

## **Increases in reported death in South Africa from 1997 to 2002: evidence for increasing mortality or improving death registration?**

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As we all know, Sub-Saharan Africa is currently said to be experiencing a severe HIV/AIDS epidemic. UNAIDS estimates that this region carries two-thirds of the global AIDS burden, with more than 25 million of its 680 million citizens currently infected. On the basis of trends in HIV antibody prevalence over time—as determined in annual surveys of pregnant women attending public antenatal clinics (ANC surveys)—UNAIDS estimates that 2.2 million of those infected died of AIDS in 2003 alone, while another 3 million became newly infected.<sup>1</sup>

In spite of the apparent enormity of the problem, there remains little empirical data to confirm these modeled estimates. Indeed, global studies have indicated that only about 1% of all deaths in sub-Saharan Africa are ever registered by their respective governments.<sup>2</sup> As a result, most data held out to represent escalating mortality in Africa are derived using indirect methods based on assumptions and computer models, all of which are “subject to potential errors and biases that cannot be ignored,” according to a recent article in the journal *AIDS*.<sup>3</sup> This leaves Africa’s public health officials in the unenviable position of making policy decisions regarding the distribution of extremely limited resources based on estimates whose accuracy is open to question.

South Africa (SA) is a striking exception, in that its demographic data is regarded to be quite good. In fact, with estimates of death registration currently over 90%,<sup>4,5,6</sup> SA is held to be the only country in Africa where it is possible to judge the accuracy of computer-generated HIV/AIDS estimates against empirical death registration data.<sup>7</sup> Unfortunately, Statistics South Africa (Stats SA)—a governmental body with the legal mandate to publish vital statistics—has repeatedly been criticized for long delays in bringing mortality statistics to the public. For example, Stats SA’s full report on reported deaths for 1996 wasn’t published until 2001.<sup>8</sup>

Starting in early 2003, the government moved to eliminate the backlog and bring mortality reports up to date. Stats SA recruited an army of enumerators whose mission was to count and encode all of the nearly 3.3 million Death Notification Forms received by the Department of Home Affairs (DHA) over the seven-year period 1997-2003. The results of this monumental effort were published in February 2005 in a report entitled “Mortality and causes of death in South Africa, 1997-2003,”<sup>6</sup> hereafter referred to as the COD report.

Publication of this report was preceded by a media campaign that appeared designed to preempt or even prevent open discussion. This campaign—orchestrated largely by AIDS activists—was successful, with media coverage of the COD report confined to three central findings: First, over the five-year period for which complete death data is available (from 1997 to 2002; data for 2003 is still incomplete), the overall number of reported deaths rose 57%. Secondly, over this same period, reported deaths among the

“sexually active” (ages 15-49) increased markedly faster, coming in at 105%. And finally, over the four-year period for which cause-specific death data is available (i.e., 1997-2001), reported deaths attributed to TB—a marker of HIV disease—soared by 134%. AIDS activists cited these findings as incontrovertible proof that South Africa is in the grip of an extremely severe AIDS epidemic.

Entirely absent from these public discussions, however, was any mention of a critical underlying issue—completeness of death registration, or CDR.

By way of illustration, imagine a tiny island where 100 real-life deaths take place each year, but completeness of death registration is only 10 percent. At this level of CDR, official statistics would show 10 deaths taking place annually. If, however, the government of this island were to take steps to reform its death registration machinery, and CDR was to rise to 50 percent, statistics would show a massive but entirely illusory rise in mortality, with 50 deaths recorded annually. Mathematically, this would represent a 400% increase in deaths<sup>9</sup> in the face of no real increase in mortality rates whatsoever. Interpretation of death registration data is therefore totally dependent on an understanding of any shifts in CDR that might have taken place during the period under study.

All observers agree that CDR in South Africa is currently very high (90% or better). There are, however, two radically divergent views about when registration in SA arrived at this point. Researchers allied to the Medical Research Council (MRC) tell us that CDR reached a high plateau (85%) as early as 1996,<sup>4</sup> with only marginal improvements thereafter. This has allowed the MRC to claim that the subsequent surge in reported deaths is real, and caused largely by HIV/AIDS.

The alternative analysis begins with the fact that during the apartheid years, death registration in black communities was by all accounts abysmal,<sup>6</sup> and virtually non-existent in the former Bantustans.<sup>10</sup> The MRC maintains that this problem was largely resolved by 1996, but data from Census 96 suggested otherwise: even though nearly half (46%) the population was found to be living in rural areas (including former Bantustans),<sup>11</sup> only a quarter (24%) of all reported deaths for that year came from such areas.<sup>12,13,14</sup> This led Dr. Sulaiman Bah of Stats SA to conclude that death reporting in these areas had to be “grossly incomplete,”<sup>13</sup> with only about a third (37%) of all rural deaths being recorded in 1996.

In the light of these findings, SA’s government embarked in 1998 on a series of reforms aimed at improving registration of deaths, particularly in rural villages and townships. These included the introduction of a user-friendly death notification form;<sup>15,16</sup> radical simplification of reporting procedures; rapid expansion of Home Affairs satellite offices; installation of computers and internet connections at data collection points; grassroots campaigns to encourage registration; workshops for Traditional Healers and Herbalists; the solicitation of Tribal Courts, midwives and chiefs to assist in vital registration at the community level; and finally, a welfare project that enabled undertakers to tender for the burial costs of poor families, provided that such deaths were properly registered.<sup>17</sup> Shortly thereafter, reported deaths began to rise rapidly.

The rise in reported deaths is not disputed. At issue is the cause: *are we seeing more HIV-related deaths, as claimed by the MRC, or more complete recording of deaths, as a result of the aforementioned government reforms?*

The MRC's case has been laid out in various studies, all of which have received extensive press coverage. On the other side, we have a factor nobody is willing to talk about. If it is indeed correct, as Dr. Bah has argued, that only 37% of rural deaths were registered in 1996, and that this figure has since improved to 90%, raw death registration data would appear to show that deaths in rural areas had risen by 143%,<sup>18</sup> even in the absence of any real increase in mortality whatsoever. Given that Census 1996 indicated nearly half of the population (46%) lived in such rural areas, the significance of this possibility cannot be understated.

I was hoping this issue would be dealt with and resolved in Stats SA's long-awaited COD report, but my expectations were not gratified. While the report repeatedly acknowledges that CDR improved between 1997 and 2003, Stats SA's researchers made no attempt to quantify the degree to which this influenced the observed increases in reported deaths. Absent such quantification, discussion of SA death registration data is almost meaningless.

