A CRITICAL ANALYSIS OF CHILD HIV PREVALENCE AS PRESENTED IN THE SOUTH AFRICAN NATIONAL HIV PREVALENCE SURVEY OF 2008

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SUMMARY

In their latest national HIV prevalence survey published in June 2009, the HSRC, in collaboration with the MRC, CADRE and NICD, have continued to present survey statistics based on their assumption that there is a causal relationship between an infectious, transmittable virus which can be measured by HIV tests and mortality as measured by official death statistics. Specifically they claim that HIV prevalence among children aged from 2 to 14 has decreased from 5.6% in 2002 to 2.5% in 2008. On the basis of their statistical evidence various assumptions are made about the effectiveness of chemotherapy drugs, known as ARVs, administered to mothers and babies, the effectiveness of sexual knowledge and behaviour communication programs and the effectiveness of preventative methods such as condoms. In their report they state that there will be a further elaboration of the dynamics of HIV among children in a children's report that will examine factors contributing to a decrease in prevalence.

This article analyses the survey statistics in combination with the statistics produced by the Medical Research Council and Statistics South Africa to show that there is no correlation between the HIV measurement and mortality among children and the assumptions made by the HSRC have no validity. It is mathematically impossible for the 2008 prevalence percentage to have decreased from 2002, the prevalence rates from the three HSRC surveys cannot be reconciled and the HIV tests have no reliability as a constant measurement over time. The maximum possible total of deaths that could be attributed to a new disease called HIV is a tiny fraction of the child prevalence totals reported by the HSRC, MRC and other research organizations. Total all cause natural deaths from age 2 through to age 19 did not exceed 22,000 in 2006 and there is no statistical evidence for any significant increase since 2000 above population growth and death registration improvement. Even if the calculations of HIV prevalence rates made by the HSRC, MRC, etc are accepted, of the 710,000 HIV prevalence from 2 to 14 reported by the HSRC in 2002, a maximum of 4,000 per year could have died by 2006.

INTRODUCTION

The following analysis of child HIV prevalence is based on the principle of the 5 year cohort whereby a cohort aged 5 to 9 in year 0 becomes a cohort aged 10 to 14 in year 5. Over a 5 year period a cohort HIV prevalence is increased by any new annual incidence to the cohort as it moves through the 5 years and decreased by any deaths in the cohort, assuming any effect of migration to be negligible. During a period of less than 5 years a 5 year age group prevalence would be increased by any prevalence moving into the age group from a younger age group plus any new annual incidence and decreased by any prevalence moving out to an older age group plus any deaths taking place in the 5 year age group.

StatsSA report annual death statistics in 5 year ranges with the under 5 range also subdivided into under 1 and 1 to 4. The single age divisions from 1 to 4 were obtained from StatsSA. In their 2002 study the HSRC subdivided 2 to 14 prevalence into 2 to 9 and 10 to 14, in their 2005 study subdivided into 2 to 4, 5 to 9,

and 10 to 14 but their latest 2008 survey report does not breakdown the 2 to 14 total. There is no explanation in the 120 page survey report why the subdivision has not been given despite the sample size being equivalent to the 2005 study and no reference to the previous subdivisions being unreliable or invalid because of sample size. These subdivisions have been obtained from the HSRC.

METHOD OF ANALYSIS

1) Real total annual deaths have been calculated from age 2 to 19 using estimates of registration completion made by the MRC in their detailed study of child mortality for the year 2000 in comparison with estimates made by StatsSA and ASSA. The detailed proportions of StatsSA deaths from 0 to 4 support the accuracy of completeness estimates made from other data. In calculating 5 to 14 completeness, comparisons were made between the male and female division of deaths by the MRC and StatsSA for the year 2000.

2) Using the MRC estimates of HIV deaths for 2000 the maximum possible total of HIV deaths in age 2 to 19 from 2000 to 2006 has been calculated.

3) Numerical prevalence totals for the 3 age groups have been calculated for the 3 survey years by applying the HSRC prevalence percentages to StatsSA population estimates.

4) Numerical prevalence for 15 to 19 in 2008 has been calculated as well as the 5 year incidence total using single year incidence percentages calculated by the HSRC.

5) Numerical prevalence totals have been calculated for 2002 and 2003 by projecting back the cohort prevalences from 2008 accounting for the maximum possible total of HIV deaths as the cohort progressed. Age 2 to 4 deaths have been calculated using StatsSA single age mortality data adjusting for completion and applying an HIV death rate of 50%. An assumption has been made that StatsSA 2007 deaths will show no change from the stable trend of the previous 3 years.

