# RAPID MORTALITY SURVEILLANCE REPORT 2011

Debbie Bradshaw,
Rob Dorrington,
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Burden of Disease Research Unit
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August 2012

SOUTH AFRICAN MEDICAL RESEARCH COUNCIL

UCT Centre for Actuarial Research

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# ACRONYMS AND ABBREVIATIONS

| | | |
|---|---|---|
| $_{45}q_{15}$ | - | Conditional probability of a 15-year-old person dying before age 60 |
| AIDS | - | Acquired Immune Deficiency Syndrome |
| ASSA | - | Actuarial Society of South Africa |
| HIV | - | Human Immunodeficiency Virus |
| DHA | - | Department of Home Affairs |
| DHIS | - | District Health Information System |
| DNF | - | Death notification form |
| $e_0$ | - | Life expectancy at birth |
| $e_{60}$ | - | Life expectancy at age 60 |
| HDACC | - | Health Data Advisory and Co-ordinating Committee |
| ICD | - | International Statistical Classification of Diseases and Related Health Problems |
| ID | - | Identity Document |
| IMR | - | Infant mortality rate |
| NSDA | - | Negotiated service delivery agreement |
| MMIEG | - | Maternal mortality interagency estimation group |
| MMR | - | Maternal mortality ratio |
| MRC | - | Medical Research Council |
| NMR | - | Neonatal mortality rate |
| NPR | - | National Population Register |
| PRMR | - | Pregnancy related mortality ratio |
| RMS | - | Rapid Mortality Surveillance |
| Stats SA | - | Statistics South Africa |
| U5MR | - | Under-5 mortality rate |
| VR | - | Vital registration |

## EXECUTIVE SUMMARY

A Rapid Mortality Surveillance (RMS) system was established to monitor the trend in the number of deaths recorded on the national population register at a time when there was a substantial time lag in the cause-of-death reports being produced by Stats SA. This report presents an analysis of the RMS data and provides empirical estimates of the mortality-based high-level indicators for Outputs 1 and 2 of the health-related outcomes of the NSDA to highlight the significant changes in mortality currently taking place in South Africa. By adjusting for known bias in the RMS data, it is possible to provide information about these key indicators two years sooner than the published vital registration data.

It is not possible to produce estimates for the neonatal mortality rate (NMR) from the RMS data, making it necessary to estimate the rate using data from the District Health Information System (DHIS). The maternal mortality ratio (MMR) cannot be obtained from the RMS either, and estimates of this have to be obtained from the cause-of-death data from Stats SA, resulting in a two-year time lag in the estimate.

The estimates show that there has been considerable progress in improving the health status of the nation. Life expectancy has started to increase through improvements in young adult mortality and child mortality. However, neonatal mortality rates have not improved since 2001, and maternal mortality appears to continue to worsen.

Further analysis of the RMS data is needed to clarify trends in older age mortality, and to develop a methodology to provide estimates of sub-national trends for the provinces and health districts.

## KEY MORTALITY INDICATORS, RMS 2009–2011

| LIFE EXPECTANCY AND ADULT MORTALITY (OUTPUT 1) | | | | |
|---|---|---|---|---|
| **INDICATOR** | **TARGET 2014** | **2009** | **2010** | **2011** |
| Life expectancy at birth: Total | 58.5<br>(Increase of 2 years) | 56.5 | 58.1 | 60.0 |
| Life expectancy at birth: Male | 56.0<br>(Increase of 2 years) | 54.0 | 55.5 | 57.2 |
| Life expectancy at birth: Female | 61.0<br>(Increase of 2 years) | 59.0 | 60.8 | 62.8 |
| Adult mortality ($_{45}q_{15}$): Total | 43%<br>(10% reduction) | 46% | 43% | 40% |
| Adult mortality ($_{45}q_{15}$): Male | 48%<br>(10% reduction) | 52% | 49% | 46% |
| Adult mortality ($_{45}q_{15}$): Female | 37%<br>(10% reduction) | 40% | 37% | 34% |
| **MATERNAL AND CHILD MORTALITY (OUTPUT 2)** | | | | |
| **INDICATOR** | **TARGET 2014** | **2009** | **2010** | **2011** |
| Under-5 mortality rate (U5MR)<br>per 1 000 live births | 50<br>(10% reduction) | 56 | 53 | 42 |
| Infant mortality rate (IMR)<br>per 1 000 live births | 36<br>(10% reduction) | 40 | 37 | 30 |
| Neonatal mortality rate[1] (<28 days)<br>per 1 000 live births | 12<br>(10% reduction) | 14 | 13 | 14 |
| **INDICATOR** | **TARGET 2014** | **2008*** | **2009** | |
| Maternal mortality ratio[2] (MMR)<br>per 100 000 live births | 270<br>(Reverse increasing trend and achieve 10% reduction) | 310 | 333 | |

1. DHIS data
2. Stats SA data

* Baseline for MMR set at 2008 due to a lag in data availability

## INTRODUCTION

In 1999, the South African Medical Research Council (MRC), in collaboration with the University of Cape Town, set up a project to capture data on deaths by age and sex recorded on the National Population Register (NPR) by the Department of Home Affairs in order to monitor the impact of HIV/AIDS on mortality at a time when there was quite a delay in the release of the cause-of-death reports produced by Statistics South Africa (Stats SA). A database was established, which is currently maintained by the MRC. This database is updated monthly, providing a means for Rapid Mortality Surveillance (RMS).

