INFECTIOUS DISEASES AT THE PAEDIATRIC ISOLATION UNITS OF CLAIRWOOD AND KING EDWARD VIII HOSPITALS, DURBAN

Trends in admission and mortality rates (1985 - 1996) and the early impact of HIV (1994 - 1996)

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Objective. Information on diseases of public health importance is scanty or unavailable in South Africa as a result of a weak health surveillance system. Large institutional databases of common diseases can, therefore, provide useful ancillary information for planning and policy, despite unavoidable selection bias. We conducted a 12-year retrospective review (1985 - 1996) of all children admitted to the only isolation facility for the Durban metropolitan region. Our aim was to document changes in admissions and mortality for common childhood infectious diseases and to detect any impact of the HIV epidemic on these diseases.

Results. During these years 19 037 children were admitted and annual admissions decreased by 79%. Measles accounted for the majority of admissions (58%), followed by varicella at 23%. No cases of poliomyelitis, diphtheria or cholera have been seen since 1990. Typhoid fever, mumps, tetanus and pertussis have decreased, but remain at low endemic levels. Between 1994 and 1996, 1% of measles and 15.3% of varicella cases have been associated with HIV-1 infection; this has resulted in 56% of measles deaths and 75% of varicella deaths occurring in HIV co-infected children. Overall, 60% of deaths during the past 3 years have been in HIV co-infected children. HIV testing based solely on clinical suspicion was performed in 11% and 29% of measles and varicella cases, respectively. Average all-disease mortality was 5.3%, a decrease of 87% over the study period, with measles accounting for most deaths (86%).

Conclusions. The changing profile of childhood infectious diseases described at the paediatric isolation units is consistent with available national data. Probable reasons for these changes are the shift in emphasis to primary health care issues, and a gradual improvement in socio-economic conditions of the poor.

S Afr Med J 1998; **88**: 867-872.

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It is widely acknowledged that the absence of a reliable health information, surveillance and monitoring system in South Africa is a formidable barrier to devising appropriate policies and targeting programmes.[1] This is a particular hindrance in the control of infectious diseases, for which effective and cost-efficient interventions such as vaccines and standardised management protocols are available. For example, the declared campaigns to eliminate measles[2] and tetanus[3] are critically dependent on accurate prevalence and incidence data, right down to district level. Given the inevitable unevenness of this current period of political, economic and social transformation, it is likely to be some years before such refinements in the measurement of disease epidemiology and evolution are developed, but policy decisions need to be made now.

Certain of the eight academic health centres, together with their associated health service facilities in South Africa, have maintained fairly accurate databases on the type and frequency of diseases managed within their institutions.[4] These inevitably over-represent urban populations, blacks and the poor, and those with diseases at the moderate-to-severe end of the spectrum. Despite these limitations, records of cases seen at units or hospitals dedicated to infectious diseases provide an additional source of information for the present, and serve as a rough guide to policy formulation. Indeed, the recommendation from some sources for the inclusion of *Haemophilus influenzae* type b conjugate vaccine into the routine immunisation schedule has been made on precisely this type of data.[5]

We have noticed a gradual change in the profile of childhood infectious diseases managed by us at the only isolation facility for the Durban metropolitan region and surrounding areas. The HIV epidemic in KwaZulu-Natal is having a profound effect on many childhood disorders (e.g. diarrhoea, pneumonia, nutritional deficiency)[6] seen at our major hospitals, but the impact on vaccine-preventable and other infectious diseases is not known. In the light of this we conducted a 12-year retrospective review (1985 - 1996) of the admission/discharge register from these isolation facilities in Durban. Data were collected at the end of each month during the study period and collated by the head of the unit into annual reports. Over the last 3 years, records of children admitted to these units were reviewed to evaluate HIV status and outcome.

