# An evaluation of the national measles vaccination campaign in the new shanty areas of Khayelitsha

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## Summary

**A local component of the national measles vaccination campaign was evaluated in an area undergoing rapid urbanisation near Cape Town. Four serial cross-sectional cluster samples were used. Proven vaccination coverage before the campaign was 55,8% (95% confidence interval (CI) 46 - 66%), immediately afterwards it was 71,1% (95% CI 65 - 77%), and 6 months later 73,6% (95% CI 67 - 80%). The increase was not sustained among Transkei-born children. Significant determinants of vaccination coverage were: place of birth ($\chi^2$ = 9,7; 2 df; $P$ = 0,008); $\leqslant$ 6 months stay in Cape Town (odds ratio (OR) 2,22; 95% CI 1,2 - 4,0%); and home birth (OR 3,21; 95% CI 1,2 - 8,4%). The value of campaigns in controlling measles, as well as the role of a comprehensive health care service are discussed.**

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Until recently, measles prevention has received low priority attention at a national level but the national measles vaccination campaign implemented in 1990 represents a change for the better. A national campaign will, however, be futile unless it forms part of a broader strategy for measles control. In this context, the effectiveness of a campaign in the rapidly changing communities so typical of urban and peri-urban South Africa needs to be evaluated. The co-ordinated effort by the various medical schools to evaluate the national campaign included several provincial-level pre-evaluations that were on too large a scale to assess the effect on specific urbanising communities. The planned post-evaluation may also be too late to identify the role of time in dilution of coverage. With these factors in mind, the Western Cape Measles Co-ordinating Committee commissioned a study to make serial assessments of a specific high-risk group in a rapidly urbanising black community near Cape Town.

The area concerned, Khayelitsha, has burgeoned in the wave of urbanisation that followed the easing of influx control and the population is at present estimated to be 305 000. During settlement many people gravitated to land planned for schools, sports fields and other facilities, and erected squatter dwellings without the benefit of planned services. These informal settlements, dispersed among the serviced areas, are known as the New Shanties.

Coetzee *et al.*[1] showed that the new shanties have the lowest proportion of inhabitants born in Cape Town, the lowest measles vaccination coverage, fewest community health-worker health-worker visits, and the highest proportion of measles cases, all of which contributed to the choice of these areas as a high-risk, urbanising community, most likely to be affected by the phenomenon of influx, and least likely to have contact with ordinary health services.

## Subjects and methods

Fig. 1 gives the timing of the four cross-sectional surveys comprising this study. Survey 1 was conducted during the week before the campaign. A publicity drive utilised stickers, pamphlets, posters, radio, newspapers, and enlisted the help of community leaders. Actual vaccination activity was divided into two phases. The first involved all available staff based at fixed clinics and in the community using two mobile units equipped with loud-hailers. If no 'Road to Health Card' (RTHC) was available, a new, specially coloured card was issued. Any child between the age of 6 months and 5 years without documentation of vaccination was given measles and/or polio vaccine. Community health workers, student nurses and health inspectors all contributed to this phase. Survey 2 followed the initial 3-week major campaign. The work-load involved in the campaign was considerable, not only due to administering measles vaccination but also, encouraged by the publicity, to a generalised increase in attendance at clinics for other ailments. Owing to a marked fall in staff morale, and to rainy weather, it was decided not to push for a campaign of similar dimensions during the second phase, and a simple 'mopping-up' policy was adopted. Survey 3 followed this phase, which marked the end of the campaign. Survey 4 followed approximately 6 months after the first campaign, in the hope of documenting any dilutional effect that might have occurred.

Each of the four surveys undertaken were cluster samples. In order to conform to the target age group of the campaign, and to make possible more detailed analysis by age, all children from 6 months to < 5 years were selected. The sampling technique was based on that recommended by the World Health Organisation's Expanded Programme on Immunisation,[2] using the comparison of aerial photographs from 1986 and 1989 as a sampling frame. Trained, experienced fieldworkers, familiar with local language and customs, not employed by the authority implementing the campaign, were given detailed instructions on locating the clusters. They were supervised in the field until it was ascertained that the methods were clearly understood.

A questionnaire, initially based on that of Coetzee *et al.*'s[1] study, was administered by the fieldworkers, and details of birth date and vaccination were obtained from the RTHC, where available. If there was no card, the informant was asked to estimate the child's age, but only actual documentation was accepted as proof of vaccination. In surveys 3 and 4 documented vaccination was compared with the subjective version reported elsewhere. Survey 4 also included a check on nonresponders, and documented the number of dwellings in which no child of the appropriate age was found.