6) An annual incidence total for age groups has been calculated using the HSRC incidence percentages from 2005 to illustrate the principle that incidence further reduces the 2002 prevalence total below that of 2008 to the point where 2002 prevalence becomes negative.

CHILDREN 2 TO 4 YEARS

The MRC Burden of Disease Study of year 2000 estimated the number of total child and HIV deaths for the 12 month period starting in mid-2000 using the ASSA 2000 model. The MRC calculated the real total of 1 to 4 deaths at 29,279 of which 2,296 or 7.8% were non-natural deaths and 18,065 or 61.7% were attributed to HIV/AIDS. The later ASSA2003 model was recalibrated to decrease the estimates of deaths. For example it predicted a non-AIDS mortality rate in 2000 for age 2 of 0.00334 for males and 0.00265 for females which computes to an HIV death rate closer to 40%. StatsSA report 10,365 deaths from 1 to 4 for year 2000 and 11,234 for year 2001 giving an MRC estimate of 36.9% registration completion whereas StatsSA estimated 0 to 14 completeness at 46% in 2000 in their 2006 report. StatsSA calculated overall completion at 63.7% in 1996 with over 5 rising to 70% by 2001. Based on the ratio of under 5 to the total it is unlikely that 1 to 4 completion exceeded 36% in 1997. StatsSA mortality reports show that from 1997 to 2006 total 1 to 4 deaths remain within the range from 23% to 28% of total 0 to 4 deaths and total 2 to 4 deaths are approximately

45% of total 1 to 4 deaths. In 2000 the totals were: age 1= 5,540, age 2= 2,426, age 3= 1,362, age 4= 1,037 Applying 65% completion and 25% proportion to the 15,983 deaths from 1 to 4 reported by StatsSA in 2006 gives total 0 to 4 deaths of 98,356 which is greater than the estimate of 75,000 for 2005 by the MRC and ASSA in the 2008 report "Every death counts". This confirms that 1 to 4 completeness had reached at least 65% by 2006. StatsSA show total 2 to 4 registered deaths rising from 3,426 in 1997 to 4,825 in 2000 to 6,472 in 2006 which would mean real 2 to 4 deaths, based on 36%, 46% and 65% respectively went from 9,516 to 10,489 to 9,957, less than 0.5% annual increase, while the ante-natal HIV rate rose from 10.4% in 1995 to 29.4% in 2004. Based on the ASSA2003 model HIV deaths in 2 to 4 could not have exceeded an annual average of 6,000 from 2000 to 2006.

CHILDREN 5 TO 9 YEARS

The MRC estimated the real total of 5 to 9 deaths at 3,925 for 2000 of which 1,445 or 36.8% were nonnatural deaths and 1,020 or 25.9% were attributed to HIV/AIDS. StatsSA report 5 to 9 deaths rising to 5,544 by 2006 of which 1,289 or 23.3% were non-natural. StatsSA report 3,617 deaths from 5 to 9 for year 2000 and 3,845 for year 2001 giving an MRC estimate of 85.6% male and 107% female registration completion. The greater StatsSA female registration confirms that the MRC underestimated 5 to 9 deaths and the 70% completion of over 5 for 2001 estimated by StatsSA in their 2006 report is likely more accurate. The decrease in StatsSA deaths from 2004 to 2006 indicates an increase from 2000 to approaching full completion by 2006. An estimate of 95% would mean real 5 to 9 deaths increased from 5,167 in 2000 to 5,835 in 2006 or 2.0% annually. Regardless of the actual increase in registration completion from 2000 to 2006, HIV deaths in 5 to 9 could not have exceeded an annual average of 2,000 based on the MRC estimate of 25.9% HIV.

CHILDREN 10 TO 14 YEARS

The MRC estimated the real total of 10 to 14 deaths at 3,848 for 2000 of which 35.7% or 1,372 were nonnatural and zero deaths were attributed to HIV/AIDS. StatsSA report 10 to 14 deaths rising to 4,273 by 2006 of which 28.9% or 1,233 were non-natural. StatsSA report 3,074 deaths from 10 to 14 for year 2000 and 3,222 for year 2001 giving an MRC estimate of 68.4% male and 103.3% female registration completion. As with 5 to 9, the greater StatsSA female registration confirms that the MRC underestimated 10 to 14 deaths. Using 70% for 2000 and 95% for 2006 would mean real 10 to 14 deaths increased from 4,391 in 2000 to 4,498 in 2006 or 0.3% annually. Given that the MRC estimated zero HIV/AIDS in 2000 it is clear that annual average HIV deaths for 10 to 14 for the 6 years to 2006 were effectively also zero.