The Health Data Advisory and Co-ordinating Committee (HDACC), established by the Director General of the Department of Health in October 2010, recommended a set of high-level indicators to be used for monitoring the health-related outcome of the Negotiated Service Delivery Agreement 'Living a long and healthy life' (Outcome 2).

In considering the indicators for the health-related ouputs, the HDACC adopted the approach of results-based planning ensuring that the indicators are:

**clear:** precise and unambiguous
**relevant:** appropriate to subject at hand
**economic:** available at reasonable cost
**adequate:** provide sufficient bases to assess performance
**monitorable:** must be amenable to independent validation.

In addition, the HDACC identified the following further requirements regarding the baseline for 2009 as well as monitoring progress. In particular:

- the baseline needs to be reliable, stable by source and consistent with other indicators
- indicators for monitoring need to use an empirical source for monitoring and not projections from a model
- the tracking indicator must be timely and consistent with the base value.

Within this context, the RMS was identified as an important source of data to be used for several high-level indicators reflecting mortality (HDACC, 2011). These include life expectancy, the adult mortality index, ${}_{45}q_{15}$, the under-5 mortality rate, the infant mortality rate and the neonatal mortality rate. The RMS database, however, does not provide details on the causes of death (other than whether the cause was unnatural or natural) from which to derive a further mortality-related indicator, the maternal mortality ratio, and it was recommended by HDACC that the cause-of-death data reported by Stats SA be used for this, forcing this index to be two years behind the other indices.

Vital registration is not yet complete across the whole of South Africa, so adjustments have to be made to allow for the under-registration of deaths. There are also challenges with the quality of the cause-of-death information and, in the case of maternal mortality, it is also necessary to adjust for the mis-classification of causes of death.

This report provides estimates of the trend in the mortality-based high-level indicators for Outputs 1 and 2 of the health-related outcomes of the NSDA to highlight the significant changes in mortality currently taking place in South Africa. In addition, a more detailed analysis of the RMS data is presented to assist with interpretating the observed trends.

## DATA SOURCE

The Department of Home Affairs is responsible for civil registration and maintaining a computerised national population register. In the event of a death, a death notification form is submitted to the Department, which then issues a burial order and an abbreviated death certificate to the family of the deceased. For deaths of individuals with South African ID numbers or whose births have been registered, the National Population Register (NPR) is updated as part of the registration process.

Since 1999, the Medical Research Council has obtained monthly information about the deaths in the National Population Register and has developed a consolidated database. Several steps in the data management process ensure that the confidentiality of the data is maintained. Ethics approval was obtained from the University of Cape Town.

These data are subject to two forms of under-reporting. The first is non-registration on the population register (because the deceased did not have a South African birth certificate or identity document). The second, in common with deaths from the vital registration system (as reported in the cause-of-death data released by Stats SA), is non-registration of the death.

As the RMS data only identify cause of death as natural or unnatural, one needs to rely on the cause-of-death data from Stats SA to identify the maternal deaths. The latest available data are for the year 2009 (Stats SA, 2011). In addition, too few neonatal deaths are recorded in the RMS data and thus it is necessary to use data from the District Health Information System (DHIS) to estimate the number of neonatal deaths from those that occur in public hospitals in order to avoid the two-year lag in the release of the cause-of-death data.

## POPULATION ESTIMATES

Demographic indicators require estimates of the population and births that should ideally:

- be available for single ages to allow for more accurate estimation of the indicators
- not change frequently (to avoid having to recast the indicators)
- be as consistent with the age distribution of the population in the 2007 Community Survey and the 2001 census as is reasonable, allowing for possible undercounting of children and age exaggeration at the old ages.

After careful deliberation, the HDACC decided that estimates produced by the ASSA2008 AIDS and Demographic model be used for calculating the mortality-related indicators (HDACC, 2011). This decision is to be reviewed in 2013 once the results of the 2011 census become available.

## ADJUSTMENTS

Evaluation of the RMS data indicates that there has been an improvement in birth and ID registration, and a consequent reduction in the under-recording of deaths on the National Population Register relative to those captured by Stats SA's cause-of-death information. From Figure 1, it can be seen that more than 95% of the registered deaths of people aged 25 and over are on the NPR while there have been rapid increases in the younger ages, particularly children.