METHOD

Clairwood Hospital is a regional hospital situated on the outskirts of Durban. It serves as the only isolation hospital for all public sector patients with measles, varicella, mumps, diphtheria, pertussis, cholera, poliomyelitis and typhoid within the Durban metropolitan region and surrounding areas. The hospital has specially designed isolation wards and cubicles within wards. Wards or cubicles are allocated for each of the common childhood infectious diseases in accordance with the needs of the particular epidemic. Specific cleaning protocols are utilised in the event of a ward or cubicle being reallocated for a different disease. Measles, varicella and pertussis are each allocated an entire ward. Typhoid fever, diphtheria and mumps share cubicles within a ward, and poliomyelitis and cholera were each allocated an entire ward during epidemic outbreaks. All cases of the abovementioned diseases, with the exception of those requiring treatment in an intensive care unit (ICU), were admitted to this unit. The unit is staffed by a dedicated group of nurses and a registrar or medical officer, with a paediatrician providing consultative services. Data for all admissions and discharges/deaths from each unit were captured monthly by the senior nursing staff and audited by the consultant in charge of these facilities for the past 12 years. Data for tetanus were obtained from records of patients admitted to King Edward VIII Hospital during the period that this hospital served as the only isolation facility for this disease. Other infectious diseases, namely tuberculosis, meningococcal disease and hepatitis, were not studied, as patients with these diseases were not admitted to a single unit.

Diagnoses for patients admitted to these isolation facilities were based predominantly on history, clinical assessment and natural progression of the disease, although laboratory investigations were also utilised where appropriate. Relevant serological tests, cultures and supportive laboratory evidence, namely serum amylase for mumps and lymphocytosis for pertussis, were undertaken where there was difficulty in establishing a diagnosis. A few children acquired more than one infectious disease during their hospital stay as a result of nosocomial cross-contamination by the infected children during play, and sometimes by health care personnel. Parents of children who were not fully immunised were educated regarding the importance of vaccination and given the opportunity to vaccinate their child. Relevant health authorities were notified of children with notifiable diseases and health facilities serving the home areas of children with vaccine failure were informed in order to identify probable deficiencies in their vaccination programmes. Health policymakers were informed of areas where vaccination programmes were failing or not fully implemented. The results are presented as numbers of patients with each disease seen annually, disease-specific mortality rates, and associations with symptomatic HIV infection. Pre- and post-test HIV counselling were provided to parents/guardians of all children tested. The decision to test for HIV seropositivity was made on clinical grounds. The diagnosis of symptomatic HIV infection in children aged under 15 months was based on positive serology and symptoms and signs suggestive of the disease.

RESULTS

During the study period a total of 19 037 children were admitted to these isolation facilities, and annual admissions decreased from a peak of 3 598 in 1986 to a low of 470 in 1995. The overall reduction in admission rate was 79% and the range of reduction for individual diseases varied between 63% and 100%. Measles accounted for the majority (58%) of admissions over the period, followed by varicella at 23% — an 80% and 64% reduction in these diseases, respectively. No cases of poliomyelitis, diphtheria or cholera have been seen since 1990.

Table I. Trends in annual patient numbers at the paediatric isolation units, Durban — specific diseases and HIV associations (1985 - 1996)

Year	Measles	Varicella	Pertussis	Typhoid fever	Tetanus	Mumps	Poliomyelitis	Diphtheria	Cholera	Total
1985	2 171	592	203	237	41	25	14	18	248	3 549
1986	2 163	551	280	202	43	6	9	6	338	3 598
1987	1 412	480	103	188	48	13	11	5	15	2 275
1988	805	450	87	90	45	11	75	2	1	1 566
1989	1 067	529	211	48	21	13	4	4	0	1 897
1990	695	367	119	32	22	22	0	0	0	1 257
1991	361	337	121	40	21	11	0	0	0	891
1992	1 012	237	75	47	21	6	0	0	0	1 398
1993	344	272	82	28	29	4	0	0	0	759
1994	395	149	28	28	16	33	0	0	0	649
1995	207	199	14	36	12	2	0	0	0	470
1996	445	213	20	27	15	8	0	0	0	728
Total	11 077	4 376	1 343	1 003	334	154	113	35	602	19 037
Reduction in admissions (%)	80%	64%	90%	89%	63%	68%	100%	100%	100%	79%
HIV-associated cases 1994 - 1996	10	86	1	0	0	0	0	0	0	97
Number of cases tested for HIV infection 1994 - 1996	98	162	5	10	0	0	0	0	0	275

