THE IMPACT OF MOTHERS' KNOWLEDGE ON THE IMMUNISATION OF CHILDREN YOUNGER THAN FIVE IN GA-RANKUWA, SOUTH AFRICA

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ABSTRACT

Routine immunisation at an appropriate age is the best means of averting vaccine-preventable diseases. Though the immunisation coverage rates for all nine provinces in South Africa are available, these are not available for smaller locations, such as Ga-Rankuwa, in the Gauteng province of South Africa (hereafter Gauteng). The main problem addressed by this study was the unavailability of immunisation coverage rate for Ga-Rankuwa, based on the Expanded Programme on Immunisation (EPI). Information was also lacking about mothers' knowledge regarding immunisation and barriers they encountered to immunise their children younger than five. Data were gathered by direct observation of the Road-to-Health charts (n = 926) of children in Ga-Rankuwa. The mothers' knowledge levels were estimated by using structured interview schedules. Of the children, 46.1% (n = 426) missed one or more immunisations according to the schedule. The 60 month coverage rate was only 19.0%. Some mothers (59.8%) only used the Road-to-Health chart for the child's weight and 31.4% were unable to interpret the chart. Community-specific interventions, based on the evidence generated by the study, are urgently required to enhance the immunisation coverage in Ga-Rankuwa.

KEYWORDS: children younger than five, Expanded Programme on Immunisation (EPI), Ga-Rankuwa, immunisation coverage, mothers' immunisation knowledge, Primary Health Care (PHC)

INTRODUCTION AND BACKGROUND INFORMATION

According to Bedford and Elliman (2006), "Immunisation against infectious diseases has probably saved more lives than any other public health intervention". This state-

ment describes the role immunisation has played since Edward Jenner first used cowpox to prevent smallpox in 1796. In 1885, Louis Pasteur developed the rabies vaccine and in 1962, the oral polio vaccine was introduced. In 1967, the smallpox eradication programme was started and by 1979 it was virtually eradicated from the world (CRCVT, 2004). According to Blackman (2006), immunisation has dramatically reduced the incidence of a number of deadly diseases. According to the (WHO/UNICEF, 2007a), review, the official South African coverage for BCG was 79.0% and for DTP3 it was 99.0% in 2006.

However, infectious diseases remain important community health problems in the developing world (Blackman, 2006). The global eradication of some infectious diseases is one of the World Health Organization's (WHO's) main objectives. In 2002, the WHO estimated that 1.4 million deaths of children younger than five were due to diseases preventable by routine immunisations. This represented 14.0% of the global total mortality of children younger than five (WHO, 2007). Until the Expanded Programme on Immunisation (EPI) was launched in 1974, fewer than 5% of the world's children were immunised during their first year against six killer diseases, namely: poliomyelitis, diphtheria, tuberculosis, pertussis, measles and tetanus. During 2006, almost 75.0% of children had received these life-saving immunisations (WHO/UNICEF, 2007a).

According to the South African EPI, newborns receive the first vaccine (BCG) within three days of birth. A Road-to-Health chart is given to the mother to keep with her (EPI-SA, 2006) on which the child's name, birth weight and height, and the next scheduled immunisation visit are recorded. At every immunisation visit, the Road-to-Health chart is signed and the next scheduled visit is indicated. The Road-to-Health chart is an important tool for monitoring the coverage of the implementation of the EPI in South Africa (EPI-SA, 2006).

RESEARCH PROBLEM

Though the immunisation coverage rate for each province in South Africa is available, no specific data are accessible for smaller locations, such as Ga-Rankuwa, in the Gauteng province of South Africa (hereafter Gauteng). According to the Task Force on Community Preventive Services (TFCPS, 2000:92), all vaccine-preventable diseases, except tetanus, are transmitted from person to person. Urban communities with a low socio-economic status, are particularly vulnerable if the immunisation rates are low. The TFCPS (2000:93) prescribes that a specific community's low immunisation rates should be investigated and addressed.

If the coverage could be determined, community-specific interventions could be developed. In 2004, the immunisation coverage in Gauteng of children younger than five was 72.4%; and only 63.4% of children younger than five were fully immunised in South

Africa (Health Systems Trust, 2005). Low immunisation coverage leads to increased incidence of communicable diseases and resultant complications. A consequence of not knowing mothers' or caregivers' levels of knowledge concerning immunisation, is that health care professionals can only provide general, rather than specific, health education messages which might not address their particular concerns.