Fortunately, the COD report contains enough data for others to rush in where Stats SA feared to tread. This data, in combination with recent census enumerations,<sup>11,19</sup> allows us to directly calculate death rates<sup>20</sup> in the only African country where such an exercise can lead to meaningful conclusions. Furthermore, Stats SA has provided us with a breakdown of this data at the provincial level, which allows us for the first time ever<sup>21</sup> to see how increases in reported deaths are correlated with other variables available at the provincial level, such as various HIV prevalence determinations, as well as markers associated with CDR.

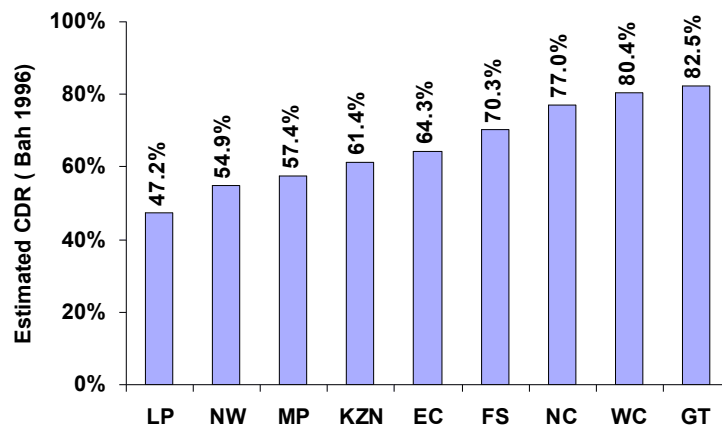
Let's start this exercise by looking at Dr. Bah's analysis of the situation in 1996. In addition to noting that CDR in rural areas appeared very much lower than CDR in urban areas (37% vs. 86%), Bah provided estimates of CDR in each of SA's nine provinces.<sup>12,14</sup> As shown in Figure 1, these estimates reveal a clear pattern—CDR is high in the predominantly urban provinces of Gauteng (GT), Western Cape (WC) and Northern Cape (NC), but much lower in the predominantly rural provinces where apartheid's worst "dumping grounds" were located. These are Limpopo (LP), North-West (NW), Mpumalanga (MP), kwaZulu/Natal (KZN) and Eastern Cape (EC).

If Bah's estimates were accurate, we would expect calculated death rates (DR) in the more rural provinces to be artificially low as a result of poor death reporting. Although the COD report contains no data for 1996, it does allow us to calculate death rates for 1997 as shown in Figure 2.

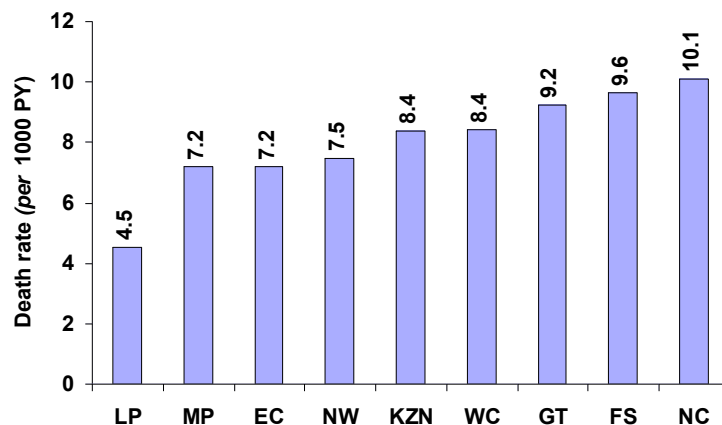
We should begin by noting that the crude death rate for SA as a whole in 1997 was only 7.8/1000 person years (PY)—curiously low for a country that includes large (and mostly rural) pockets of extreme poverty and deprivation, not to mention an adult HIV

prevalence rate of 17% (ANC 1997).<sup>22</sup> Furthermore, death rates range from a low of only 4.5/1000 PY for LP, to a high of 10.1 for NC. Taken at face value, this data suggests that in 1997, predominantly coloured persons in NC were dying off 125% faster than predominantly black persons in poverty-stricken LP. The data in Figure 2 also suggests the death rate in relatively rich and developed WC was nearly twice that in backward LP. Such conclusions are not credible. I would argue that these discrepancies arise from the fact that 70% of the population of NC, and 89% of the population of WC, was living in towns or similar urbanized settings with access to governmental infrastructure (e.g., death registration machinery), as compared to only 11% in LP.<sup>23</sup>

**Figure 1. Estimated completion of death registration (CDR) in 1996 by province (Bah):**



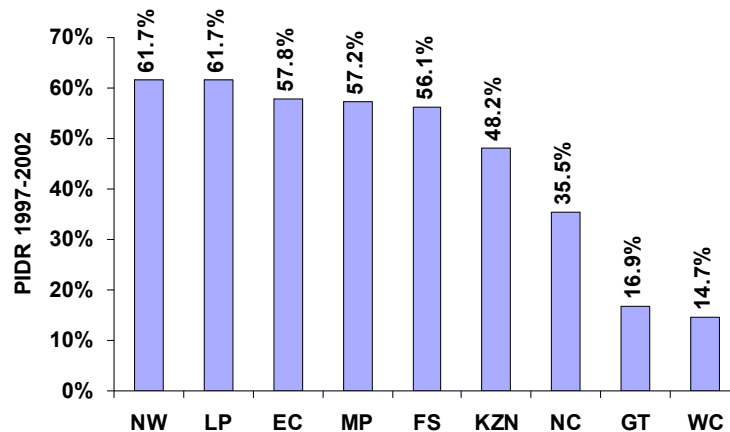
**Figure 2: Crude provincial death rates (per 1000 PY) for persons of all ages in 1997 (COD report):**



Now let's look at how crude death rates changed over the next five years. In what follows, increases in death will be expressed as the percentage increase in death rates (PIDR), which serves the purpose of removing any distortions to the data that might arise

from changes in population over time.<sup>24</sup> Specifically, for the current period under question (i.e., from 1997-2002),  $PIDR = [(DR_{2002} - DR_{1997})/DR_{1997}] \times 100\%$ . Figure 3 clearly shows that the predominantly urban provinces of GT, WC, and NC experienced the smallest increases over this period, while the highly rural provinces like LP, EC, NW, KZN and MP show the largest increases.

**Figure 3: Provincial percentage increase in crude death rates (PIDR) from 1997 to 2002 for persons of all ages (COD report):**



In short, what we see here is very clear evidence that crude death rates are rising most rapidly in provinces where CDR was the lowest in 1996. These are, of course, the provinces where reforms aimed at improving death registration would have had the largest impact.