CHILDREN 15 TO 19 YEARS

StatsSA report 15 to 19 total deaths rising from 9,033 in 2002 of which 45.1% or 4,073 were non-natural to 9,394 in 2006 of which 43.0% or 4,044 were non-natural. Natural 15 to 19 deaths rose from 4,960 in 2002 to 5,350 in 2006 or 1.9% annually before adjusting for registration completion. The lack of any increase in total deaths from 2003 to 2006 indicates approaching full completion. Estimating 90% in 2002 and 95% in 2006 would mean real natural deaths increased from 5,511 to 5,631 or 0.5% annually. Neither StatsSA nor the MRC attributed any 15 to 19 deaths in 2002 to HIV/AIDS which is confirmed by the latest 2008 study in which single year HIV incidence levels are mathematically derived from age 15 to 20 with the justification that the calculations are not affected by AIDS related mortality (Page 64 of report). It is clear that HIV/AIDS

deaths from age 15 to 19 for the 4 years to 2006 and up to 2008 according to the incidence calculations were effectively zero.

CALCULATION OF NUMERICAL PREVALENCE TOTALS FROM HSRC SURVEYS

Using the 2 to 14 prevalence percentage rates from the three HSRC studies applied to the population totals reported by the HSRC the numerical prevalence totals can be calculated. The HSRC used StatsSA mid-year population estimates in 2005 and 2008, and 2002 has been made consistent with 2005 using best estimates of annual births and deaths, as in Table 1 below. Based on StatsSA birth and death statistics and estimates of registration completion, the 3 year cohort moving out of 2 to 14 would increase population by 450,000 as a result of more deaths and fewer births relative to the 3 year cohort moving in to 2 to 14.

Table 1

	Population in thousands					
Age		Year				
Group	2002	2005	2008			
0 to 4	4850	5064	5140			
5 to 9	4950	5031	5254			
10 to 14	4950	5099	5279			
Total	14750	15194	15673			

2 to 4 population can be calculated on the same basis relative to 0 to 4 but the HSRC calculation of numerical totals for 2 to 4 and 5 to 9 in their study of 2005 has used lower estimates of population, probably based on projected deaths from HIV/AIDS rather than reported deaths from StatsSA. The following calculation of numerical totals in Table 2 below is based on the application of the overall prevalence percentage to the estimated 2 to 14 population calculated by deducting an estimate of 0 to 1 population based on StatsSA births and deaths, with the difference adjusted in the 2 to 4 calculation. The HSRC actual numerical totals for 2005 have been used.

Table 2

Prevalence ir	thousands
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		2002			2005			2008	
Age	Pop.	Prev.	Prev.	Pop.	Prev.	Prev.	Pop.	Prev.	Prev.
Group	000's	%	000's	000's	%	000's	000's	%	000's
2 to 4	2775	6.2	170	2920	5.1	130	3067	4.5	120
5 to 9	4950	6.2	307	5031	4.4	214	5254	2.9	152
10 to 14	4950	4.7	233	5099	1.7	86	5279	1.3	68
Total	12675	5.6	710	13050	3.3	430	13600	2.5	340

CALCULATION OF PREVALENCE AND INCIDENCE FOR 15 TO 19 IN 2008

Based on StatsSA estimate of 2008 mid-year population for 15 to 19 of 5,152,000 and the HSRC estimate of HIV 15 to 19 prevalence of 4.4% it can be calculated that the numerical prevalence was 226,000 in 2008. In addition the 2008 survey estimated HIV incidence in 15 to 19 using prevalence data by single year of age (page 37) in which incidence percentages are calculated for all 3 surveys. In 2002 these range from 1.1% for age 15 to 1.8% for age 19 and in 2008 from 0.6% for age 15 to 1.2% for age 19. Applying these incidence percentages to the single year populations from 15 to 19 over a period of 5 years to 15 (5+4+3+2+1) single years gives a calculation of new HIV incidence of 136,000 as the 10 to 14 cohort of 2003 moves through to become 15 to 19 in 2008.