Typhoid fever, tetanus, mumps and pertussis have decreased substantially over the study period but remain at low endemic levels. Measles and varicella also still occur in sizeable numbers, with the vast majority of measles cases (394 of the 445 current cases (1996)) having occurred in the first 8 months of the year. Of this number, 53% originated from a subsection of Umlazi where vaccination practices were ineffective and inadequate — for example patients were refused vaccination if they presented on unscheduled days and if there were too few children to utilise a vial of measle vaccine completely. These practices have been corrected and a substantial decrease in measles cases has subsequently been noted.

In recent years (1994 - 1996) a small proportion (±1%) of measles admissions and many more cases of varicella (15.3%) have been associated with HIV infection (Table I).

Most previous mortality was due to tetanus and measles. The overall mortality rate was 5.3% (1 005 deaths), with measles accounting for 861 or 86% of deaths (Table II). Most deaths (75%) occurred in infants. A decrease of 87% in the overall mortality for infectious diseases was seen over the study period ($P < 0.01$; χ^2 test).

Reduction in number of deaths is most striking for measles (92%, $P < 0.01$). However, 56% of measles deaths (9 deaths) between 1994 and 1996 occurred in HIV co-infected children. The mortality rate for varicella infection has increased more than fourfold between 1985 and each of the last 3 years (1994 - 1996). This increased mortality is primarily due to HIV, as 75% of these varicella deaths (8 deaths) over the last 3 years were HIV-associated. Overall, 60% of deaths over the last 3 years occurred in HIV-infected children. There have been no deaths from pertussis, typhoid fever or tetanus during the last 2 years of study.

Seasonal variation was also noted (Table III), with measles occurring predominantly during autumn (April to June),

Table II. Trends in disease-specific mortality rates and HIV associations at Clairwood Hospital, Durban (1985 - 1996)

Year	Measles No. (%)	Varicella No. (%)	Pertussis No. (%)	Typhoid fever No. (%)	Tetanus No. (%)	Poliomyelitis No. (%)	Cholera No. (%)	Total No. (%)
1985	258 (11.9)	2 (0.3)	2 (0.9)	1 (0.4)	10 (24)	0	2 (0.8)	275 (7.7)
1986	230 (10.6)	2 (0.4)	3 (1.0)	0	13 (30)	0	4 (1.2)	252 (7)
1987	146 (10.0)	4 (0.8)	0	0	18 (37.5)	0	0	168 (7.4)
1988	87 (10.7)	2 (0.4)	1 (1.2)	1 (1.1)	18 (40)	2 (2.7)	0	111 (7.1)
1989	54 (5.0)	0	2 (1.0)	0	2 (9.5)	0	0	58 (3.1)
1990	44 (6.3)	2 (0.6)	1 (0.9)	0	12 (54)	0	0	59 (4.7)
1991	8 (2.2)	4 (1.2)	3 (2.5)	1 (2.5)	2 (9.5)	0	0	18 (2)
1992	21 (2.1)	0	2 (2.7)	0	9 (43)	0	0	32 (2.3)
1993	4 (1.1)	2 (0.7)	0	0	6 (38)	0	0	12 (1.6)
1994	2 (0.5)	2 (1.3)	1 (3.5)	0	2 (12.5)	0	0	7 (1.1)
1995	3 (1.3)	3 (1.5)	0	0	0	0	0	6 (1.3)
1996	4 (0.9)	3 (1.4)	0	0	0	0	0	7 (1.0)
Total	861 (7.8)	26 (0.6)	15 (1.1)	3 (0.3)	92 (27.5)	2 (1.8)	6 (1%)	1 005 (5.3%)
Mortality rate change (%)	92%*↓	366%†↑	100%↓	100%↓	100%↓	N/A	N/A	87%‡↓
HIV-associated deaths (1994 - 1996)	5/9 (56)	6/8 (75)	1/1 (100)	0	0/2 (0)	0	0	12/20 (60)
Mortality (%) for HIV-infected children (1994 - 1996)	5/10 (50)	6/86 (7%)	1/1 (100)	0	0	0	0	12/97 (12.3)

* $P < 0.05$.
† $P = 0.08$.
‡ $P < 0.05$.
No deaths in cases with mumps and diphtheria over the 12-year study period.