On the other hand, the relationship between rapidly rising death rates and provincial HIV prevalence is, at first glance, ambiguous. Take LP, for instance. Over the years, HIV prevalence in LP has consistently been about half that observed in GT (ANC 1997,<sup>25</sup> 8.2% vs. 17.1%; ANC 2002,<sup>26</sup> 15.6% vs. 31.6%). And yet death rates in this highly rural and underdeveloped province have increased more than 3.5-fold faster than those in GT. Taken in isolation, such an observation would suggest that rising mortality has nothing at all to do with HIV. But then again, according to the 2001 ANC survey,<sup>27</sup> HIV prevalence in NW province was found to be 1.7-fold higher than NC (26.2% vs. 15.1%). And according to data in the COD report, death rates in NW province likewise increased 1.7-fold faster than those in NC. Taken in isolation, this observation would strongly suggest that the observed increase is due to higher HIV infection rates in NC.

These two contrasting examples illustrate why the search for a link, or correlation, between two factors (in this case, HIV and rising mortality) entails deeper investigation that takes into consideration all of the data concurrently.

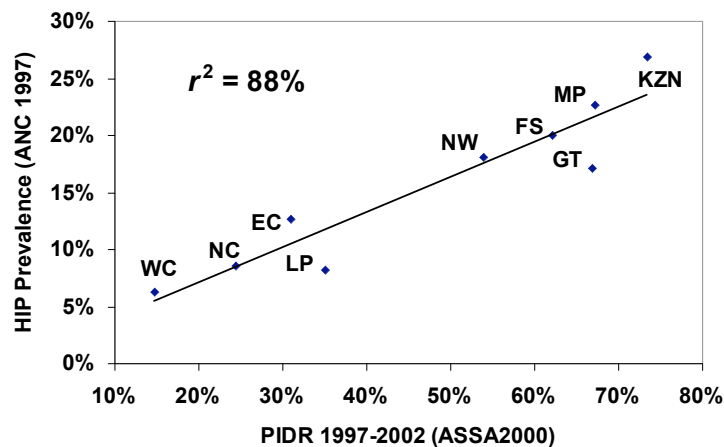
A correlation between two variables (e.g., smoking and death rates) is best illustrated by constructing what is known as an “x-y scatter graph,” from which a correlation coefficient ( $r$ ) can be calculated. The square of this number ( $r^2$ ) tells us how well a

change in one variable (e.g. smoking rates) explains, or predicts, changes in another variable (e.g., death rates). This is a useful tool, although it should be emphasized that no correlation, even if perfect (i.e.,  $r^2 = 1.0$ , or 100%), is sufficient to declare a causal link between two variables. Rather, correlations should serve as clues that inform further investigation. In general, and for purposes of this review, variables with  $r^2$  values of less than 15% will be considered to be unlinked, or independent.

In what follows, I have scanned all the mortality data available at the provincial level in the COD report for correlations that provide clues as to which factors might be driving the observed rise in reported mortality.

Let's start by looking at correlations between rising mortality for persons of all ages over the entire period (1997-2002) and HIV prevalence. Given that we are looking at persons of all ages in this case—rather than just the sexually active—is it reasonable to expect a strong correlation here? According to modelers associated with the MRC and the Actuarial Society of South Africa (ASSA), the answer is an unequivocal yes. As shown in Figure 4, the ASSA2000 demographic model<sup>28</sup> predicts that provincial death rates for persons of all ages over this period should have increased in near perfect concordance with relatively higher HIV prevalence at the start of this period (ANC 1997). In fact, according to this model, relatively higher provincial HIV prevalence should account for 88% of the overall increase in all-age death rates over this period (i.e.,  $r = 0.94$ ,  $r^2 = 0.882$ ; or 88.2%). A similar comparison using HIV prevalence as determined in the year 2002 ANC survey is likewise equally strong ( $r = 0.94$ ,  $r^2 = 88\%$ , graph not shown).

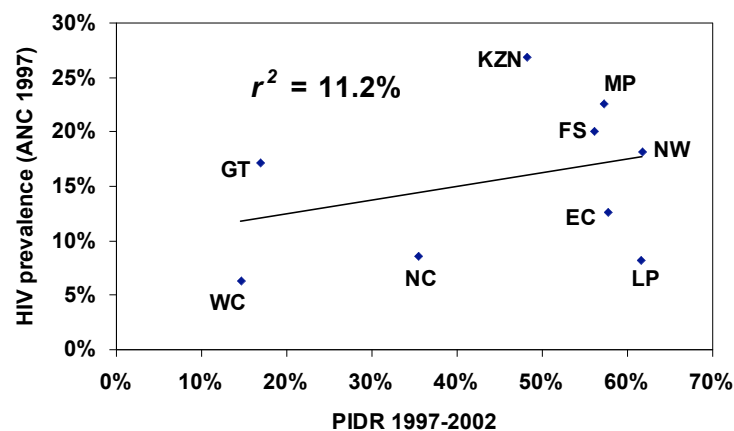
**Figure 4. Predicted PIDR from 1997-2002 for persons of all ages (ASSA2000) vs. HIV prevalence (ANC 1997):**



In other words, if it is indeed the case—as the MRC contends—that the increase in reported mortality in SA over this period was primarily the result of HIV/AIDS, then the corresponding increases at the provincial level would necessarily have to be the greatest precisely in those provinces with the highest HIV prevalence.

Real-life data from the COD report, however, tells a different story. As shown in Figure 5, the correlation between the actual increases in reported death (expressed as PIDR) and HIV prevalence as determined in the 1997 ANC survey is feeble at best ( $r = 0.34$ ,  $r^2 = 11\%$ ). The same correlation using data from the 2002 ANC survey is weaker yet ( $r = 0.21$ ,  $r^2 = 4.5\%$ ). And completely contrary to expectations, year 2002 provincial HIV prevalence as determined in the arguably more representative population-based HSRC/Mandela Foundation study (HSRC study),<sup>29</sup> cannot account for any of the increases in reported mortality over this period ( $r = 0.03$ ,  $r^2 = 0\%$ ).

**Figure 5. Observed PIDR from 1997-2002 for persons of all ages (COD report) vs. HIV prevalence (ANC 1997):**



It is further interesting to note that the expected powerful correlation between increasing death rates and HIV prevalence fails to reveal itself even during the last year of this period (i.e. 2002) when deaths from HIV/AIDS were supposedly soaring. For example, provincial HIV prevalence as determined in the 2002 ANC survey can account for only 12% of the increases in death rates (PIDR) over this period ( $r = 0.34$ ,  $r^2 = 12\%$ ). And remarkably, a similar comparison using HIV prevalence for females age 15-49 as determined in the HSRC study, actually reveals a notable negative correlation, with higher provincial HIV prevalence in 2002 predicting smaller increases in mortality in the same year ( $r = -0.45$ ,  $r^2 = 20\%$ ).

