

Measles control in the urbanising environment

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Summary

The relationship between urbanisation and measles control is examined. In urban settings in developing regions measles is a disease of particular importance, since it tends to affect children at a younger age and with greater severity than in rural settings. A further finding in urban areas, especially peri-urban slums, is the lower measles vaccination coverage rates compared with rural regions. Factors identified as determinants of measles vaccination coverage among children under 2 years of age in urban areas include: home delivery; being born outside the urban setting; and length of stay in the city. These factors are probably related to the low socio-economic status and lack of social integration experienced by new urban immigrants. A number of additional obstacles, such as distance, economic and cultural barriers, and inconvenient clinic hours all prevent parents from gaining easy access to vaccination services.

In order to address the problems of measles control in expanding urban settings, a regional approach — with full integration of curative and preventive services — is called for. A more effective use of existing services will probably go a long way towards improving urban vaccination coverage with resultant measles control.

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The Expanded Programme on Immunisation (EPI) of the World Health Organisation set the dramatic objective of providing universal childhood immunisation by 1990.¹ From a baseline of 15% 10 years ago, world coverage for measles had risen to 61% by July 1989, a truly remarkable achievement, and yet pitifully short of the target.^{2,3} The necessary material resources and management expertise were simply not forthcoming and, amid threats of global recession, there is still a long way to go, particularly with the last 30% representing the most elusive group.¹ Yet in much of the developing world, as if the task were not daunting enough it is being aggravated by a phenomenon of particular relevance to the control of childhood infectious diseases, and measles in particular, that of rapid urbanisation.⁴

When measles vaccine was first used in Africa by Morley⁵ and Woodland in the village of Imesi in Nigeria in 1963, it was considered to be 'the most significant public health measure available in the developing world'. Since that time the eradication and even the control of measles has, however, eluded most countries and especially those in less developed regions.⁶ The rapid tempo of urbanisation in sub-Saharan Africa and parts of Asia has placed even more pressure on already over-extended services with demand dangerously outstripping supply.⁷ It is with these factors in mind that the WHO and

UNICEF have identified urban areas (especially peri-urban squatter and slum areas) as a priority for improving EPI and primary health care delivery, thereby making the achievement of 'health for all by the year 2000' more of a reality.⁸

In this article the implications of urbanisation for measles control in the developing world are examined, with particular reference to South Africa. A single disease is addressed because of the magnitude of preventable morbidity and mortality associated with it, and in order to highlight specific issues. The importance of a comprehensive and integrated approach to the control of childhood infectious diseases cannot be over-emphasised.

Epidemiology — urban and rural connections

Host and environment

In newly urbanised communities in developing countries, measles infection in childhood is characterised by a high risk between 5 and 11 months of age, soon after loss of maternal antibodies.^{9,10} This was well illustrated in Kinshasa, Zaire, between 1980 and 1985 where 45% of measles cases were reported in children under the age of 1 year, with the highest age-specific incidence rate in children 6 - 11 months old.¹¹ During a 1983 measles epidemic in Port Elizabeth more than 54% of cases occurred in children under 1 year of age, with incidence rates similar to those in Kinshasa.¹²

Age at time of disease onset differs markedly between urban and rural areas, particularly in Africa. Loening and Coovadia¹³ have shown that in Natal/KwaZulu up to 45% of children in urban areas compared with 10% in rural areas are infected with measles before 8 months of age. Between 1982 and 1986, 48% of measles notifications in Cape Town were in children under the age of 1 year compared with only 12% in the rest of the western Cape.¹⁴

The high morbidity reported at such a young age is thought to be related to sheer population density as well as to the overcrowded living conditions experienced by the urban poor, resulting in both a greater probability of coming into contact with an infected person, and a larger infecting dose when this occurs.^{12,13,15} The younger age group also experiences a higher mortality due to the compromised status of the host and the more severe complications of measles experienced by children in conditions of poverty and deprivation.¹⁶

Disease reservoir

In cities of the developing world there is a constant supply of susceptible infants either as a result of high birth rates or due to immigration from areas of poor vaccination coverage. Because these children are too young to be vaccinated, yet old enough to contract the disease, the pattern of measles transmission is usually endemic in large urban settings with perennial occurrence of the disease.¹⁷ The city therefore acts as a reservoir and disease is spread to rural areas when children travel there from the city. A mutually destructive relationship results where the rural areas continue to provide a supply of poorly integrated susceptible children, and the periodic outbreaks characteristic of rural measles epidemiology are fuelled by the urban endemic disease. The key to the relationship is, of course, the flux of people in both directions, and the

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situation for a particular city will depend on the relative magnitude of in- and out-migration, and the respective vaccination coverage rates.¹⁵ In Khayelitsha, a peri-urban township of Cape Town, the influx of children was found to be particularly apparent, with new arrivals representing a poorly vaccinated group.^{18,19} The extent of back-and-forth migration in this instance is not known, but is thought to be significant.