The research questions were: "What is the EPI coverage rate for children younger than five in Ga-Rankuwa?" and "What are the mothers' knowledge levels about immunisation?"

OBJECTIVES OF THE STUDY

The objectives of this study were to determine the immunisation coverage rate of children younger than five living in Ga-Rankuwa and their mothers'/caregivers' levels of knowledge about immunisation.

Theoretical basis of the study

The theoretical basis of the study was anchored in the primary health care (PHC) approach, health promotion and McFarlane's Community as Partner Model (Ervin, 2002:86), as frameworks for healthcare service and nursing service delivery.

Definitions of key terms

Immunisation coverage rate measures the proportion of a targeted population (usually children at certain ages) that have received the recommended doses of vaccines to protect them against contracting certain serious illnesses (Bos & Batson, 2000:7).

The Expanded Programme on Immunisation (EPI) was launched by the WHO in 1974, to increase immunisation rates from 5% to 80% of all children within 30 years, by 2014 (Van Hoang, Nguyen, Kim, Dao, Nguyen & Wright, 2007:429).

Immunisation is the process of making an individual immune (resistant to infection) by inoculation (Freshwater & Maslin-Prothero, 2005:296).

RESEARCH METHODOLOGY

Research setting

This study was based in Ga-Rankuwa, part of the City of Tshwane Metropolitan Municipality, in Gauteng. According to Census 2001 (Statistics South Africa, 2001), the

major languages spoken were Setswana and Sepedi. In 2001, the total population for the area was approximately 83 000 with 6 000 under five-year-olds.

Research design

The immunisation coverage was investigated using a cross-sectional, descriptive design – checking the Road-to-Health chart against a checklist. The knowledge of the mothers was determined using a descriptive, quantitative survey with structured interview schedules.

Population, sample and sampling technique

A stratified sampling method was used because the population was spread over a large geographical area (Timmreck, 2002:254). Ga-Rankuwa consists of 14 residential zones with almost 9 800 numbered residential stands. To maximise the coverage of the area, seven zones were chosen using simple random sampling. The chosen units were 1, 2, 3, 4, 6, 7 and 8. To be able to determine which specific households to target, a 1:10 000 scale map of Ga-Rankuwa was used. A starting point in Zone 1, between stands 1–10, was chosen randomly (Bailey, Vardulaki, Langham & Chandramohan, 2005:155) and thereafter 1 000 stand numbers were chosen by systematic sampling (i = 9) using all the chosen zones. All the mothers/caregivers on a selected stand were included in the survey. The sample size recommended by the statistical support section of the Directorate Research and Development of Tshwane University of Technology, was 1 000 households.

Data collection

Data collection was done through audits of the Road-to-Health charts of the children of families living on the chosen stand numbers in Ga-Rankuwa (n = 982) in November 2007. The data-gathering instrument was a checklist, using the Road-to-Health chart as a basis. The fieldworkers had to evaluate the completeness of the Road-to-Health chart in terms of obtaining the PHC personnel's signature for a specific immunisation on the required date.

To explore knowledge of the mothers/caregivers, structured interviews were conducted. The pre-tested structured interview schedule contained both open-ended items and questions with fixed alternative choices for potential answers. The structured interview schedule was based on the EPI.

The data were analysed using SPSS version 15 (SPSS for Windows®, 2007). During data analysis, the percentage distributions, means and ranges of specific variables were

reported. Chi-square tests of independence and Pearson's product-moment correlation coefficients were used to investigate relationships between variables (Burns & Grove, 2005:518)

Validity and reliability

The validity of the data was assured by implementing the following measures: The sampling method, a stratified sample combined with a systematic sample using a random start, ensured a representative sample of the Ga-Rankuwa community. The coverage of immunisation was determined by actual observation of the Road-to-Health chart, which is the official document provided by the Department of Health to record each child's immunisations. The chart is kept by the mother/caregiver, which supports the design of a house-to-house survey. Ten socio-culturally congruent fieldworkers, known to the Tshwane University of Technology, were trained and supervised by the researcher during the survey. The respondents were addressed in English, Setswana or Sepedi to improve understanding of the questions and build trust. The cross-sectional data were gathered within one month so that the data would not be biased by community members' relocations. The structured interview approach prevented selection bias due to respondents' literacy levels.