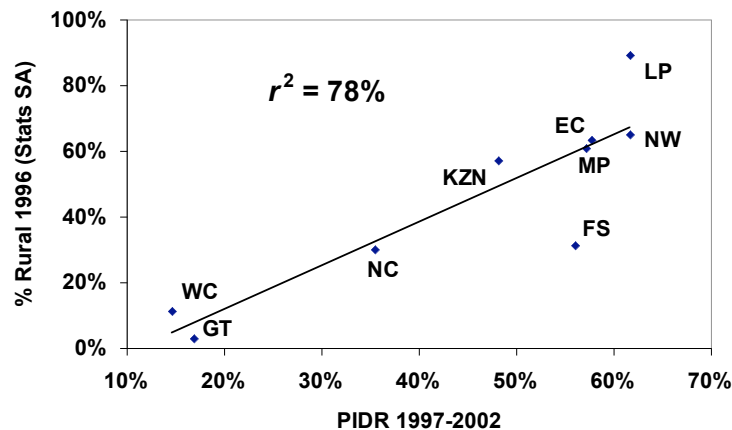
Having established that provincial increases in death (expressed as PIDR) are not well, if at all, correlated with the various available determinations of provincial HIV prevalence, let's take a look at correlations between rising mortality and the proportion of the population in a province that was living in rural areas in 1996 (% Rural 1996).<sup>30</sup>

As you will recall, it was the disparity between reported deaths in rural and urban areas in 1996 that initially led Dr Bah at Stats SA to realize that CDR in rural areas was abysmally low (estimated to be only 37%). As mentioned earlier, if Dr Bah's estimates are accurate, and if death reporting in rural areas improved to 90% over time, this shift alone would cause reported deaths for the whole of rural SA to increase by 143%.<sup>18</sup> In other words, failure to adjust for this factor would create the illusion of a 143% increase

in deaths without any real increase in mortality whatsoever. In contrast, if CDR in urban areas (estimated to be 86% in 1996) were to improve, even to 100% over time, the resulting increase in reported deaths due to this factor would be at most only 17%.<sup>31</sup>

It follows that if improvements in CDR were primarily responsible for the observed increases in reported deaths in the COD report, we would expect to see these increases concentrated primarily in the more rural provinces. As shown in Figure 6, this is precisely the case.

**Figure 6. PIDR from 1997-2002 for persons of all ages (COD report) vs. % Rural 1996 (Census 1996):**



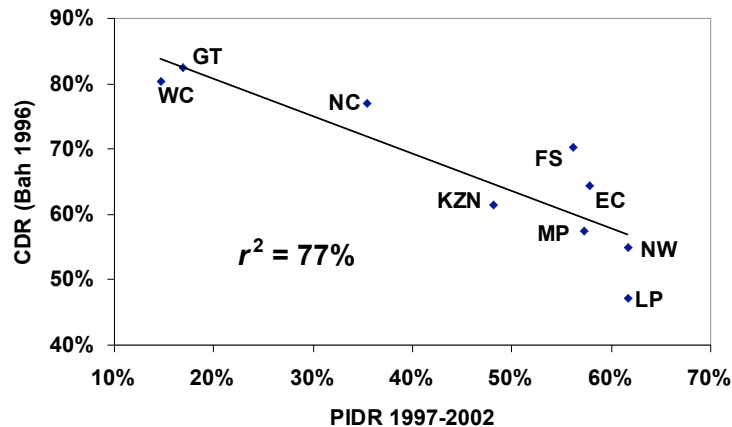
The proportion of a province that was living in rural areas in 1996 can explain 78% of relatively higher increases in reported mortality from 1997-2002 ( $r = -0.88$ ,  $r^2 = 78\%$ ). This observation cannot be attributed to relatively higher HIV prevalence in the more rural provinces, because % Rural 1996 is not correlated with higher HIV prevalence (e.g., % Rural 1996 vs.: HIV in ANC 1997,  $r^2 = 2\%$ ; vs. HIV in ANC 2002,  $r^2 = 0\%$ ).

In addition to estimating CDR for rural and urban areas, Dr Bah also provided us with estimates of CDR at the provincial level for 1996 as shown in Figure 2. Again, if these estimates are accurate, and if the post-1997 governmental reforms aimed at improving registration were successful, one would expect to see the most rapid rises in reported deaths taking place not in highly developed provinces such as WC, GT, and NC, where CDR was quite good back in at the beginning of the period under investigation; but rather in the more rural and underdeveloped provinces where there was massive room for improvements in CDR. As shown in Figure 7, this is exactly what is observed.

In this case, relatively lower provincial CDR in 1996 predicts 77% of higher subsequent increases in calculated death rates over this period. Furthermore, this correlation cannot be attributed to coincidentally higher HIV prevalence in provinces with lower estimated CDR, because Bah's estimates of CDR are not related to HIV (e.g., CDR vs.: HIV in ANC 1997,  $r = -0.23$ ,  $r^2 = 6\%$ ; HIV in HSRC  $r = 0.03$ ,  $r^2 = 0\%$ ). Taken in combination with the observation that increases in reported deaths are at best only weakly correlated

with HIV prevalence, these observations forcefully suggest that the observed rise in reported deaths in SA over the past several years has been very profoundly influenced by improvements in death reporting.

**Figure 7. PIDR from 1997-2002 for persons of all ages (COD report) vs. estimated CDR (Bah 1996):**



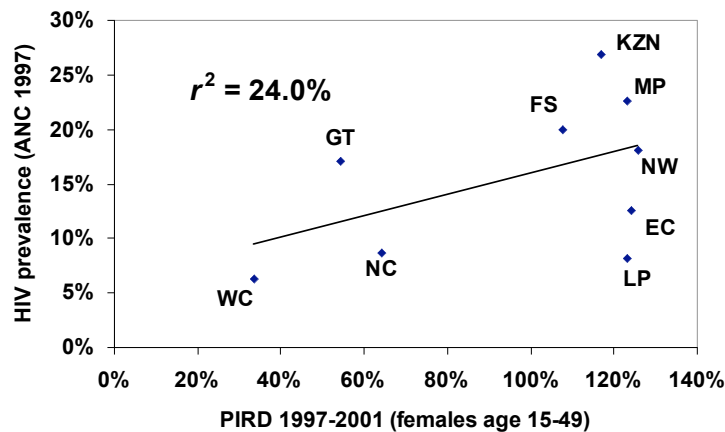
Thus far we have focused only on reported deaths for persons of all ages, as opposed to the sexually active. As previously noted, the MRC and its allies have understandably made much of the fact that reported deaths over the past several years have been increasing far faster in the sexually active. For example, over the period for which we have age-specific data at the provincial level for analysis by correlations (i.e., from 1997-2001), crude death rates among the sexually active (ages 15-49) increased by 61% as compared to only 33% for persons of all ages; and among the sexually active, death rates for females increased faster yet, coming in at 96% as compared to only 40% for males.