Transmission

Seasonal population migrations (such as end of year vacations for migrant labourers and their families) or a host of individual variations may bring large groups of susceptible infants into contact with infected children.^{15,18} In fact, any place where children meet, such as family gatherings, festivals, markets, schools, clinics and hospitals, is important in transmission of the virus,^{15,20,21} the most disturbing and ironic being the role of health facilities.

Herd immunity

Even in a homogeneous and stable population, measles poses a formidable challenge to immunisation programmes. Its basic reproductive rate (the average number of secondary cases produced by 1 primary case) is 15 - 17,²² meaning that 92 - 95% of children would have to be effectively immunised to break transmission. In an urbanising environment the pattern of population mixing, number of susceptible children, and the rate and intensity of contact between children,²³ would seem to imply an even more stringent coverage requirement.

Disease control

Vaccination coverage

Vaccination programmes in South Africa have failed to make an adequate impact on the incidence of measles. Using the measles incidence data given by Ijsselmuiden *et al.*,²⁴ one can calculate the slope on the regression line to be approximately 4% per year, implying an optimistic projected date for control in about 15 years. Despite objections, these data are probably reliable enough to confirm that the improvement is painfully slow. The prime reason for this does not lie in the absence of an effective vaccine, but rather in failure on the part of health services to evaluate vaccination programmes and achieve adequate vaccination coverage.^{25,26} Although economic factors are contributory, the political will in South Africa to give priority to vaccination coverage has been considerably behind many countries in the developing world.

The 1990 national measles campaign was a welcome departure, but does not reach the root of a problem, which requires extensive input over a long period. There are certain simple questions the answers to which are crucial to appropriate planning. For example, what aspects of immunisation programmes prevent parents from having their children vaccinated, and what similarities and differences exist between urban and rural determinants of coverage? The unique nature of urban and peri-urban squatter communities implies that answers cannot always be generally applied to all areas. Resources need to be directed toward appropriate targets, and a detailed knowledge is required of the determinants of vaccine uptake, including the role of social marketing strategies.

Urban priority

Until recently there has been a general conception that children unreached by vaccination campaigns are to be found in remote villages and rural areas. One of the most striking

features about recent coverage estimations is that a number of rural areas appear to have higher measles vaccination coverage rates than the urban or peri-urban areas.^{27,28} The lower coverage in urban areas is an international phenomenon attributed to 'high migration rates, lack of social cohesion and friction between new immigrants and established authorities' in slum areas.⁸ In the Vulindlela/Edendale regions of KwaZulu the rural measles vaccination coverage (70%) is almost double that of the peri-urban areas (38%).²⁸ A 1989 Cape Province survey²⁹ reported the measles vaccination coverage for black children to be 54% in urban areas as opposed to 69% in the rural stratum. The assumption is strengthened by a recent evaluation of the vaccination outreach programme in Mozambique, which reported coverage estimates of 82% in rural areas and 74% in urban settings.²⁷

There are, of course, many rural areas where the old impression still holds and measles vaccination coverage is extremely low. In such areas basic primary health care delivery is lacking, such as is found in Transkei,^{30,31} and distances are great, such as on Orange Free State farms.³² In contrast, in rural areas where services are uniform and comprehensive and involve the effective use of mobile outreach programmes and/or village health workers remarkable results have been achieved.³³⁻³⁶

Determinants of vaccination coverage

Home delivery

Children delivered at home and whose mothers have not had initial contact with health services, even from the antenatal period,³⁷ form a select group who do not establish an early and sustained relationship with the health service. These children have lower vaccination coverage rates, irrespective of their place of abode in later life.^{19,27,33,35} The odds of not having been vaccinated for home-delivered children residing in Khayelitsha relative to children who were delivered at health care institutions is 2,2 (95% confidence interval (CI) 1,6 - 3,9).¹⁹ In rural settings with good primary health care services the children delivered at home, often members of resettled groups,³⁸ also have lower vaccination coverage rates. Home deliveries as a determinant of poor vaccination coverage in urban immigrants is therefore not specific to city areas, but rather a reflection of past access to health services.