RECONCILIATION OF COHORT PREVALENCE FROM 2008 TO 2002

It is immediately apparent that the age group prevalences over the 3 HSRC surveys cannot be reconciled. If the prevalence in 15 to 19 in 2008 was 226,000 of which 136,000 had arisen from new incidence in the previous 5 years then 10 to 14 prevalence in 2003 could not have exceeded 90,000 given that there were effectively zero HIV deaths from age 10 to 19, up to 2006 according to StatsSA mortality reports and up to 2008 according to the HSRC assumption that 15 to 19 incidence calculations were not affected by HIV mortality. In 2002, 6 years previously, 9 to 13 could not have exceeded 90,000, disregarding 1 single year deaths of 400 (2000/5), yet the HSRC report 307,000 prevalence in 5 to 9 and 233,000 in 10 to 14. The HSRC incidence analysis of 2008 estimates prevalence of 3.11% for age 14 in 2002 which equates to 30,000.

Similarly if the HSRC calculated 68,000 in 10 to 14 in 2008 then 5 to 9 prevalence in 2003 could not have exceeded 74,000 as there were a maximum of 6,000 HIV deaths in 5 to 9 or 15 single years (5+4+3+2+1) as it moved to 10 to 14. In 2002, 6 years previously, 4 to 8 could not have exceeded 77,000, as there were a maximum of 8,000 HIV deaths in 5 to 9 or 19 single years (4+5+4+3+2+1) and 1,000 HIV deaths in age 4 as it moved to 10 to 14. Yet the HSRC report 170,000 in 2 to 4 and 307,000 in 5 to 9 in 2002 and 214,000 in 5 to 9 in 2005.

Finally if the HSRC calculated 7 to 9 prevalence of 91,000 in 2008 (3 years of 152,000 assuming an even distribution) then 2 to 4 prevalence in 2003 could not have exceeded 105,000, as there were a maximum of 4,000 HIV deaths in 5 to 9 or 9 single years (1+2+3+3) and 10,000 HIV deaths in age 2 to 4 or 6 single years (3+2+1) as the 2 to 4 cohort moves through to 7 to 9. If the HSRC calculated 61,000 prevalence in 8 to 9 in 2008 (2 years of 152,000) then 2 to 3 prevalence in 2002 could not have exceeded 73,000 as there were a maximum of 9,000 HIV deaths in 2 to 4 or 5 single years (2+2+1) and 3,000 HIV deaths in 5 to 9 or 7 single years (1+2+2+2) as the 2 to 3 cohort moved through to 8 to 9 in 2008.

The above calculations are summarised in the following Table 3 below

	Prev.	Prev.	Proj.Prev		Proj.Prev
Age	2008	2002	2003	Age	2002
Group	000's	000's	000's	Group	000's
2 to 4	120	170	105	2 to 3	73
5 to 9	152	307	74	4 to 8	77
10 to 14	68	233	90	9 to 13	90
				14 to 14	30
Total	340	710	269		270

Projected Prevalence in thousands

Table 3

Based on the HSRC survey 2008 prevalence calculations, StatsSA mortality reports and the MRC child mortality report, 2 to 14 prevalence could not have exceeded 270,000 in 2002 contrary to the 710,000 reported by the HSRC survey of 2002. This is 2.1% of the population (270/12,675) , less than the 2.5% reported by the HSRC in 2008.

ADDITIONAL IMPACT OF ANNUAL INCIDENCE

The above calculations do not take into account the additional impact of annual incidence from 2 to 14 which would further decrease the total of 2 to 14 prevalence in 2003 and 2002 as projected back from the reported 2008 total, as in Table 4 below. Annual incidence percentages were first calculated for the 2005 survey based on testing of 16,000 sample specimens. These were reported as 0.8% for 2 to 4, 1.5% for 5 to 9 and 0.4% for 10 to 14. The 2008 survey report (page 37) states that two approaches were used to measure incidence; BED EIA and mathematically derived incidence using prevalence data from the three population based surveys, with the BED findings not available at the time of the report. It also states (page 19) that the BED HIV incidence calculation will apply the same formula-based adjustment that was carried out for the 2005 incidence estimates. HIV incidence derived from single year prevalence in the 15 to 20 age group is presented in detail for the three survey years showing a substantial drop in incidence for 15 to 19 for 2008, which was calculated above at 136,000 for 5 years, compared to 2005 and 2002. 15 to 19 for 2008 is 0.74%, 2005 is 1.50% and 2002 is 1.32%.