As such, if the predicted strong correlation between increases in mortality and HIV prevalence is to reveal itself, it should have the best chance to do so in the case of sexually active females. However, as seen in Figure 8, the correlation between provincial PIDR for females aged 15-49 as revealed in the COD report and HIV prevalence as determined in the 1997 ANC survey, indicates that only about a quarter of the observed increases can be explained by HIV ( $r = 0.49$ ,  $r^2 = 24\%$ ). Furthermore, the strength of this correlation actually drops off in the latter half of this period (i.e., PIDR from 1999-2001 vs. HIV in ANC 1997:  $r = 0.34$ ,  $r^2 = 12\%$ ), when it should in theory have been strengthening as the AIDS epidemic gathered momentum. Additionally, a comparison of PIDR for these females over the entire period to HIV prevalence in females of the same age as determined in the HSRC study, actually reveals a weak negative correlation, with higher provincial HIV prevalence in year 2002 being associated with smaller increases in death rates over this earlier period ( $r = -0.23$ ,  $r^2 = 5\%$ ). These observations are completely unexpected in light of what is predicted by the MRC/ASSA models.

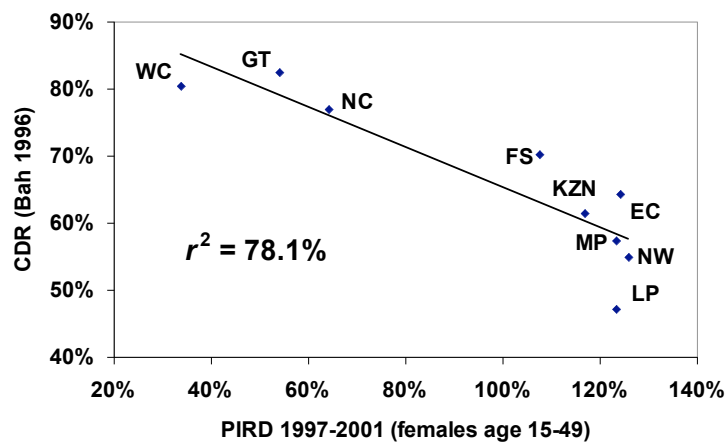
What is going on here? A possible answer lies in the correlation between rising mortality and estimated CDR at the start of the period under review. As seen in Figure 9, the

provincial increases in reported mortality for these sexually active females over this period are very strongly correlated with lower estimated CDR in 1996. In fact, this data suggests that more than three-fourths ( $r^2 = 78\%$ ) of the observed 96% increase in calculated death rates for these females may well be the result of nothing other than improved death reporting. If this were indeed the case, then the actual increase in mortality for these women over this four-year period would be only 21% [i.e.,  $0.96 \times (1 - 0.78)$ ], which corresponds to a *per-annum* increase of only 4.9%. Is this even remotely possible? The answer is yes.

**Figure 8. Provincial PIDR from 1997-2001 for females aged 15-49 (COD report) vs. HIV prevalence (ANC 1997):**



**Figure 9. Provincial PIDR from 1997-2001 for females aged 15-49 (COD report) vs. estimated CDR in 1996 (Bah):**



Let's take a closer look at sexually active females aged 15-49 in LP province, where 89% of the population was living in rural settings back in 1996.<sup>11</sup> Overall, reported deaths for these females increased from 2,699 in 1997, to 6,649 by 2001. Taken at face value, this represents an astronomical 146% increase in deaths in only four years.<sup>32</sup> However, what if it is indeed the case—as Bah has calculated—that only 45% of female deaths<sup>33</sup> in this

province were ever registered at the beginning of this period, and that this number subsequently increased to 90% by 2001 as a result of the post-1997 governmental campaigns to improve registration? In this case, the actual number of deaths for these females would have been 5,998 in 1997 (i.e.,  $5,998 \times 0.45 = 2,699$ ), as compared to 7,388 in 2001 (i.e.,  $7,388 \times 0.90 = 6,649$ ), which would correspond to an actual increase in deaths of only 23% [i.e.,  $(7,388 - 5,998) / 5,998$ ]. And if we further correct this data for the 10.3% increase in population for these females over this period,<sup>20</sup> then the actual increase in mortality rates would have been only 12%.<sup>34</sup> If CDR had improved to only 80% by 2001, then the observed number of reported deaths would correspond to an actual increase in mortality rates of only 26%,<sup>34</sup> which is still less than a fifth of what is suggested by the raw data. As such, shifts in CDR can result in dramatic distortions to observed increases in reported mortality over time; particularly among populations living in the more remote and rural areas where Bah estimated death reporting to be “grossly incomplete” at the start of this period.

In this light, it is useful to recall that one of apartheid’s central objectives was to restrict the movement of black females to precisely such areas, including the former Bantustans. In contrast, black males were allowed to freely migrate to cities and urban areas for labour purposes. Laws controlling such movement were scrapped in the 1980s, but Census 1996 showed that their legacy persisted strongly ten years later, with adult females in highly rural provinces such as LP, EC, and KZN, outnumbering their male counterparts by a remarkable 34%, 30%, and 21%, respectively. It follows that subsequent government campaigns to improve death registration in these areas would inevitably result in a disproportionately higher number of female deaths coming onto the governmental radar.

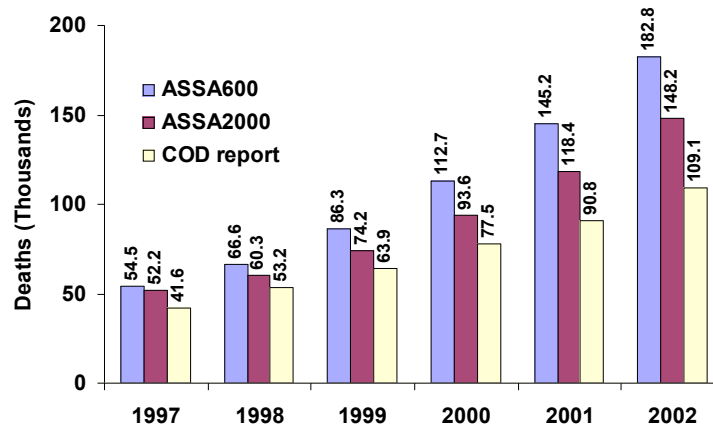
In summary, based on the above observations, it seems entirely reasonable to hypothesize that the majority of the observed increases in reported mortality in SA over the past several years, even among sexually active females, are the result of improved death reporting, rather than HIV/AIDS. This contention is supported by the powerful correlation between the observed increases at the provincial level and relatively lower CDR at the beginning of this period, as revealed in Figures 7 and 9. The launch of massive governmental reforms aimed at improving CDR in rural provinces in 1998, along with the lack of any notable correlation between rising mortality and HIV prevalence, makes this possibility even more believable.