The confounding variable in the association between home delivery and low vaccination coverage is the region (place) of birth of the child. One-third of children 6 - 23 months of age residing in Khayelitsha were not born in the Cape Town area; the majority originated from Transkei (65%) and Ciskei (13%).^{18,19} The home-delivery rate in Cape Town is known to be less than 5%, in contrast to high rates in Transkei (50%) and Ciskei (20%).^{19,38,39} The regional difference is reflected in the fact that children living in Khayelitsha who were born in Transkei and Ciskei have home-delivery rates of 42% and 13% respectively — similar to the rates in their regions of origin.¹⁹

Place of birth

In the urban/peri-urban environment children who were not born in the city have lower coverage rates.^{18,19,40} In Khayelitsha the Cape Town-born children displayed a 64% measles vaccination coverage compared with 48% for children born outside the city.¹⁸ A more recent study showed that the odds of not being vaccinated was 2,5 times higher for children born outside Cape Town compared with local births (95% CI 1,6 - 3,9).¹⁹ Children in the new shanty areas (unserviced squatter settlements) of Khayelitsha had the highest proportion of non-Cape Town births (40%) and the lowest measles vaccination coverage compared with other more established residen-

tial areas.¹⁹ An interesting finding is that measles vaccination coverage of children living in Khayelitsha who were born in Transkei (50,1%) is similar to a recent EPI estimate for measles vaccination in Transkei (47,1%).³⁰ This suggests that migrant children are probably not a select group in terms of vaccination coverage.

Recentness of arrival

The lack of social integration and low socio-economic status experienced by new urban migrants is contributory to their children having lower vaccination coverage.^{41,42} Children who have recently migrated to Khayelitsha from rural areas have significantly lower vaccination coverage rates (39%) compared with those resident for > 4 months (58%).¹⁸ The odds of not being vaccinated for children resident for < 6 months was 3,1 (95% CI 1,9 - 4,9) compared with more permanent residents.¹⁹ These findings are consistent with reports from Maputo, Mozambique, where the odds ratio for not being vaccinated for children resident in the city for less than 1 year was 4,7 ($P < 0,01$).²⁷

There is obvious confounding in the relationship between the above three variables (home delivery; place of birth; recentness of arrival) as determinants of measles vaccination. The individual contribution of each of these variables is difficult to unravel. Using multiple logistic regression analysis in a Khayelitsha study, length of stay was the factor explaining most variation in measles vaccination coverage.¹⁹

Access to health care

The ease with which mothers gain access to vaccination services is a major factor in deciding the potential coverage that could be achieved. In rural areas the great distance that has to be travelled to reach immunisation services^{43,44} is obviously a far greater obstacle, but physical distance remains important in urban areas.³⁷ The concept of social distance is also crucial, both in rural and urban areas, predominating in the latter. Cultural, educational, economic and political obstacles need to be overcome.

New migrants who have poor education and are often culturally isolated have great difficulty in using the health services effectively.^{27,41} In contrast to studies in similar peri-urban areas,^{27,41} the educational level of mothers in Khayelitsha was not associated with the vaccination status of their children.¹⁹ Although no-one would venture to say that education is irrelevant to the issue, it certainly seems to be more complicated than at first glance.

New arrivals are also least likely to be exposed to or even understand health promotion messages⁴² and are more likely to be influenced by reports of adverse vaccination reactions.²⁷ In classic circumstances measles is a disease that affects the poor with greater severity.¹² Those living in the new shanty areas of Khayelitsha not only have lower measles vaccination coverage, but have the highest incidence of measles, poorest knowledge of oral rehydration therapy and least home visits by village health workers.⁴²

Issues of timing, particularly in the pressured urban environment, are important determinants of access to health care. The more days per week a vaccination service is offered, the higher the resulting coverage.^{27,45} At present very few health services in South Africa offer vaccination on all days of the week, a factor which could easily be altered to great effect.

Political violence

The disruption of health service delivery in times of political unrest has emerged as a major determinant of primary health

care coverage in recent years. In situations of political conflict, such as have occurred in neighbouring states,⁴⁶ Cape Town^{47,48} and more recently in Natal and on the Witwatersrand, well-functioning services have been disrupted, with children's health inevitably suffering. Preventive and promotive care, such as antenatal and child health programmes (including home visits and mobile immunisation teams), are usually the first to be discontinued. Basic services and most forms of transport are affected, resulting in delays in vaccine delivery to clinics, health workers not being able to reach their places of work, and mothers and children being denied access to health care.