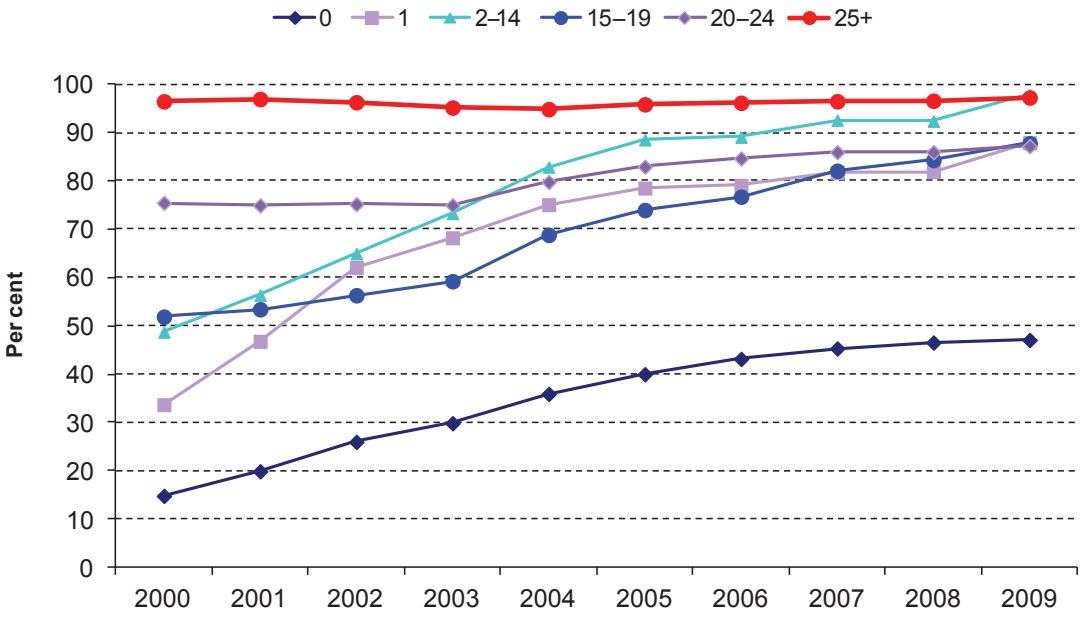


**Figure 1: Proportion of Stats SA deaths in RMS by age group, 2000–2009**

The HDACC recommended that the RMS data, adjusted to approximate Stats SA vital registration (VR) data for the year, be used (as the cause of death data processed by Stats SA is only available two years after the year in which the deaths occurred) by single ages to an open interval of 25+ for each sex. Above the age of 24, adjustments are made in the following broad age groups: 25–59, 60–89 and 90+ years. Thereafter, the estimated numbers of deaths are adjusted for general under-registration (i.e. deaths with no death certificates). The levels of completeness of the VR data assumed by HDACC are as follows:

- Age 0: 92%
- Age 1: 73.4%
- Age 2–14: linear trend between the figure for age 1 and the figure of 93% for age 15
- Ages 15+: 93%

Aside from adjusting for under-registration of deaths and the high proportion of ill-defined causes, the HDACC has recommended that, in line with the practice of the UN advisory group on Maternal Mortality (MMIEG), the number of deaths should be increased by 50% to allow for the general under-notification of maternal causes. This was based on the maternal experience of some 22 studies estimating the extent in under-notification in countries with good VR data (WHO, 2010).

The RMS data cannot be used to estimate neonatal deaths because less than 10% of the registered deaths in this age group are captured on the NPR (possibly because the birth is not registered). Furthermore, this proportion appears to have been increasing (possibly with improving birth registration), which makes it difficult to extrapolate. Comparison of the number of neonatal deaths recorded in the DHIS with those in the VR suggests that the DHIS represents more than three-quarters of the deaths in the VR. In order to track neonatal mortality in parallel with the infant and under-5 mortality, the number of neonatal deaths that occurred in facilities, as captured by the DHIS, is scaled up to estimate the number expected to be captured by the VR data and the result corrected for the same level of under-registration as is applied to the infant deaths, in much the same way as the infant and under-5 deaths are estimated.

## TRENDS IN RMS DATA

The number of deaths from the national population register is shown in Table 1 for 2000–2011 alongside the number of deaths reported by Stats SA cause-of-death reports for 2000–2009. The total numbers (T) are broken down into natural deaths (N) and unnatural deaths (U). It can be seen that the total number of deaths in both series increased to a peak in 2006. The Stats SA numbers increased from 416 316 in 2000 to a peak of 613 040 in 2006 and declined to 572 673 in 2009. The RMS numbers increased from 359 470 in 2000 to a peak of 555 081 in 2006 and declined to 485 023 in 2011. It should be noted that the changes in the numbers of deaths cannot be interpreted without taking into account the improvement in death registration, and in the case of the RMS, improved birth registration.