It is also interesting to note that the MRC/ASSA models have consistently overestimated future deaths in SA, as judged by the actual data as it becomes available. One possible explanation for this is that the modeling committee was in error when it assumed that past increases in reported mortality were mostly real and the result of HIV/AIDS, as opposed to possible improvements in death reporting. In other words, an overestimation of the impact of AIDS in the present would necessarily lead to an overestimation into the future—geometrically so in the case of an infectious disease. The first full report on the demographic impact predicted by the earliest release of these models (i.e., the ASSA600) was published in September 2001.<sup>4</sup> Although conservative in its estimates of impending AIDS deaths as compared to those emanating from UNAIDS,<sup>35</sup> this model nevertheless

painted a grim picture for South Africa's future. Specifically, the model suggested that 40% of all adult deaths in the previous year (i.e., 2000) were the result of AIDS, and that without immediate intervention cumulative AIDS deaths might soar to as many as 7 million by 2010. Females were predicted to be particularly hard hit with annual AIDS deaths in those aged 15-49 reaching 290,000 in this current year alone (i.e., 2005).<sup>39</sup>

Thanks to the COD report, we at last have some complete mortality data against which these headline-making projections can be assessed. Keeping in mind that this particular model was tuned to available mortality data through the end of 1999,<sup>36</sup> let's see how it performed at forecasting deaths for sexually active females into the future. As seen in Figure 10, even as of the year the report was released (i.e., 2001), the ASSA600 was already over-projecting all-cause deaths for females aged 15-49 by a remarkable 60%.<sup>37</sup> And by 2002, this discrepancy had increased to 68%.<sup>38</sup>

**Figure 10. Predicted (ASSA models)<sup>39</sup> vs. observed (COD report) all-cause deaths (thousands) for females age 15-49.**



In fairness, modeling is an evolving process. When available mortality data through the end of 2001<sup>36</sup> came in lower than expected, the modeling committee released a downward reversion of the model known as the ASSA2000. However, as we can see in Figure 10, by 2002, this model was likewise already overestimating deaths for these females by 36%.<sup>40</sup> Finally, based on continued lower-than-expected mortality data through the end of 2003,<sup>36</sup> the modeling committee released yet another downward revision of the model in July of 2004 (i.e., the ASSA2002). Will this model be able to forecast the future, or will it follow in the footsteps of its predecessors? Unfortunately, we will not know the answer until such time that Stats SA completes the counting of deaths for year 2005. It is nevertheless interesting to note that this most recent version of the model is predicting annual AIDS deaths for sexually active females in this current year (2005) to be only about half of what was announced to the world back in 2001 (i.e., 153,000<sup>41</sup> as compared to the 290,000 mentioned above). This is remarkably good news. Why the major media considers it to be of no interest remains a mystery.

Okay, let's stand back and see what we have learned here. As previously stated, SA is the only country in Africa where it is possible to assess the accuracy of computer-generated HIV/AIDS estimates against real-life death registration data.<sup>7</sup> As such, mortality data gathered by the South African government assumes awesome significance. It is, literally, unique. However, in the absence of a better understanding of how shifts in death registration have influenced this data, it will be of little value. Unfortunately, the MRC's certainties on this issue have been achieved at the expense of scientific rigor.

The MRC has never publicly addressed the issues raised in Dr. Sulaiman Bah's seminal analysis of shortcomings in CDR in rural SA. They simply declared that CDR had somehow risen from negligible levels under apartheid<sup>10</sup> to a near-perfect 85% in 1996.<sup>4</sup> How this might have happened in the midst of the chaotic reintegration of former "independent" homelands (1994-1996), and in the complete absence of any reforms to improve death registration,<sup>42</sup> is baffling to say the least. At one point, MRC scientists undertook to publish the calculations that led them to a different conclusion from Bah's, but this has never happened.<sup>43</sup> Bah's arguments were never engaged, let alone refuted, and his call for "healthy debate in this area"<sup>12</sup> went unheeded. And finally, the government's post-1997 campaigns to improve CDR have been ignored entirely. These omissions, for lack of a better term, have allowed the MRC and its allies to attribute rapidly rising death registration almost entirely to HIV/AIDS. However, as we have seen, if this were indeed the case, then these increases would necessarily have to be concentrated in those provinces with the highest HIV prevalence, and this is unequivocally not the case.

I was hoping that Stats SA would attempt to clarify the role played by potential shifts in CDR in its latest mortality report. Alas, this appears to have been politically impossible. As soon as it became apparent that Stats SA might reach a conclusion that embarrassed or challenged the AIDS lobby, the agency and its head became the object of a campaign of vilification that inspired sectors of the media to dismiss the COD report as "unhelpful" or "flawed" before its findings were even known. It also seems to have intimidated Stats SA to such an extent that the final report refrained from making any pronouncement regarding the critical CDR issue. Every graph in the report contained a caveat noting that CDR had improved during the period under review, but there was no attempt at quantification. And absent quantification, the significance of the observed increases remains unknown.

It was therefore dismaying to see the media accepting the spin offered by the AIDS industry and its allies. To be sure, the number of registered deaths has risen by 57 percent since 1997, and these increases are notably greater in the sexually active age groups. But as shown above, more than three-fourths of these increases—even in the sexually active population—may well be due to nothing more than improvements in death registration. It is also true that deaths attributed to TB rocketed by 134% during the period for which cause-specific data is available (i.e., 1997-2001), but there is something Orwellian about the manner in which this was offered up as proof of the ravages of HIV. Those who propounded this idea were surely aware that the data they were looking at shows deaths due to assault and gunshots soaring by 187%<sup>44</sup> and 250%<sup>45</sup> respectively during same

period. Although the numbers are small, suicides likewise skyrocketed by 275%<sup>46</sup> over this period. Did SA really experience a catastrophic epidemic of murder and suicide between 1997 and 2001, or are these illusions generated by revolutionary improvements in death reporting? Every South African knows the answer.