To ensure reliability, the data were gathered using a pre-tested checklist and a structured interview schedule based on the EPI, as used in South Africa.

ETHICAL CONSIDERATIONS

The Research Ethics Committee of Tshwane University of Technology approved the research study (Reference number: 2006/07/004). The principles of respect for human dignity, justice, privacy and beneficence were upheld. Respondents were fully informed what their participation involved and signed informed consent before being interviewed. Anonymity and confidentiality were maintained by using the same sequential number on the checklist and structured interview schedule. The completed structured interview schedules were locked away and only the research team had access to the raw data.

FINDINGS OF THE STUDY

Immunisation coverage level: complete immunisation records per age group

Table 1 reports the EPI coverage levels for children younger than five in Ga-Rankuwa in 2007. The coverage levels for two groups, those up to 11 months and those from 12–23

months old were compared with the indicator data published by the Health Systems Trust (2002).

Table 1: Immunisation indicator data for Gauteng (1998, 2002) and Ga-Rankuwa (2007)

Age group (months)	Gauteng Province Immunisation Indicator Data* (%)	Ga-Rankuwa %	n
Up to 11	60.7 (2002)	69.9	173
12–23	72.4 (1998)	61.2	139
24–35		56.3	323
36–47		57.9	140
48–60		19.5	149
Total			924

Source: Health Systems Trust (1998, 2002)

The immunisation coverage level for the up to 11 months group increased from 60.7% in 2002 to 69.9% in 2006. The level of the 12–23 months age group, however, decreased from 72.4% to 61.2%. The immunisation coverage rate decreased from the up to 11 months group (69.9%; n = 173) to the 48–60 months age group (19.5%; n = 149) (see table 1). The correlation between age group and complete records was significant at the 0.01 level (two-tailed test). The implication of this significant finding is that the older the child gets, the lower the percentage of full immunisation coverage.

Immunisation coverage: number of missing immunisations per year age group

The records of the group with incomplete charts (46.1%; n = 426) were investigated for the number of missing vaccines as prescribed by the EPI. The evaluation included one, two and three or more missing records. Table 2 displays these results.

Table 2: Missing vaccinations observed from Road-to-Health charts per age group (n = 426)

Age group (months)	Number of missing vaccines						Total	
	1		2		≥ 3			
	n	%	n	%	n	%	n	%
Up to 11	24	46.2	11	21.2	17	32.7	52	100
12–23	16	29.6	6	11.1	32	59.3	54	100
24–35	31	22.0	19	13.5	91	64.5	141	100
36–47	10	16.9	7	11.9	42	71.2	59	100
48–60	3	2.5	26	21.7	91	75.8	120	100
Total	84	19.7	69	16.2	273	64.1	426	100

Of the group who had missed vaccinations, more than half (64.1%; n = 273) had missed three or more vaccines prescribed by the EPI (table 2). The implication of this result is that, from the sample of 924 children, 273 children (29.5%) had an increased risk of contracting communicable diseases. The risk was higher for children in the 48–60 months age group (75.8%; n = 120) compared to younger children in the up to 11 months age group (32.7%; n = 52).

EPI coverage per vaccine for children younger than five

Table 3: EPI coverage of each vaccine for children younger than five (n = 924)

Age in weeks	Road-to-Health chart schedule	Eligible sample	Vaccines given	Coverage %
Birth	BCG	924	909	98.4
Birth	Polio 0	924	904	97.8
6	Polio 1	908	888	97.8
6	DTP 1	908	841	92.6
6	Hib 1	908	823	90.6
6	Heb B 1	908	841	92.6
10	Polio 2	886	825	93.1
10	DTP 2	886	781	88.1
10	Hib 2	886	797	90.0
10	Heb B 2	886	830	93.7
14	Polio 3	855	802	93.8
14	DTP 3	855	755	88.3
14	Hib 3	855	756	88.4
14	Heb B 3	855	789	92.3
36	Measles 1	721	630	87.4
72	Polio 4	671	529	78.8
72	DTP 4	671	514	76.6
72	Measles 2	671	507	75.6
260	Polio 5	131	54	41.2
260	DT 1	131	26	19.8