**Table 1: Number of natural (N), unnatural (U) and total (T) deaths in RMS compared with Stats SA data by year**

| | RAPID MORTALITY SURVEILLANCE | | | STATS SA CAUSE-OF-DEATH DATA | | |
|---|---|---|---|---|---|---|
| YEAR | Natural (N) | Unnatural (U) | Total (T) | Natural (N) | Unnatural (U) | Total (T) |
| 2000 | 319 228 | 40 242 | 359 470 | 366 536 | 49 780 | 416 316 |
| 2001 | 360 348 | 39 835 | 400 183 | 404 633 | 50 338 | 454 971 |
| 2002 | 401 098 | 41 563 | 442 661 | 450 670 | 51 463 | 502 133 |
| 2003 | 446 580 | 42 204 | 488 784 | 504 047 | 52 835 | 556 882 |
| 2004 | 467 889 | 41 928 | 509 817 | 523 456 | 53 353 | 576 809 |
| 2005 | 492 688 | 43 645 | 536 333 | 544 277 | 53 963 | 598 240 |
| 2006 | 509 636 | 45 445 | 555 081 | 559 812 | 53 228 | 613 040 |
| 2007 | 505 367 | 46 606 | 551 973 | 549 645 | 54 455 | 604 100 |
| 2008 | 498 699 | 46 771 | 545 470 | 541 852 | 53 300 | 595 152 |
| 2009 | 488 305 | 44 860 | 533 165 | 523 217 | 49 456 | 572 673 |
| 2010 | 465 363 | 43 597 | 508 960 | - | - | - |
| 2011 | 442 291 | 42 732 | 485 023 | - | - | - |

The rapid decline in the number of deaths makes it important to investigate whether there are any indications of system failure. Although subtle changes in completeness of recording are quite difficult to detect, extensive investigation did not identify any evidence of systems failure.

The trends in the number of deaths from the RMS are shown in Figure 2, indicating that the marked decline since 2006 are due to natural causes in the young adult age group and children <15 years. There is also a noticeable dip in natural deaths of adults 60+ years between 2003 and 2004.

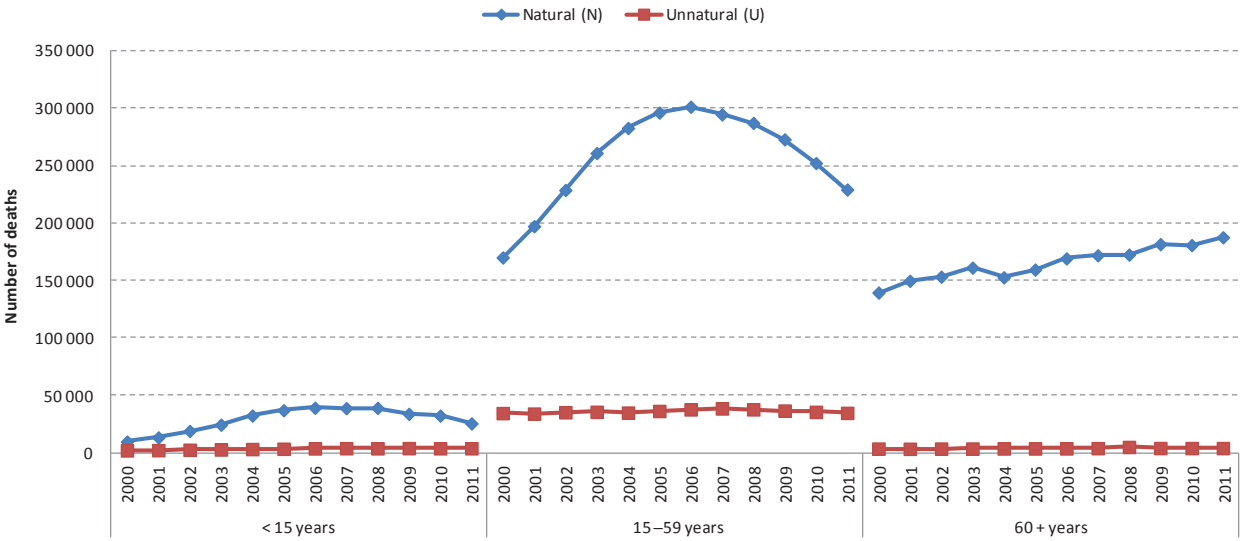


**Figure 2: Trend in the number of natural (N) and unnatural (U) deaths by broad age group, RMS 2000–2011**

The proportion of the VR deaths captured by the RMS increased from 86.3% in 2000 to 93.1% in 2009 (Figure 3). The proportion of unnatural deaths captured by the RMS was level at about 80% up until 2004, after which it increased to above 90% in 2009. Table 2 shows the numbers in broad age groups, while the proportion of the VR deaths captured by the RMS is shown in Figure 4 for each age group. There has been a considerable increase in the proportion recorded of children <15 years, with the proportion of unnatural deaths in the RMS being higher than that of the natural deaths. There has been less change in the 15–59 year age group, while the proportions in the 60+ year age group has been consistently high for the natural deaths and unnatural of deaths has increased since 2005.