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Projected Prevalence less Incidence in thousands

	2005	2005	2005	03 to 08	2003	2003
					Proj.Prev	Proj.Prev
Age	Pop.	Inc.	Inc.	Inc.		Less Inc.
Group	000's	%	000's	000's	000's	000's
2 to 4	2920	0.8	23	115	105	-10
5 to 9	5031	1.5	75	375	74	-301
10 to 14	5099	0.4	20	100	90	-10
Total	13050		118	590	269	-321

DISCUSSION OF ABOVE CALCULATIONS

The HSRC 2005 incidence estimates have been used to illustrate the principle that annual incidence would have a substantial impact in reducing the mathematically possible prevalence total for 2 to 14 in 2002. The 2005 estimates could be higher than the average from 2002 to 2008 and the laboratory testing method could be less accurate than in 2008 but these factors are not discussed in the 2008 report. The calculation of incidence for 15 to 19 uses the same methodology in comparing 2008 with 2005 and 2002 and the BED incidence calculation in 2008 will apply the same formula-based adjustment used for the 2005 estimates. If the incidence was only half the levels calculated in 2005, the 2 to 14 prevalence for 2003, and by extension 2002, would still be less than zero in contrast to the 710,000 reported in the 2002 survey. The calculation of 2002 prevalence relative to 2008 cannot be affected by the 95% confidence intervals applicable to the percentages because the critical factor is the number of deaths that occurred during the period. This has been calculated above to be not more than 21,000 as the 2 to 14 cohort moved through to 8 to 20 and some of these could have resulted from incidence during the period. The expected decrease in 6 years to the 2 to 14 prevalence in 2002 is the difference between the 9 to 14 cohort of 294,000 moving out (233,000+1/5x307,000) and the 2 to 7 cohort of 211,000 moving in (120,000+3/5x152,000) plus the deaths in 2 to 8 calculated above at 21,000 which totals 104,000. According to the HSRC surveys the actual decrease was 370,000. Without any incidence the expected 7 to 19 prevalence in 2007 was 690,000 (710,000 less 20,000) compared to actual prevalence of 386,000 in 2008 (3/5x152+68+226)

CONCLUSIONS

1) Based on StatsSA mortality reports, the MRC report on child mortality for year 2000 and the HSRC incidence estimates it is mathematically impossible for the 2008 prevalence percentage for 2 to 14 to have decreased from 2002.

2) Assumptions made about the effectiveness of chemotherapy drugs, sexual behaviour change and other communication programs and of condoms in preventing transmission of a fatal disease among children cannot be based on the statistical evidence reported in the HSRC surveys.

3) There is no statistical evidence in the HSRC surveys of any correlation between the HIV measurement and later mortality among children.

4) The prevalence percentages from the three HSRC surveys cannot be reconciled and no attempt has been made to do so in the 2008 survey although comparisons are made with the earlier surveys.

5) Whatever the various HIV tests are measuring is not a constant over time as there is no mathematical relationship between incidence, prevalence and mortality.

6) The HSRC states (page 73) that there will be further elaboration of the dynamics of HIV among children in a children's report that will examine factors contributing to a decrease in prevalence. This will be based on a false premise.

FUTURE RESEARCH PRIORITIES

The method of science is to re-examine a hypothesis when accumulated data do not confirm the predictions and to re-examine methodology when later evidence does not support earlier findings. If, for example, the HIV prevalence of children in 2002 was significantly over-estimated, the scientific method requires a re-examination of the sampling and testing methodologies in order to be able to explain, understand and correct for future surveys. Nowhere is the failure of the HSRC et al to address major differences more apparent than in its treatment of the race prevalence disparities. In the 2002 survey the prevalence of Africans was reported as 3 times greater than Whites (18.4/6.3), in 2005 as 22 times greater (13.3/0.6) and in 2008 as 45 times greater (13.6/0.3). Although the 2008 survey report continually uses race classification as a variable there is in the body of the report no attempt to explain the dramatic change over 6 years, no attempt to explain why the 2002 percentage for Whites was significantly miscalculated, no attempt to explain why an African is 45 times more likely than a White to fall victim to a sexually transmitted disease. The relevant percentages are only to be found in an appendix and the race variable is not analysed as the other important variables are.

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