Table 3 indicates that the EPI schedule was followed closely from birth till 14 weeks; the percentage of doses given remained above 90% except for DTP 3 (88.3%; n = 755) and Hib 3 (88.4%; n = 756). The coverage level for the measles 1 vaccine at 36 weeks (9 months) was still high at 87.4% (n = 630). The 72 week (18 months) vaccines were below the 80% objective, with Polio 4 at 78.8%, DTP 4 at 76.6% and measles 2 at 75.6%. The most important result, however, was the coverage of the 260 weeks (five years). The Polio 5 vaccine was given to only 41.2% (n = 54) and DT 1 to only 19.8% (n = 26) of the eligible sample. The implication is that these children might not have full

immunity against measles, polio, diphtheria or tetanus should a polio outbreak occur in this community.

Demographic profile of mothers or caregivers

The sample comprised 982 mothers. More than half of the group (59.9%; n = 588) had a secondary education, while 18.1% (n = 177) had a tertiary education. Approximately half of the women (51.1%; n = 501) were unemployed, with 39% (n = 382) being formally employed. Almost half of the respondents (49.3%; n = 484) indicated receiving no income, while a third (30.5%; n = 299) had a monthly income within the R1–R2400 range.

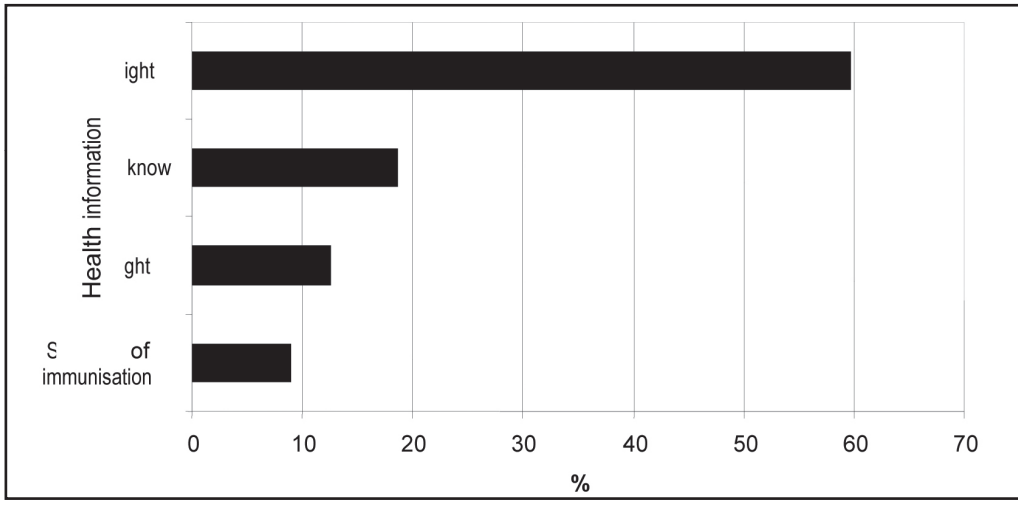

Figure 1: Mothers/caregivers' knowledge of health information provided by Road-to-Health chart (n = 982)

Some mothers (59.8%; n = 587) knew that the child's weight could be obtained from the Road-to-Health chart and 12.6% knew about the height of the child (see figure 1). A slightly larger group (18.6%; n = 182) could not indicate any health-related information that they could obtain from the Road-to-Health chart. This result provided support for the group (16.6%; n = 163) who reported no knowledge relating to immunisation. From the findings of the study, it could be stated that two out of every ten mothers were not knowledgeable about the Road-to-Health chart or the need for immunisations.

Regarding health education relating to immunisations, most respondents (66.6%; n = 654) indicated that they had received health education. Of this group, the majority (94.6%) had received the education in groups, while only 5.4% had received individual

education. The majority (82.6%; n = 811) had been reminded about their children's next scheduled appointments. However, 17% (n = 167) indicated that they had not been reminded about their children's next scheduled appointments.

DISCUSSION OF THE FINDINGS

In the Ga-Rankuwa community in 2007, the coverage rate of immunisation amongst children younger than five was 76.5%, compared with the coverage of 72.4% in Gauteng (Health Systems Trust, 2005). Although the immunisation rate for children is rising, coverage levels have not reached optimal goals (Jacobson Vann & Szilagi, 2005:1). Improving coverage in impoverished urban communities should be a priority for health-care workers. An urban, low socio-economic status population is particularly vulnerable when the immunisation rate is low.