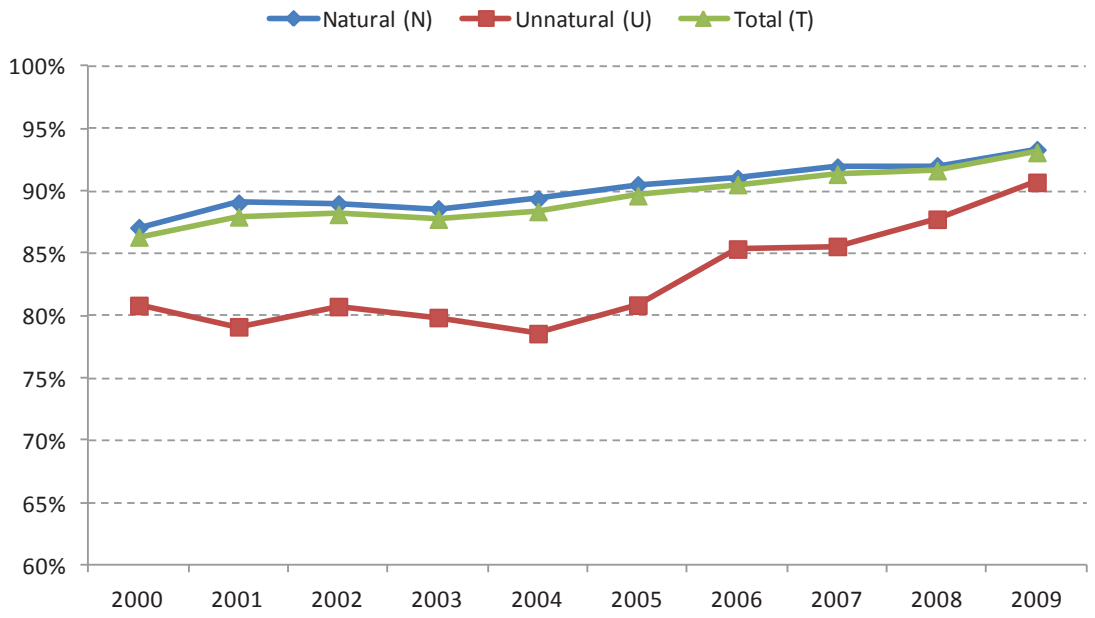


**Figure 3: Ratio of RMS to Stats SA data (%) by natural (N), unnatural (U) and total (T) category, 2000–2009**

**Table 2: Number of natural (N), unnatural (U) and total (T) deaths in RMS in broad age groups compared with Stats SA data by year**