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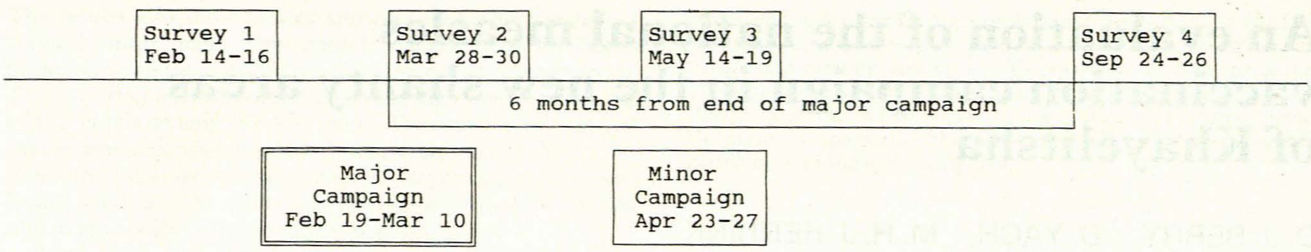


**Fig. 1. The timing of the cross-sectional surveys.**

## Statistical analysis

Data were analysed in consultation with the Institute for Biostatistics of the South African Medical Research Council. Software used included Epi-Info5, Lotus 123, as well as PC and mainframe SAS.

Methods described by Henderson and Sundaresan,[3] Cochran,[4] and Felligi[5] were used in the analysis of cluster sampling. The latter reference suggests an interesting approach to correcting for the effect of cluster sampling on the result of the $\chi^2$-test.

At the time of analysis it became clear that the quality of the work of 1 of the 6 fieldworkers made it unsuitable for inclusion in the analysis. Fortunately, design effects were relatively low, making the smaller sample size adequate for the aims of the study.

## Results

The irregular size of samples shown in Table I reflects not only the effect of having to exclude one fieldworker, but also the fact that larger numbers were required in survey 3 for a sub-study not reported here.

With respect to the response rate, 9,7% of dwellings were locked; of the remaining 90,3%, 11,7% had no children, 70,1% had 1, 17,0% 2, and 0,4% 3. If the locked houses were to have the same distribution of children as those visited, this would yield a response rate of 90,4%.

The RTHC was available for 61,7% of cases in study 1, while in the other studies, this ranged from 77,4% to 85,1% ($\chi^2$-test 33,4; 3 df; $P = 0,0001$). Reasons given for not having a card included the following: 45% — left behind when they came to Cape Town; 25% — lost; 12% — left at mother's work; 9% — burnt; and 4% — at crèche. In surveys 2 - 4 37% of cards came from a big hospital, 46% from a fixed clinic, 2% from a mobile clinic, and 13% were the special card given out during the campaign. The proportion of cases in which the informant was the mother remained constant over the studies. The last study demonstrated a distinctly higher proportion of children with a history of measles ($\chi^2$-test 18,34; 3 df; $P = 0,0004$).

The coverage figures are given in Table II. The initially low value of 55,8% rose 15,3% by the time of survey 3 and stayed at this level over the follow-up period.

Median age at first vaccination was 8,2 months overall, and this varied very little between surveys. Between 11,5% and 13% of children had been vaccinated before the age of 6 months. The second vaccination (30,7% of all vaccines) occurred at a median age of 12,9 - 15,5 months.

Between 33,7% and 38,5% of children had not been born in Cape Town. Of these, 58% came from Transkei and 27% from Ciskei, 25,5% had been in Cape Town less than 6 months, and 27,8% were less than 6 months of age on arrival (Table III). The proportion of children who had arrived over the previous 6 months was unchanged from survey 1 to survey 4. This is evidence against a trend towards increasing rate of influx. The cross-sectional nature of these surveys makes calculation of influx rates complex and small numbers aggravate the problem, as does the phenomenon of regression to the mean. No attempt has therefore been made to assess the rate of influx itself.

**TABLE I. SUMMARY DATA**

| | Survey 1 | Survey 2 | Survey 3 | Survey 4 |
|---|---|---|---|---|
| **No. of children** | **206** | **175** | **350** | **205** |
| **Clusters** | **25** | **26** | **50** | **30** |
| **Mean age (mo.)** | **27,4** | **25,6** | **26,2** | **26,2** |
| **No. 12 - 23 mo.** | **48** | **56** | **107** | **65** |
| **RTHC available (%)** | **61,7** | **85,1** | **77,4** | **80,0** |
| **Proportion where informant is the mother (%)** | **84,4** | **86,9** | **84,9** | **83,8** |
| **History of measles disease (%)** | **13,7** | **14,3** | **12,8** | **26,0** |
| **Median age at time of disease (mo.)** | **—** | **12** | **14** | **12** |
| **No. less than 9 months at time of disease (%)** | **—** | **1 (4,4%)** | **5 (20%)** | **6 (35,3%)** |
| **Born** | | | | |
| **Cape Town (%)** | **64,9** | **66,3** | **61,8** | **61,5** |
| **Ciskei (%)** | **13,2** | **8,0** | **9,3** | **9,3** |
| **Transkei (%)** | **19,0** | **20,0** | **23,6** | **21,0** |
| **Elsewhere (%)** | **2,9** | **5,7** | **5,2** | **8,3** |