Table III. Seasonal variation in the common childhood infectious diseases seen in the isolation units at Clairwood and King Edward VIII Hospitals, Durban (1985 - 1996)

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Measles	738	684	933	1 191	1 232	1 238	1 000	901	844	808	727	781	11 077
Varicella	277	164	176	162	265	476	607	586	506	455	463	239	4 376
Pertussis	105	77	74	96	142	135	138	151	130	110	111	74	1 343
Typhoid	119	116	90	76	87	87	76	69	60	62	69	92	1 003
Tetanus	20	23	22	25	22	30	30	40	39	29	25	29	334
Mumps	17	9	11	33	9	8	7	10	16	9	10	15	154
Diphtheria	6	7	3	1	6	4	1	0	0	2	3	2	35

Table IV. Changes in selected indicators for South African blacks between specified periods

Indicators	Value	Period of observed change	Ref.
Mortality rates			
Life expectancy from birth	45 → 62 years	1950 - 1985	26
General mortality rates	19.9 → 8.3 per 1 000 live births	1955 - 1985	27
IMR	190 → 61 per 1 000 live births	1945 - 1985	26
U5MR	85.9 → 16.3 per 1 000 live births	1970 - 1990	27
U5MR as percentage of total death	30.7 → 23.3%	1980 - 1985	26
Change U5MR for notifiable infectious diseases	26 → 10%	1970 - 1990	26
Immunisation coverage (children)			
BCG1	65 → 74%	1986 - 1991	28
DPT 1, 2, 3	75 → 81%	1986 - 1991	28
Poliomyelitis 1, 2, 3, 4	60 → 82%	1986 - 1991	28
Measles 1	70 → 85%	1986 - 1991	28
Notification rates (infectious diseases) per 100 000 population			
Tuberculosis	459 → 211	1965 - 1985	29
Diphtheria	7.6 → 0.2	1965 - 1985	29
Poliomyelitis	5.6 → 0.29	1972 - 1985	29
Tetanus	2.07 → 1.2	1976 - 1985	29
Measles	82.4 → 40.7	1980 - 1986	29
Typhoid	26.6 → 7.1	1970 - 1986	29
Cholera	79.5 → 3	1982 - 1986	29
Demographic social changes			
Population increase	7 832 → 24 298 X 1 000	1946 - 1995	30
% of GNP spent on health	2.7 → 3.3%	1971 - 1986	20
Doctor/population ratio	1 2 157 → 1:1 800	1960 - 1982	20
Nutritional disorders	13.8 → 6.9 per 100 000	1978 - 1986	29
Electrification provision	31 000 → 300 000	1991 - 1995	13
Black to white education funding proportions	1:18 → 1:3	1970 - 1994	3
Change in number of matriculation candidates	30 000 → 400 000	1980 - 1994	31
Overall matriculation pass rates	56 → 51%	1980 - 1994	31

varicella occurring mainly in winter (July to September), pertussis mainly between May and August and typhoid mainly in summer (December to February). Tetanus, mumps and diphtheria occurred throughout the year and cholera occurred as an epidemic in South Africa.