Of concern is the complete immunisation record per age group (table 1). The coverage rate of the children younger than five decreased with age, with an immunisation coverage level of 19.5% for the DT 1 immunisation. The goal of the EPI was to ensure that by 2010, routine immunisations of children younger than one should have reached 90% nationally and at least 80% in every district or equivalent administrative unit (UNICEF, 2007). The coverage rate for the Ga-Rankuwa area, in terms of the younger than one-year-olds, was 69.9%, which was low compared with the target level of 80% coverage set by the EPI.

The situation in South Africa is similar to other parts of the world. Up until September 2003, South Africa was considered to have virtually eliminated measles. No measles-related deaths had been reported since 2000 as a direct result of the Measles Elimination Strategy (Naidoo, 2009). However, the 2003–2004 Gauteng Province outbreaks of measles dealt a significant blow to measles control and elimination in South Africa. By mid-2006, the overall routine immunisation coverage for South Africa was less than 80.0% and that of the DTP3 97% (WHO, 2007). The WHO set a routine coverage target for fully immunised children under the age of one year of 90.0%.

Other communicable diseases on the EPI schedule are also problematic. In South Africa, pertussis rates are 5–10 times higher than in the United Kingdom or the United States of America. Pertussis hospital discharge rates have increased steadily since the 1960s, with the average rate in the 2000s (5.8 per 100 000 person-years) being 50% greater than in the 1960s (3.8 per 100 000 person-years) (Goodyear-Smith, Grant, York, Kenealy, Copp, Petousis-Harris, Turner & Kerse, 2007:477). Other countries also experience similar problems. Reportedly, New Zealand's childhood immunisation coverage rate is lower than that of many other westernised countries and that of its Pacific neighbours. UNICEF 1998 data indicated that New Zealand ranked 102nd out of the 193 listed

countries for its primary infant series immunisation rates (Petousis-Harris, Goodyear-Smith, Turner & Soe, 2004:2340).

Internationally, several systems have been put in place to increase the immunisation rate of children younger than five. By 2004, 99.0% of New Zealand's general practitioners were using computerised practice management systems, with electronic registration and recall of patients. The practice management system has the ability to collect and audit the immunisations given by the primary healthcare practitioners. Practices have kept age and sex registers of their patients, with precall and recall systems in place to maximise immunisation coverage (Goodyear-Smith et al., 2007:477).

In Australia, the implementation of incentives for both health services providers and parents to immunise infants has resulted in childhood immunisation coverage being amongst the highest in the world (O'Grady, Taylor-Thomson, Chang, Torzillo, Morris, Mackenzie, Wheaton, Bauert, De Campo, De Campo & Ruben, 2008:S01). Despite Australia's success in achieving comparatively high immunisation coverage rates at 12 and 24 months of age, problems with the timelines of vaccinations in the primary series have been identified (O'Grady et al., 2008:S01).

In Africa, other factors have been identified. Migration of parents, particularly rural to rural migration, was identified as an important influence on a child's immunisation status in Ethiopia because of limited social networks for the mothers in host communities (O'Grady et al., 2008:S01). The influence of family relocation in the current study was not extensive as only 16.4% (n = 161) had reportedly moved recently and, of this group, 78.3% had up-to-date Road-to-Health charts.

Number of missing immunisations per child per year age group

In the Ga-Rankuwa community in 2007, there was a decreasing level of coverage through the five age groups, ending with the 48–60 months age group (table 4.3). The rate was high during the initial 14 weeks but declined after 188 weeks (47 months). Of the group who had missed vaccines (n = 426), a high number, 64.1% (n = 273), had missed three or more of the vaccines prescribed by the EPI (table 4.2). Based on these results, three possible reasons for the declining coverage are proposed: The mothers/caregivers might consider the first year of the child's life as being the most important for receiving immunisation. Once the child is growing well, the importance of health-promoting behaviour is less apparent, especially in terms of the low socio-economic status which is prevalent in the community. Another possible reason might be that if the child is growing well, there is no need to take the child to the clinic and the travel expenses are avoided. The study has shown that the mothers/caregivers frequently associate the Road-to-Health chart with the growth of the child, rather than as a comprehensive document with various applications. Registered professional nurses might also

focus more on the importance of immunisation during the first year of the child's life. Should the child be healthy, the registered professional nurse might not see the child at all and would therefore not remind the mother/caregiver of the next due immunisation. Healthy children might become "invisible" precisely because they are healthy.