**TABLE II. VACCINATION COVERAGE* IN THE NEW SHANTY AREAS**

| | Survey 1 | | Survey 2 | | Survey 3 | | Survey 4 | |
|---|---|---|---|---|---|---|---|---|
| | % | 95% CI | % | 95% CI | % | 95% CI | % | 95% CI |
| **All ages** | **55,8** | **46 - 66** | **74,9** | **66 - 83** | **71,1** | **65 - 77** | **73,6** | **67 - 80** |
| **6 - 11 mo.** | **55,6** | **37 - 74** | **79,4** | **64 - 95** | **65,8** | **56 - 76** | **73,8** | **60 - 88** |
| **12 - 23 mo.** | **64,6** | **48 - 79** | **75,0** | **62 - 88** | **79,4** | **72 - 87** | **81,5** | **72 - 91** |
| **24 - 59 mo.** | **52,2** | **41 - 64** | **72,9** | **60 - 86** | **68,3** | **60 - 77** | **68,4** | **58 - 79** |

* At least one documented measles vaccination.

**TABLE III. CHILDREN BORN OUTSIDE CAPE TOWN**

| | Survey 1 | Survey 2 | Survey 3 | Survey 4 | Total |
|---|---|---|---|---|---|
| **No. of non-CT births (%)** | **72 (34,9)** | **59 (33,7)** | **131 (37,3)** | **79 (38,6)** | **341 (36,4)** |
| **Period of stay** | | | | | |
| **Mean (mo.)** | **14,6** | **15,3** | **15,7** | **13,7** | **14,9** |
| **Median (mo.)** | **10,0** | **11,9** | **12,0** | **9,0** | **11,0** |
| **% in CT at least 6 mo.** | **30,6** | **20,3** | **22,9** | **29,1** | **25,5** |
| **Median age on arrival (mo.)** | **17,7** | **12,0** | **10,0** | **13,5** | **12,0** |
| **Arriving before 6 mo. (%)** | **15,1** | **26,0** | **36,6** | **25,0** | **27,8** |

CT = Greater Cape Town area.

In study 1, before the campaign, 61,7% of Cape Town-born children, 33,3% of Ciskei and 51,3% of Transkei-born children had been immunised (Table IV). Note the differences over time between children born in Cape Town and in Transkei. Coverage of the former rose by 16%, and continued to rise; that of the latter rose, perhaps even more sharply, and yet by the 6-month follow-up was virtually the same as before the campaign. The numbers for Ciskei are small, and should be viewed with caution. Overall, there is a statistically significant difference in the vaccination status by place of birth. The significance was maintained after Felligi's adjustment for complex sampling ($P = 0{,}037$).

There was also a significant inverse relationship, in those children born outside Cape Town, between period of residency and vaccination status. In study 4, a question on home births was included, yielding a significant inverse relationship: of the 13,4% of children who had been born at home, only 52% had been vaccinated, while of those born at a health facility, 77,6% had been vaccinated (odds ratio (OR) 3,21; 95% confidence interval (CI) 1,2 - 8,4%; Felligi[5] $\chi^2$-test 6,19; $P = 0{,}013$).

The proportion of children vaccinated in the campaign was estimated by defining a campaign vaccination as one given either during the dates of the official campaign, or having the abbreviated date-stamp of the campaign. In surveys 2 and 3, the proportion of children fulfilling these criteria was 24,8% (95% CI 20,2 - 29,3%). In survey 4, this proportion had fallen to 6,8 (95% CI 3,9 - 9,8%). The difference of these proportions was 18,0% (95% CI for the difference 15,2 - 20,8%).