Discussion

The four most striking findings of this study were firstly a decrease in the total number of infectious disease patients admitted to the paediatric isolation units under study over a 12-year period, secondly the absence of diphtheria, cholera and poliomyelitis for the past 7 years, thirdly an accompanying fall in mortality rates for measles, pertussis, typhoid and tetanus, and lastly the early impact of HIV on measles and varicella. Before 1988 over 10% of children admitted with measles died, between 1989 and 1990 the mortality rate dropped to around 5%, and since then it has declined to approximately 1%. Reasons for this dramatic and significant reduction in mortality are probably multifactorial. For instance, decreased admissions may be due to more effective vaccine strategies (these would have lowered the wild virus load in the isolation unit) and the introduction of vitamin A in 1991 as part of the standard measles case management protocol.

The dramatic decrease in the overall number of vaccine-targeted childhood infectious diseases, namely measles, diphtheria, poliomyelitis, tetanus and pertussis, and the significant improvement in the outcome of these diseases are the consequence of a shift in emphasis to primary health care and a more extensive programme of immunisation in South Africa.[7] These initiatives preceded changes to the political order and the creation of a democratic government of national unity in 1994, but have gained considerable momentum during the new administration. By 1994 immunisation coverage rates of between 81% and 85% have been attained as a result of appropriate strategies introduced for the six target diseases; these levels show a substantial improvement over this 12-year period[8] (Table IV).

A clear picture of the incidence, prevalence and epidemiology of the major childhood infectious diseases in South Africa is not available. Immunisation coverage and notification rates for infectious diseases are notoriously unreliable. For example, the total number of reported cases of neonatal tetanus in South Africa for 1993 was 21, while in King Edward VIII Hospital alone there were 27 cases during the same period.[9] The available data and references seem to suggest that with the exception of tuberculosis all other diseases targeted by the immunisation programme have shown marked improvements.[10] There has been a substantial increase in the incidence of tuberculosis (224/100 000), with 90 000 new cases seen annually.[11] This high incidence is probably related to the failure of the tuberculosis control programme and the rapid escalation in HIV infection. As such the general trend in prevalence of childhood infectious diseases detected by us is not inconsistent with the available information based on national notifications. Also, during the 12-year study period no substantial changes were noted in the isolation facilities for infectious diseases for the Durban metropolitan region and surrounding areas, and these results are likely to be a true reflection of these disorders over this period.

Measles is the most serious and frequently seen infectious disease at Clairwood Hospital. Reduction in the number of measles cases over the study period is also, in part, a result of the mass measles campaign run during June - July 1990.[2] The trend we report here was confirmed by a national decrease in the prevalence of measles in infants from 337.8/100 000 in 1989 to 37.1/100 000 in 1994.[12] The upsurge in prevalence noted by us during 1992 was also recorded nationally, and was probably related to a higher occurrence in school-going children due to insufficient herd immunity, poor coverage and incorrect vaccination.[13] Measles, however, remains the third commonest notifiable disease after tuberculosis and malaria in South Africa, with an incidence of 12.2/100 000 for blacks. Accelerated, sustained efforts to lower incidence are still required.[14]

The number of tetanus cases has substantially decreased over the study period so that the goal now is elimination. A policy to eliminate neonatal tetanus by toxoid immunisation was initiated in 1987, but it failed to achieve its goal, namely the eradication of tetanus by 1995. This stems primarily from lack of accurate information as to the regions where the disease remains a public health problem, as well as a failure to implement the guidelines enumerated in the campaign. This was illustrated by a study from King Edward VIII Hospital, where 52% of mothers of neonates with tetanus were found to have missed opportunities for immunisation during their pregnancies.[9] The elimination of tetanus would, therefore, require improved targeting of efforts at maternal immunisation, safer delivery practices, provision of delivery kits and training of traditional birth attendants. The current incidence of tetanus for South Africa is said to be 0.1/100 000, with KwaZulu-Natal and Northern Province provisionally identified as high-risk areas.[15]

Eradication of poliomyelitis appears to be a realistic option. Surveillance for the disease has not been able to uncover a single confirmed case of wild poliomyelitis over the past 5 years.[16-18] Despite this South Africa cannot be declared a poliomyelitis-free country, as unconfirmed cases among those presenting clinically with acute flaccid paralysis are still being seen. Poliomyelitis epidemics tend to occur in 5 - 6-year cycles, with the next cycle long overdue.