These proposals must be researched in depth in order to provide evidence for an intervention to improve the immunisation coverage up to five years of age. Boggs (2007) recommends that when a mother comes for an antenatal consultation, registered professional nurses should initiate the education about childhood health problems, especially childhood diseases and their prevention. Another point is the importance of the next visit's reminder. Mothers or caregivers living in Ga-Rankuwa did not report reminders as barriers to immunisation. According to Vann Jacobson and Szilagyi (2005:2), patient reminder and recall systems in primary healthcare settings are effective for improving immunisation rates within developed countries. The current study revealed that 17.0% (n = 167) of mothers/caregivers of children younger than five living in Ga-Rankuwa were not reminded of the next appointment for routine immunisations. This put 167 children at risk of missing an opportunity for receiving their vaccinations.

Immunisation drop-out rate (DTP3-measles)

The percentage of children receiving the third DTP3 immunisation is an indicator of how well countries provide routine immunisations. According to the WHO (2008), in 1974 less than 5% of the world's children had received immunisations in the first year of life, compared to 30% in 1980 and 79% in 2006.

The DPT3 coverage rate is a combined indicator of the health system's capacity to provide regular services and the population's sustained demand for those services over time (WHO, 2008). The number of children younger than one year of age who did not receive DTP3 worldwide was 26.3 million in 2006, compared with 28.1 million in 2005. Of these children, 75% lived in the following ten countries: India, Nigeria, Indonesia, China, Angola, Niger, Bangladesh, the Democratic Republic of the Congo (DRC), Pakistan and Ethiopia (WHO, 2008). Moreover, 14 countries reported that 80% of their districts had achieved DPT3 coverage of 80% or higher, an increase over the nine countries reporting this level of coverage in 2002.

Immunisation coverage declined or stagnated in the Africa region in the 1990s. As a result, in 2002, the region accounted for 11 million of the estimated 33.4 million children globally who had not received at least three doses of DPT vaccine by 12 months of age. To reach these non-immunised children, service partners should search for innovative strategies to improve childhood immunisation coverage. In South Africa, the coverage level for DTP3 was 99.0% in 2006, compared with that of Mozambique (72.0%) for the

same year. Deaths from measles, a major killer, declined by 60.0% worldwide and by 72% in sub-Saharan African countries between 1999 and 2005 (WHO/UNICEF, 2007b).

Another aspect is the consideration of the herd immunity amongst children younger than five in the Ga-Rankuwa community. Herd immunity describes a type of immunity which occurs when the vaccination of a population (herd) provides protection to unprotected individuals (John & Samuel, 2000:601). This means that in diseases passed from person to person, it is more difficult to maintain a chain of infection when many persons in a population are immune to a specific infectious disease.

CONCLUSIONS

A complete immunisation record is a gift a mother/caregiver can give every child in South Africa. Many systems have been developed and implemented to facilitate this valuable gift. The study, however, provided evidence that although the immunisation coverage in 2007 was excellent during the infant's first three months, the coverage decreased as the child grew older. In addition, evidence was produced that if a child's immunisation record was not up to date, the chances were high that the child had missed more than one immunisation. Without community-specific interventions to raise awareness of the total programme, and systems to identify and follow-up on children who missed an opportunity, the life-saving protection possible through immunisation might never become a reality for all South African children.

RECOMMENDATIONS

To enable the primary health clinic personnel to identify a child who has missed an immunisation, a surveillance system should be developed and implemented enabling the identification of such children. Such a system should preferably be electronic and allow for operation by an administrative staff member. In addition, a system must be developed that is able to locate such children. In-depth research of the system, the personnel and the cost of implementing such a comprehensive system should be conducted as a matter of urgency.

LIMITATIONS

The research was conducted in Ga-Rankuwa, which is part of the City of Tshwane, an urban area in Gauteng. The results can, therefore, not be extrapolated to rural areas in Gauteng or other provinces.

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