| | RAPID MORTALITY SURVEILLANCE | | | STATS SA CAUSE-OF-DEATH DATA | | |
|---|---|---|---|---|---|---|
| Year | Natural (N) | Unnatural (U) | Total (T) | Natural (N) | Unnatural (U) | Total (T) |
| **<15 years** | | | | | | |
| 2000 | 9 682 | 2 075 | 11 757 | 41 590 | 4 613 | 46 203 |
| 2001 | 13 378 | 2 283 | 15 661 | 43 596 | 4 709 | 48 305 |
| 2002 | 18 995 | 2 617 | 21 612 | 50 057 | 4 375 | 54 432 |
| 2003 | 24 439 | 2 873 | 27 312 | 56 044 | 4 713 | 60 757 |
| 2004 | 32 401 | 3 232 | 35 633 | 62 314 | 5 119 | 67 433 |
| 2005 | 37 031 | 3 498 | 40 529 | 67 643 | 5 077 | 72 720 |
| 2006 | 39 168 | 3 815 | 42 983 | 68 877 | 5 394 | 74 271 |
| 2007 | 38 859 | 3 973 | 42 832 | 65 945 | 5 312 | 71 257 |
| 2008 | 39 058 | 3 875 | 42 933 | 65 254 | 4 961 | 70 215 |
| 2009 | 33 833 | 4 022 | 37 855 | 54 491 | 4 720 | 59 211 |
| 2010 | 32 341 | 3 904 | 36 245 | - | - | - |
| 2011 | 25 374 | 3 853 | 29 227 | - | - | - |
| **15–59 years** | | | | | | |
| 2000 | 170 044 | 34 532 | 204 576 | 185 846 | 39 606 | 225 452 |
| 2001 | 197 284 | 34 089 | 231 373 | 213 060 | 40 252 | 253 312 |
| 2002 | 228 815 | 35 302 | 264 117 | 247 630 | 41 422 | 289 052 |
| 2003 | 260 984 | 35 652 | 296 636 | 284 583 | 42 153 | 326 736 |
| 2004 | 282 753 | 34 944 | 317 697 | 304 623 | 41 805 | 346 428 |
| 2005 | 296 196 | 36 393 | 332 589 | 314 937 | 42 711 | 357 648 |
| 2006 | 301 284 | 37 811 | 339 095 | 320 236 | 42 370 | 362 606 |
| 2007 | 294 608 | 38 615 | 333 223 | 311 433 | 43 176 | 354 609 |
| 2008 | 287 152 | 37 832 | 324 984 | 303 294 | 42 440 | 345 734 |
| 2009 | 272 906 | 36 724 | 309 630 | 286 952 | 39 069 | 326 021 |
| 2010 | 252 244 | 35 615 | 287 859 | - | - | - |
| 2011 | 228 128 | 34 743 | 262 871 | - | - | - |
| **60+ years** | | | | | | |
| 2000 | 139 502 | 3 635 | 143 137 | 139 100 | 5 561 | 144 661 |
| 2001 | 149 686 | 3 463 | 153 149 | 147 977 | 5 377 | 153 354 |
| 2002 | 153 288 | 3 644 | 156 932 | 152 983 | 5 666 | 158 649 |
| 2003 | 161 157 | 3 679 | 164 836 | 163 420 | 5 969 | 169 389 |
| 2004 | 152 735 | 3 752 | 156 487 | 156 519 | 6 429 | 162 948 |
| 2005 | 159 461 | 3 754 | 163 215 | 161 697 | 6 175 | 167 872 |
| 2006 | 169 184 | 3 819 | 173 003 | 170 699 | 5 464 | 176 163 |
| 2007 | 171 900 | 4 018 | 175 918 | 172 277 | 5 968 | 178 245 |
| 2008 | 172 489 | 5 064 | 177 553 | 173 304 | 5 899 | 179 203 |
| 2009 | 181 566 | 4 114 | 185 680 | 181 774 | 5 667 | 187 441 |
| 2010 | 180 778 | 4 078 | 184 856 | - | - | - |
| 2011 | 188 789 | 4 136 | 192 925 | - | - | - |