Health service failure

Even when all the obstacles to reaching susceptible children are overcome, the quality of the service may leave much to be desired. The failure of health services to use every available opportunity to vaccinate susceptible children is a major obstacle in the path of achieving measles control.^{45,49,50} Missed opportunities to vaccinate result from poor co-ordination and training of health staff, and the rift between curative and preventive services, which is especially severe in large cities with a multitude of services attending to infants. Recent studies have shown that in Cape Town up to 60% of susceptible children seen at a tertiary hospital were not vaccinated against measles during their visit.⁴⁹

Cold-chain failures and poor stock control, although not specific to urban settings, may also result in failure of vaccination programmes despite having reached the target population. Examples of cold-chain evaluations are available only from the rural areas of Gazankulu and Venda,^{51,52} probably reflecting the need for urban appraisal.

Conclusions

Reliable and accessible vaccination services are essential for the control of measles in the highly urbanised situation.²⁷ There are, however, a number of problems that need to be rectified in order to reach this objective in South Africa. Services within urban areas need to be integrated into single metropolitan health authorities.⁴⁹ The artificial differentiation between curative and preventive care has to be eliminated as a matter of urgency.^{28,49}

Metropolitan health liaison groups are essential for solving problems, improving patient access, co-ordinating services, and up-dating staff on new treatment protocols.⁵³ Such groups could also co-ordinate the activities of governmental and non-governmental organisations. Both have an important role to play in improving vaccination uptake, and are able to compliment each other.⁴² In-service training of health workers on aspects of vaccination is an area that has received far too little attention.^{27,54} Instructions concerning the contraindications to vaccination are often too complicated, leaving nurses confused and over-cautious. Knowledge of the cold chain and sterilisation procedures has often been lacking, resulting in a relatively high incidence of post-vaccination abscess formation.⁵⁵

Rural areas with low coverage, such as Transkei,³⁰ serve as a constant source of unimmunised children coming to the cities. The problems of improving rural vaccination coverage^{30,43,54} need to be addressed, together with urban problems on a regional basis, if control is to be achieved in the future.

The attitude of health services towards new migrants and those living in peri-urban slums is often an impediment.⁴⁹ Health staff admit that they prefer not to visit the homes of squatters living in areas without basic services, such as water and sanitation (N. Coetzee — unpublished observation, 1989). One of the most important areas for improving coverage is that of preventing missed opportunities for vaccination.^{27,49}

Reluctance of staff to vaccinate on a 'non-immunisation day' or not opening a vial of vaccine for one or two children are still common practice. Refusal to vaccinate sick children, especially in curative settings, has resulted in many infants being denied one of the few available opportunities to receive protection. Health services for children should be organised for the convenience of mothers and not of service providers, and immunisation should be available at every session and also outside of normal working hours. Restricting vaccination to one or two clinic sessions a week has prevented many areas from achieving adequate and sustained coverage.^{28,49}

In the past coverage figures for city slum (squatter) areas were not available, or were too inaccurate, resulting in exclusion of these statistics from official reports.⁷ A finer disaggregation of health data for the urban population is needed in order to identify high-risk groups with low coverage.⁴² Vaccination programmes should then be targeted at risk groups: children delivered at home, recent arrivals, and large families. In Maputo the success of such an approach is illustrated by the fact that new arrivals to the city are not a risk group for low coverage as they are specifically identified by health workers and channelled to clinics for vaccination.²⁷

As the urban health services become more directed and integrated the need for reliance on mass vaccination campaigns as a means of bolstering coverage will diminish. The effects of such campaigns have been shown to be short-lived under conditions of rapid urbanisation.¹⁸ In an evaluation of the 1990 national measles campaign in the new shanty area of Khayelitsha, it was noted that apart from a dramatic and expected initial coverage increase, there was a positive effect on routine vaccination services over the period following the campaign. By 6 months after the campaign a definite decrease in coverage could, however, be detected (D. J. Berry — unpublished observations, 1990). A further disadvantage of mass campaigns is that pockets of unimmunised children are usually not reached. Although the overall urban coverage increases temporarily, the heterogeneity of coverage remains,¹⁸ leaving a great potential for epidemics.

Further advances in vaccine technology, such as the introduction of the Edmonston-Zagreb vaccine to be given at 4 - 6 months of age,⁵⁶ will undoubtedly improve herd immunity, and possibly also vaccination coverage. Younger children are more likely to attend health services than those > 9 months, thus increasing the probability of being vaccinated.

A lesson for measles control under conditions of urbanisation can be learned from Maputo, where the expansion of vaccination services, using mainly outreach sessions, was found not to have the desired effect. The solution to the attainment of the EPI goal of measles control, particularly in rapidly expanding urban settings, lies in a more effective and efficient use of existing services.²⁷

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