In conclusion, everything put forth in this analysis supports the contention that the majority of the observed increases in reported death in SA over the past several years—even among the sexually active—are the result of improvements in death reporting. Presumably this is a result of the massive registration campaigns launched by the government in 1998 to achieve precisely this end. Advocacy campaigns based on the unfounded proposition that these increases are primarily the result of HIV/AIDS may serve a valuable purpose in drawing attention to a potentially alarming problem, but to sacrifice an accurate understanding of South Africa's mortality data to this end can ultimately be of no value to public health. Accurate vital statistics are crucial to effective policy formulation and to the proper management of public resources in any country. This is particularly the case in the developing world where limited resources are strained in the first place. As such, until such time that researchers and policymakers decide to clarify how changes in death registration might be influencing mortality statistics in South Africa, they are perpetuating a disservice on its citizens.

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<sup>1</sup> UNAIDS. 2004 report on the global HIV/AIDS epidemic : 4<sup>th</sup> global report. UNAIDS/04.16E (English original, June 2004).

<sup>2</sup> See for example: Murray CJL and Lopez AD. Mortality by cause for eight regions of the world: Global Burden of Disease Study. *Lancet* 1997; **349**: 1269-76.

<sup>3</sup> Blacker J. The impact of AIDS on adult mortality: evidence from national and regional statistics. *AIDS* 2004, **18 (suppl 2)**: S19-S26.

<sup>4</sup> Dorrington RE, Bourne D, Bradshaw D, Laubscher R, Timaeus IM. *The impact of HIV/AIDS on adult mortality in South Africa*. MRC Technical Report. MRC: Cape Town, September 2001.

<sup>5</sup> Bradshaw D, Laubscher R, Dorrington R, Bourne DE, Timaeus IM. Unabated rise in number of adult deaths in South Africa. *S Afr Med J* 2004; **94**: 278-9.

<sup>6</sup> Statistics South Africa. *Mortality and causes of death in South Africa, 1997–2003: Findings from death notification*. Statistical Release 0309.3. Statistics South Africa, Pretoria, February 2005. Available at [www.statssa.gov.za/](http://www.statssa.gov.za/).

<sup>7</sup> Timaeus IM. Impact of the HIV epidemic on Mortality in sub-Saharan Africa: evidence from national surveys and censuses. *AIDS* 1998; **12 (suppl 1)**: S15-S27.

<sup>8</sup> Statistics South Africa. *Recorded deaths, 1996*. Report No. 03-09-01 (1996). Statistics South Africa, Pretoria, January 2001. Ordering information can be found at [www.statssa.gov.za/](http://www.statssa.gov.za/).

<sup>9</sup>  $(50 \text{ deaths} - 10 \text{ deaths}) / 10 \text{ deaths} = 4.0$ ; or 400%.

<sup>10</sup> Botha J.L. and Bradshaw D. African vital statistics—a black hole? *S Afr Med J* 1985; **67**: 977-981.

<sup>11</sup> Statistics South Africa. *The people of South Africa: population census 1996, census in brief*. Statistics South Africa, Pretoria, 1998. 86p. [Report No 03-01-11 (1996)] ISBN 0-621-28073-9. Downloaded from [www.statssa.gov.za/](http://www.statssa.gov.za/) on June 6, 2001. For purposes of this review, “rural” will be considered synonymous with “non-urban.”

<sup>12</sup> Statistics South Africa. *Mid-year estimates 2000*. Statistical Release P0302. Statistics South Africa, Pretoria, November 2000. Available at [www.statssa.gov.za/](http://www.statssa.gov.za/).

<sup>13</sup> Statistics South Africa. *South African Life Tables, 1985-1994 and 1996*. Report 02-06-04. Statistics South Africa, Pretoria, 21 December 2000.

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<sup>14</sup> See also, Statistics South Africa. *Villages and Townships vital statistics network*. Issue No. 17, Sep/Oct 2000. Statistics South Africa, Pretoria. Available at [www.statssa.gov.za/](http://www.statssa.gov.za/).

<sup>15</sup> National Health Information System of South Africa. Project Report: Vital Registration Infrastructure Initiative by the Departments of Health, Home Affairs and Statistics South Africa department of Health, Pretoria, 1999. Available at <http://196.36.153.56/doh/nhis/vital/docs/vregistra.html>

<sup>16</sup> Bradshaw D, Kielkowski D, and Sitas F. New birth and death registration forms—A foundation for the future, a challenge for health workers? *S Afr Med J* 1998; **88**: 971-4.

<sup>17</sup> For details on these reforms, see: Statistics South Africa. *Villages and Townships vital statistics network*. Issues No. 12-19, Sep/Oct 1999-Jan/Feb 2001. Statistics South Africa, Pretoria. Available at [www.statssa.gov.za/](http://www.statssa.gov.za/).

<sup>18</sup>  $(0.90 - 0.37)/0.37 = 1.43$ , or 143%.

<sup>19</sup> Statistics South Africa. *Census 2001: Census in brief. Statistics South Africa*. Pretoria: Statistics South Africa, 2003. Available at [www.statssa.gov.za/](http://www.statssa.gov.za/).

<sup>20</sup> Provincial death rates (DR) in this analysis are calculated by dividing reported deaths in the COD report by populations revealed in census enumerations. Given that Census 1996 (see reference 11) and Census 2001 (see reference 19) were enumerated in October of their respective years, these data should closely approximate populations as of January 1, 1997 and January 1, 2002. As such, DRs for 1997 and 2002 were calculated directly using 1996 and 2001 census populations. In order to calculate DRs for intervening years, the necessary populations were imputed assuming annual compounding of 1996 populations to arrive at the corresponding 2001 populations.

<sup>21</sup> Prior to the publication of this report, the only mortality data in SA stratified by province was that which was extracted from the national population register (PR). Data on the PR, however, is only for those citizens in possession of proper ID, which represents only a subset of the actual mortality data. Furthermore, there is no available data for the number of living persons on the PR stratified by age or gender, which renders it impossible to express these deaths as rates.

<sup>22</sup> Compare this to, for example, a crude death rate of 13.1/1000 PY as determined in a five-year follow-up study of a rural community in Uganda with an adult HIV prevalence rate of only 8.3% (Nunn AJ, et al. Mortality associated with HIV-1 infection over five years in a rural Ugandan population: cohort study. *BMJ* 1997; **315**: 767-71). In fact, the observed death rate among HIV-negative persons in this study was 8.1/1000 PY.

<sup>23</sup> The proportion of the population in a province living in rural centers was derived from data in Census 1996 (see reference 11).

<sup>24</sup> While representing the increases in death as PIDR serves to remove distortions due to population changes over time, it should be emphasized that calculated death rates—as well as the increases over time—are not being held out in this analysis to represent actual death rates or increases over time. In fact, the calculated increases in death rates (PIDR) reflects the combined result of improvements in death reporting (CDR), as well as actual increases in mortality, over time. As such, the calculated PIDR may be entirely due to increases in CDR, entirely due to actual increases in mortality rates, or a combination of both.