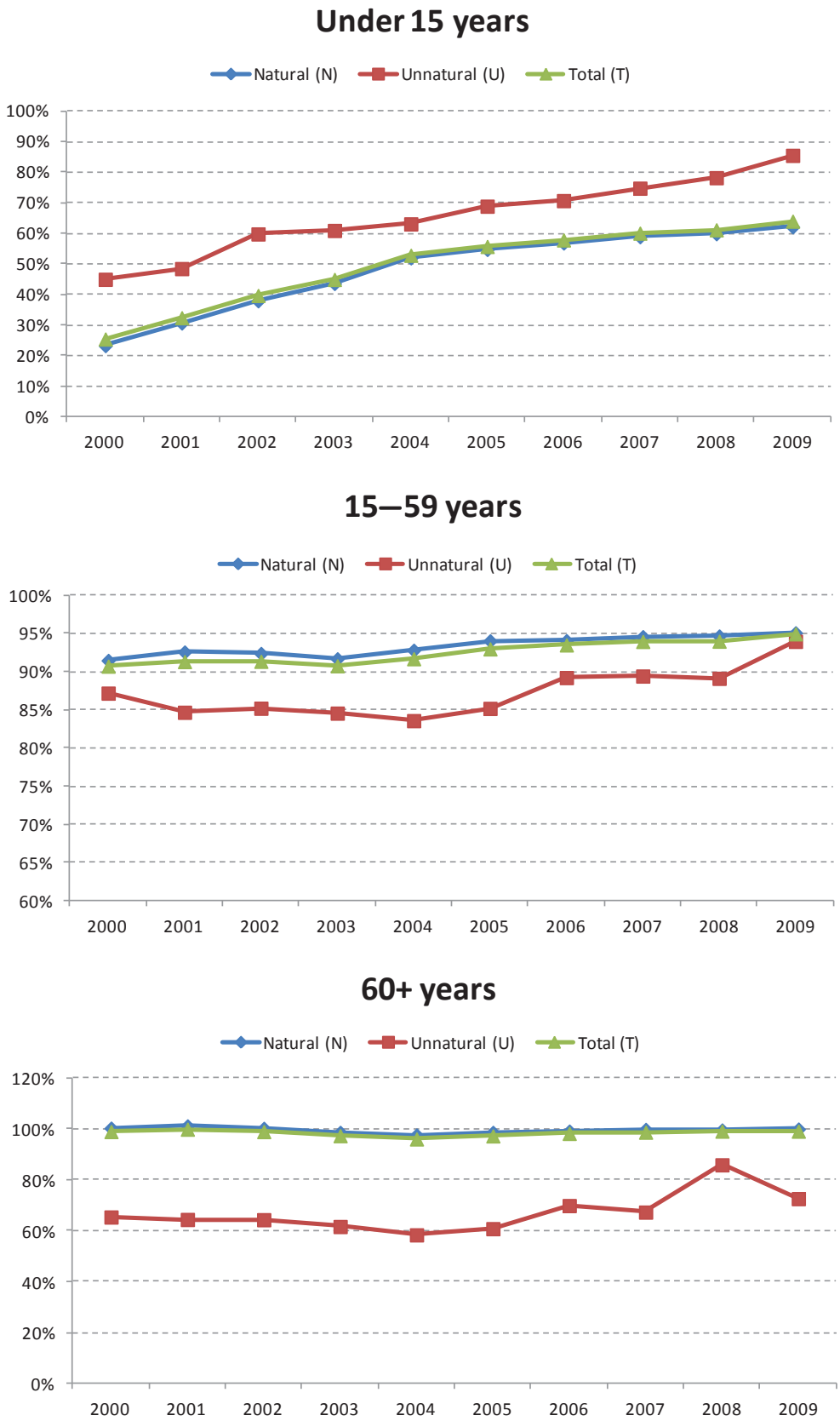


**Figure 4: Ratio of RMS to Stats SA data (%) in broad age groups by natural (N), unnatural (U) and total (T) category, 2000–2009**

## CORRECTING FOR INCOMPLETENESS

Figure 5 to Figure 9 compare the number of deaths, in total and for various age ranges, as reported by Stats SA (VR), from the national population register (RMS), together with the VR adjusted for incompleteness of registration (Adj VR) and the RMS adjusted for registered deaths of people not on the national population register (Est VR). This number is further adjusted for incompleteness of registration (Est Adj VR).

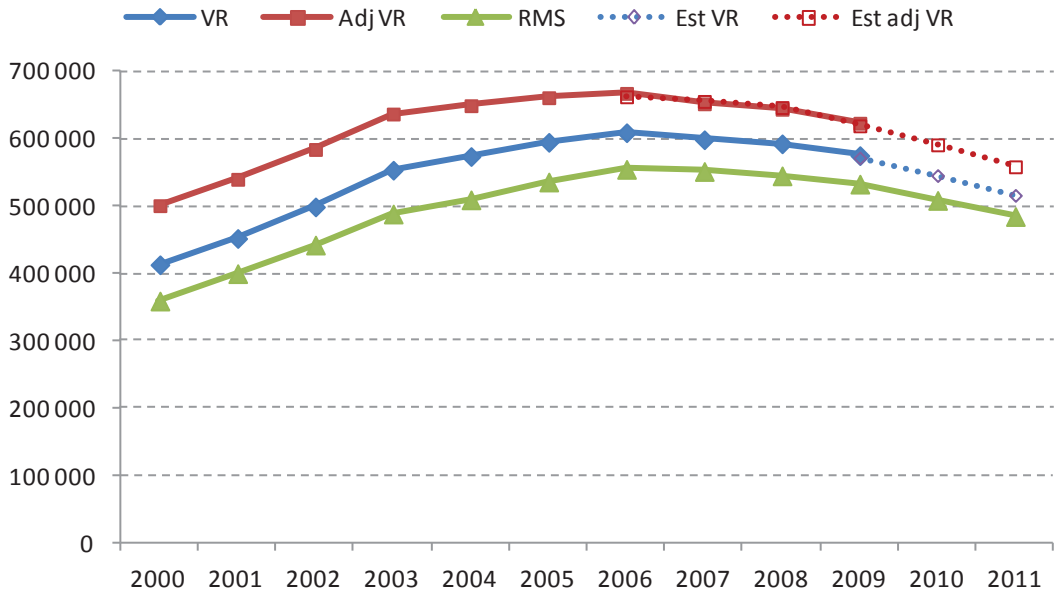


**Figure 5: VR, VR adjusted for incompleteness of reporting, RMS, estimated VR, estimated adjusted VR: Total deaths**

For the total numbers (Figure 5) and the 15–59 numbers (Figure 9), the adjustments to the RMS data appear to work well.

