659	0,700	70%	3,047	Consistency ındex	0,011
SC04	0,118	1,000	0,550	SC04	0,081	0,088	0,121	0,097	10%	3,007	Random ındex	0,580
SC05	0,333	1,818	1,000	SC05	0,230	0,161	0,220	0,203	20%	3,012	Consistency ratio	0,019
Sum	1,451	11,318	4,550		1,000	1,000	1,000			9,066		

Legal framework and ACT availability

Results				Normalisation				Average		Consistency	No	3
	LF01	LF02	LF03		LF01	LF02	LF03				Average Consistency	3,000
LF01	1,000	0,950	1,050	LF01	0,333	0,336	0,329	0,333	33%	3,000	Consistency ındex	0,000
LF02	1,053	1,000	1,140	LF02	0,350	0,354	0,357	0,354	35%	3,000	Random ındex	0,580
LF03	0,952	0,877	1,000	LF03	0,317	0,310	0,313	0,314	31%	3,000	Consistency ratio	0,000
Sum	3,005	2,827	3,190		1,000	1,000	1,000			9,000		

Technological factors affecting ACT availability

Results				Normalisation				Average		Consistency	No	3
	TF01	TF03	TF04		TF01	TF03	TF04				Average Consistency	3,001
TF01	1,000	0,467	4,310	TF01	0,296	0,295	0,311	0,301	30%	3,001	Consistency ındex	0,000
TF03	2,141	1,000	8,570	TF03	0,635	0,631	0,617	0,628	63%	3,001	Random ındex	0,580
TF04	0,232	0,117	1,000	TF04	0,069	0,074	0,072	0,072	7%	3,000	Consistency ratio	0,001
Sum	3,373	1,584	13,880		1,000	1,000	1,000			9,002		

Economic factors

Results				Normalisation				Average		Consistency	No	3
	EF01	EF02	EF03		EF01	EF02	EF03				Average Consistency	3,069
EF01	1,000	0,450	0,130	EF01	0,092	0,148	0,074	0,105	10%	3,022	Consistency ındex	0,034
EF02	2,222	1,000	0,630	EF02	0,204	0,329	0,358	0,297	30%	3,052	Random ındex	0,580
EF03	7,692	1,587	1,000	EF03	0,705	0,523	0,568	0,599	60%	3,131	Consistency ratio	0,059
Sum	10,915	3,037	1,760		1,000	1,000	1,000			9,206		