Although no cases of diphtheria have been notified for the past 7 years, there is no cause for complacency. The main lesson relevant to South Africa from the recent Russian epidemic is the importance of maintaining high rates of coverage through primary and adult immunisation. The 1996 outbreak of diphtheria in Russia was believed to be the consequence of low immunity resulting from lack of exposure to the bacteria over a prolonged period of time. This lack of exposure may have been caused by absence of infection, or by vaccine.

The prevalence of pertussis, although much lower during recent years, is still of concern. Pertussis presents several problems, namely lack of reliable clinical guidelines for diagnosis, failure to use available clinical guidelines, the unavailability of a sensitive and specific diagnostic tool and the ambiguity of data regarding the efficacy of the vaccine. These problems make national notification data and our own findings difficult to interpret.[19]

Although the more extensive immunisation programme is the most likely reason for the substantial epidemiological changes in paediatric infectious diseases over the past decade described above, it is clear that the prevalence of other non-vaccine-preventable diseases has also declined over this same period. Causes of this latter phenomenon are not clearly understood. It seems to us that a gradual amelioration in living conditions of the poor (who were overwhelmingly black) over the past decade or so, is the most likely basis for the overall reduction in infectious diseases such as typhoid, varicella and mumps. This slow upward drift in socio-economic conditions may also have had some influence on the downward trend in vaccine-preventable diseases.

In past years focus was on the exposure of racial discrimination in the allocation of national resources.[20,21] This emphasis, which was both justifiable and appropriate for the apartheid period, probably obscured the trickle-down effect of these allocations from whites to blacks. In support of this hypothesis we show that some of these trickle-down effects are visible in the pattern of demographic and social changes, mortality rates, immunisation coverage and disease notifications listed in Table IV. The trend in typhoid fever seen here and nationally exemplifies this phenomenon.[22] Similarly, cholera occurred as a brief epidemic in the mid 1980s, and has since virtually disappeared.

The HIV pandemic arrived late in South Africa. The first paediatric cases began to be recognised by 1988 and by 1995 1.8 million people were estimated to be HIV-infected, with an estimated 32 000 HIV-infected babies born each year.[23] The impact of HIV on paediatric infectious diseases has not yet been clearly delineated, although some evidence (as in this study) seems to suggest that the virus predisposes children to heightened disease severity. These observations support data which show that HIV co-infection increases severity of measles and chickenpox.[24,25] In this study HIV accounted for the majority (60%) of deaths from the time that the effects of the epidemic became noticeable in the isolation units. More studies are necessary to confirm these findings and to devise ways to minimise their impact. The use of varicella vaccine and zoster and measles immunoglobulin for HIV-infected children may need to be considered.

In the main, this study demonstrates fundamental improvements in the prevalence and outcome of both vaccine-preventable and non-vaccine-preventable diseases at a regional isolation facility in the Durban metropolitan area. It also highlights the consequences of the HIV epidemic on measles and varicella mortality. Health care authorities should take cognisance of these findings in order to implement a composite health policy.