<sup>25</sup> Provincial HIV prevalence for the 1997 ANC survey was extracted from data in *ASSA2000 Provincial Outputs* (see reference 28).

<sup>26</sup> Department of Health, 2003. National HIV and Syphilis Antenatal Sero-Prevalence Survey in South Africa: 2002. Available at [www.doh.gov.za/index.html](http://www.doh.gov.za/index.html).

<sup>27</sup> Department of Health, 2002. National HIV and Syphilis Antenatal Sero-Prevalence Survey in South Africa: 2001. Available at [www.doh.gov.za/index.html](http://www.doh.gov.za/index.html).

<sup>28</sup> Provincial deaths and populations necessary to calculate death rates (DR), and the percentage increase in death rates (PIDR), as predicted by the Provincial ASSA2000 model were taken from: *Provincial Outputs*, downloaded from the Actuarial Society of South Africa's (ASSA) website on August 25, 2005. Available at [www.assa.org.za/default.asp?id=1000000050](http://www.assa.org.za/default.asp?id=1000000050).

<sup>29</sup> Shisana O. *Nelson Mandela/HSRC Study of HIV/AIDS: South African National HIV Prevalence, Behavioural Risks and Mass Media. Household Survey 2002*. Cape Town: Human Sciences Research Council Publishers, 2002.

<sup>30</sup> For the purpose of this analysis, “rural” will be considered synonymous with “non-urban.” The proportion of a province living in non-urban areas in 1996 is detailed in the 1996 Census report from Statistics South Africa (see reference 11).

<sup>31</sup>  $(1.0 - 0.855)/0.855 = 0.17$ , or 17%.

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<sup>32</sup>  $(6,649 - 2,699)/2699 = 1.46$ , or 146%

<sup>33</sup> This number differs from that in Figure 1, because it refers to estimated CDR among females only. The numbers in Figure 1 are averages for males and females.

<sup>34</sup> The data can be adjusted for population growth by expressing deaths in the COD report as crude death rates, followed by adjustments for possible shifts in CDR. Crude death rates for these females were 2.16 and 4.82 *per* 1000 PY, in 1997 and 2002, respectively. Assuming that CDR = 45% in 1997, and 90% in 2001, actual death rates would be 4.80  $(2.16/0.45)$  and 5.36  $(4.82/0.9)$  *per* 1000 PY, respectively. The actual PIDR would then be  $(5.36 - 4.80)/4.80 = 0.116$ , or 11.6%. If CDR were 80% in 2001, then the actual death rate for that year would have been 6.03  $(4.82/0.8)$  *per* 1000 PY, and PIDR would then be  $(6.03 - 4.80)/4.80 = 0.256$ , or 25.6%.

<sup>35</sup> According to: “UNAIDS: Epidemiological fact sheets on HIV/AIDS and sexually transmitted diseases (South Africa, year end 2001),” 360,000 adults and children died from AIDS in year 2001, as compared to only 230,000 estimated by the ASSA600 model (data corrected to represent calendar year, see ref. 39).

<sup>36</sup> All of the ASSA models have been calibrated to mortality data extracted from the national population register (PR), which reflects only registered deaths for those citizens in possession of valid identity documents (ID) at the time of death. According to various assumptions regarding the proportion of the population that might have been in possession of ID, this data is then adjusted to estimate all registered deaths. Finally, according to assumptions regarding CDR, this data is further adjusted to estimate all deaths.

<sup>37</sup>  $(145.2 - 90.8)/90.8 = 0.599$ , or 59.9%. If we assume CDR = 90% in 2001, then the model would be overestimating deaths by only 44%.

<sup>38</sup>  $(182.8 - 109.1)/109.1 = 0.676$ , or 67.6%. If we assume CDR = 90% in 2002, then the model would be overestimating deaths by only 50.8%.

<sup>39</sup> The default output for death estimates in the ASSA600 model is for the 12-month period starting November 1, of the year in question. Data was corrected to represent calendar year based on trends in outputs from 1996 to 2005 according to 3<sup>rd</sup> order polynomial curve fitting. The default output for death estimates in the ASSA2000 model is for the 12-month period starting July 1, of the year in question. Data was corrected to represent calendar year based on trends in outputs from 1996 to 2005 according to 3<sup>rd</sup> order polynomial curve fitting.

<sup>40</sup>  $(148.2 - 109.1)/109.1 = 0.358$ , or 35.8%. If we assume CDR = 90% in 2002, then the model would be overestimating deaths by only 22%.

<sup>41</sup> The default output for death estimates in the ASSA2002 model is for the 12-month period starting July 1, of the year in question. Data was corrected to represent calendar year based on trends in outputs from 1996 to 2005 according to 3<sup>rd</sup> order polynomial curve fitting.

<sup>42</sup> The first action taken by the post-apartheid government to improve death registration was the formation of a partnership between the Departments of Health and Home Affairs in 1996. Statistics South Africa was invited to join this initiative at a later date. The first actual policy reform toward this end, however, did not occur until 1998 with the release of a simplified death notification form. For further details, see references 15 and 16.

<sup>43</sup> Details regarding the MRC’s position on CDR can be found in their first Technical Report pertaining to the ASSA demographic models (see reference 4). Although this report itself contains no details on the methods used to estimate CDR, it does reference another document where such details could be found: Timæus I.M., Dorrington R.E., Bradshaw D. and Nannan N. *Mortality trends 1985-2000: From Apartheid to AIDS*. MRC Technical Report (forthcoming). However, this latter document is still not available on the MRC website, and more recent publications from researchers at the MRC no longer even make reference to this “forthcoming” publication to justify assumptions regarding CDR (see for example, reference 5, or, Groenwald P, et al. Identifying deaths from AIDS in South Africa. *AIDS* 2005; **19**: 193-201). As such, there is currently no published document detailing how the MRC has arrived at its conclusions regarding CDR.

<sup>44</sup> Reported deaths from assaults increased from 1,302 in 1997 to 3,742 in 2001;  $(3,742 - 1,302)/1,302 = 1.87$ , or 187%; see pages 40-42 in the COD report (reference 6).

<sup>45</sup> Reported deaths from gunshot wounds increased from 2,039 in 1997 to 7,141 in 2001;  $(7,141 - 2,039)/2,039 = 2.50$ , or 250%; see page 38 (codes Y22-Y24) in the COD report (reference 6).

<sup>46</sup> Reported deaths from suicide (i.e., Intentional self harm, code X60-X84) increased from 103 in 1997 to 386 in 2001;  $(386 - 103)/103 = 2.75$ , or 275%. These numbers were derived by adding the deaths from this cause in all 9 provinces as revealed on page 43 of the COD report (reference 6).