## Discussion

The main question posed in the introduction was whether mass vaccination campaigns achieve enough to warrant their use. The results do not provide any simple answer to this question. The pre-campaign figure of 55,8% certainly warranted

**TABLE IV. DETERMINANTS OF VACCINATION COVERAGE — NO. VACCINATED AT LEAST ONCE RELATED TO OTHER VARIABLES**

| | Survey 1 | Survey 2 | Survey 3 | Survey 4 | Total |
|---|---|---|---|---|---|
| **Place of birth** | | | | | |
| **Cape Town (%)** | **61,7** | **77,6** | **73,6** | **78,6** | **72,7** |
| **Ciskei (%)** | **33,3** | **64,3** | **65,6** | **94,7** | **62,0** |
| **Transkei (%)** | **51,3** | **80,0** | **65,4** | **53,5** | **62,6** |
| **Felligi's adjusted $\chi^2$-test for complex sampling (overall) = 6,6 ($P = 0{,}038$)** | | | | | |
| **Mantel-Haenszel $\chi^2$ controlling for age group (overall) = 9,2 ($P = 0{,}002$)** | | | | | |
| **Period of stay in CT** | | | | | |
| **At least 5 months (%)** | **31,6** | **70,0** | **63,6** | **52,6** | **52,9** |
| **>6 months (%)** | **50,0** | **65,9** | **81,1** | **73,1** | **71,4** |
| **OR** | **2,17** | **0,83** | **2,45** | **2,44** | **2,22** |
| **95% CI of OR (%)** | **0,6 - 8,4** | **0,1 - 4,4** | **0,8 - 7,7** | **0,7 - 8,4** | **1,2 - 4,0** |
| **Overall Mantel-Haenszel OR = 1,98; 95% CI = 1,1 - 3,5%** | | | | | |

extraordinary measures whether there had been a national campaign or not. Also, a proven and sustained rise to above 70% is definitely desirable. However, two questions must immediately be raised. Firstly, is there a more cost-effective way of achieving the same outcome, and, secondly, are the figures achieved good enough to help combat measles.

The first question has been the subject of much debate. There is little doubt from the results of overseas studies that campaigns cost more per vaccinated child than routine services.[6,7] However, because of their very effective way of 'marshalling political will', and the rapid results achieved,[8,9] campaigns are seen as a legitimate arm of the acceleration process. They should not be seen in isolation, and due attention must be given to the allied questions of 'sustainability'[10] of the effect as well as integration into the broader health care context. The observation in this study, that there seemed to be a boost in numbers vaccinated in the months following the campaign, may reflect a longer-lasting influence on public awareness. However, this effect did not seem to be sustained in all groups beyond 4 - 5 months. Kearney *et al.*[11] in 1987 demonstrated a similar response to a campaign in Khayelitsha with figures rising from 55% to 76%; but by the time of Coetzee *et al.*'s[1] study in 1989, the coverage was only 63%. Campaigns are not enough on their own!

The second question, regarding whether our efforts will actually control measles, does not have a very optimisic answer at present. Despite the remarkable effort in the western Cape, and by the Regional Services Council in particular, there remains a shortfall in coverage of at least 25%. Also, a median age at first vaccination of 8 months implies that seroconversion to the Schwartz vaccine will be far from adequate. If one considers that 95% effective immunisation is required to interrupt measles transmission and establish herd immunity,[12] it becomes clear that a considerable task remains. Every assistance is essential if the goal is to be achieved, not least the use of the most effective vaccine possible.[13,14] High-dose Edmonston-Zagreb vaccine is strongly recommended.

The influx of children with poor vaccination status from rural areas is an aggravating factor. This study confirmed the finding of the study by Coetzee *et al.*[1] that place of birth is a major determinant for present vaccination status. Also, the more recently a child had arrived, the greater the odds of not being vaccinated. Of particular note was the effect of the campaign on children from Transkei, viz. a dramatic improvement followed by a precipitate drop to pre-campaign levels by 6 months. The role of home deliveries yet again emphasised the concept of a culturally isolated group of newly urbanised people. Far from simply being intimidating, this could be very helpful for management purposes if addressed directly. Careful consideration should be given to techniques such as channelling[6,8] where at-risk groups are targeted for special intervention. For instance, the idea of vaccination check-points on major routes of influx, should be considered.

## Conclusion

Dramatic successes have been reported for campaigns in Burkina Faso (9 - 75%), Nigeria (10 - 95%), Colombia (40 - 75%), and so on.[8] Campaigns work in the short term and they usually stimulate interest in prevention among staff and probably the public as well. On their own, however, campaigns do not have a sustained effect, and they represent an admission of failure to deliver comprehensive primary health care. If infectious and nutritional diseases are to be controlled, of which measles is only one, then the principles of primary health care need to become common practice. As simple measures such as the *g*rowth monitoring, *o*ral rehydration, *b*reast-feeding and *i*mmunisation programme of UNICEF and also its *f*emale education, *f*amily spacing and *f*ood supplementation campaign (GOBI-FFF) have demonstrated, this is not Utopian fantasy. On the contrary, a rapid evolution to equitable health services is a practical imperative, which must include the control of measles as one of its goals.

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