References

1. Yach D, Buthelezi G. Health status. In: Harrison D, Neilson M, eds. *South African Health Review 1995*. Durban: Health Systems Trust and Henry S Kaiser Family Foundation, 1993.
2. Abdool Karim SS, Abdool Karim Q, Chamane M. Impact of measles immunisation campaign on measles admissions to a Natal hospital. *S Afr Med J* 1991; **88:** 579-581.
3. Wright PF. Global immunisation — a medical prospective. *Soc Sci Med* 1995; **41:** 609-616.
4. Department of National Health and Population Development. *Health Trends*. Pretoria: DNHPD, 1990: 67-72.
5. Hussey G, Hitchcock J, Schaaf H, *et al*. Epidemiology of invasive *Haemophilus influenzae* infections in Cape Town, South Africa. *Ann Trop Paediatr* 1994; **14:** 97-103.
6. Bobat R, Coutsoudis A, Moodley D, Coovadia HM. Moving from AIDS to symptomatic HIV infection. *S Afr Med J* 1995; **85:** 495.
7. Department of National Health and Population Development. The six vaccine preventable diseases. *Epidemiological Comments* 1990; **17**(10): 13.
8. Department of National Health and Population Development. Immunisation coverage status. *Epidemiological Comments* 1995; **22**(9): 190-214.
9. Jeena PM, Coovadia HM, Gouws E. Risk factors for neonatal tetanus in KwaZulu-Natal. *S Afr Med J* 1997; **87:** 46-48.
10. Department of National Health and Population Development. Primary health care and preventive medicine. *Health Trends in South Africa* 1986; **1:** 19-24.
11. Department of National Health and Population Development. Tuberculosis Control Programme — 1992. *Epidemiological Comments* 1994; **21**(1): 2-8.
12. Department of National Health and Population Development. The Measles Strategy, South Africa, 1991. *Epidemiological Comments* 1992; **19**(7): 112-127.
13. Schoub BD, Martin DJ. Lessons from the 1992 measles epidemic in South Africa. *S Afr Med J* 1993; **83:** 82-83.
14. Yach D, Buthelezi G. Health status. In: Harrison D, Neilson M, eds. *South African Health Review 1996*. Durban: Health Systems Trust and Henry J Kaiser Family Foundation, 1996.
15. Department of National Health and Population Development. Tetanus neonatorum. *Epidemiological Comments* 1993; **20**(10): 168-171.
16. Department of Health and Population Development. Polio countdown. *Epidemiological Comments* 1990; **17**(8): 3-9.
17. Wigton A, Hussey G, Fransman D, *et al*. The winter 1996 mass immunisation campaign — is it the best strategy for South Africa at this time? *S Afr Med J* 1996; **86:** 794-795.
18. Department of National Health and Population Development. Poliomyelitis eradication. *Epidemiological Comments* 1996; **25**(3): 20-25.
19. Ramkissoon A, Coovadia HM, Loening WEK. Subclinical pertussis in incompletely vaccinated and unvaccinated infants. *S Afr Med J* 1993; **85:** 662-667.
20. Benatar SR. Medicine and health care in South Africa. *N Engl J Med* 1986; **315:** 527-533.
21. McIntyre DE, Dorrington RE. Trends in distribution of South African health expenditure. *S Afr Med J* 1990; **78:** 125-129.
22. Department of National Health and Population Development. Typhoid fever in South Africa 1919 - 1994. *Epidemiological Comments* 1995; **22**(2): 24-38.
23. Department of National Health and Population Development.Fifth national HIV survey in women attending antenatal clinics of the public health services in South Africa October/November 1995. *Epidemiological Comments* 1995; **22**(5): 90-100.
24. Kaplan LJ, Daum RS, Smaron M, *et al*. Severe measles in immunocompromised patients. *JAMA* 1992; **267:** 1237-1241.
25. Leibovitz E, Cooper D, Giurgurtiu D, *et al*. Varicella-zoster virus infection in Romanian children with human immunodeficiency virus. *Pediatrics* 1993; **92:** 838-842.
26. Central Statistical Service 1985. *Human Science Report* 5-158.
27. Central Statistical Services supplied mortality data on computer tape: analysed by CERSA, MRC in 1994, using the latest data (1990) and new provincial boundries; data presented are based on an unpublished report by Debbie Bradshaw, Laubscher Ria and Michelle Schneider. Parow: MRC.
28. Department of National Health and Population Development. *Epidemiological Comments* 1987; **14**(7): 28.
29. Department of National Health and Population Development: Directorate Epidemiology Notification Rates.
30. Department of National Health and Population Development. A perspective on the general health status in South Africa. *Health Trends in South Africa* 1986; **1:** 1-3.
31. Vorgey H. *Fast Facts. The Bulletin of the South African Institute of Race Relations* 1998; **2:** 2-3.

Accepted 14 Jan 1998.