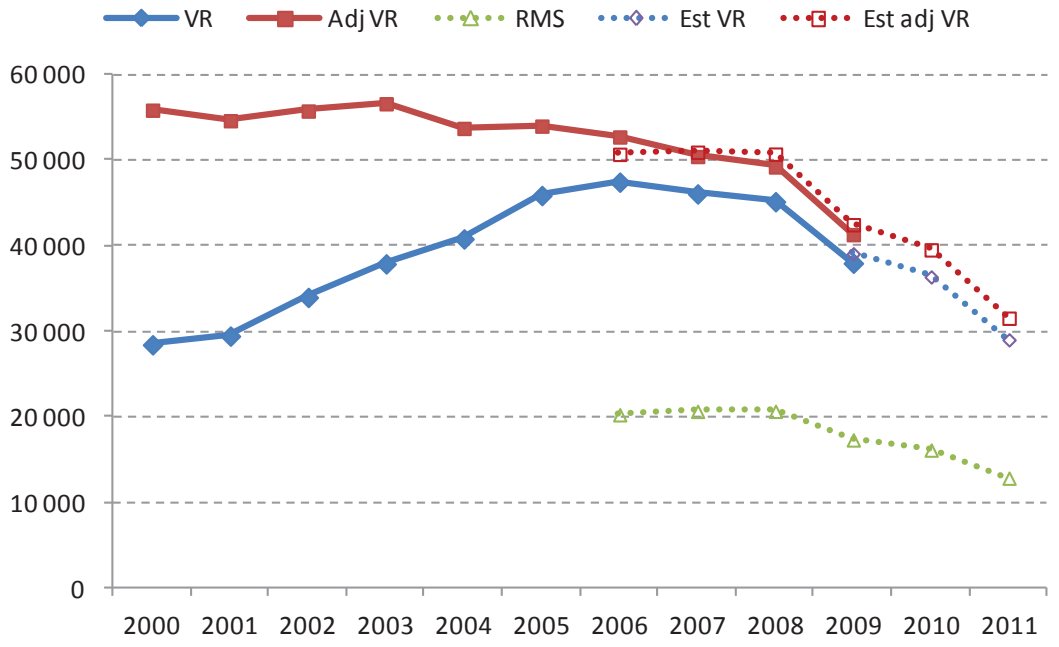


**Figure 6: VR, VR adjusted for incompleteness of reporting, RMS, estimated VR, estimated adjusted VR: Deaths < 1 year**

The comparison of the numbers of deaths occurring under the age of 1 (Figure 6), indicate the large (but declining over time) adjustment required for deaths of babies not on the NPR. However, despite the uncertainty introduced by having to make such a large adjustment, the estimates produced from the RMS data appear quite reasonable.

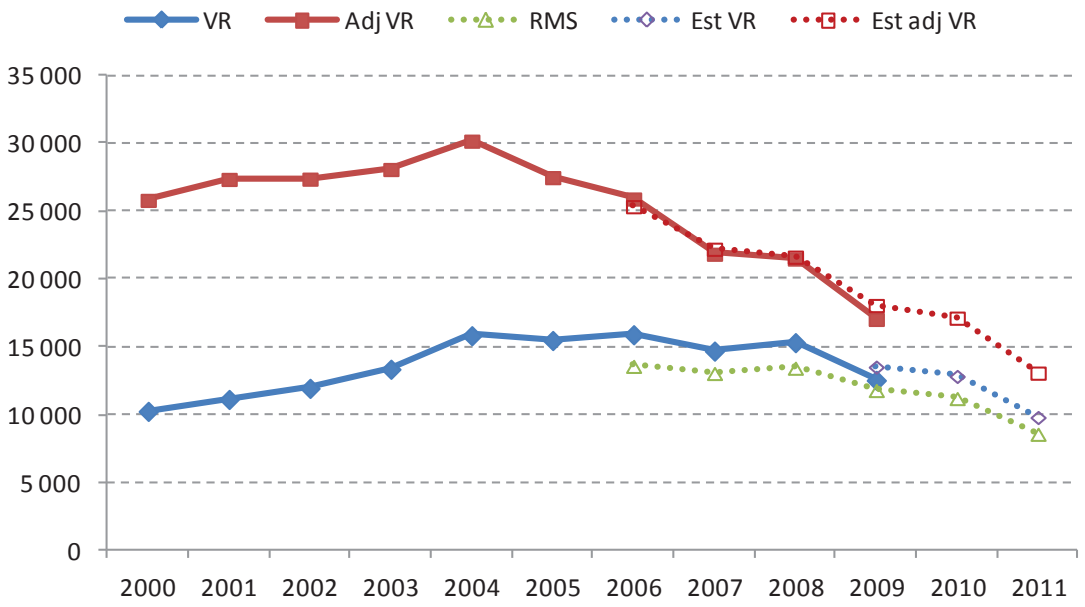


**Figure 7: VR, VR adjusted for incompleteness of reporting, RMS, estimated VR, estimated adjusted VR: Deaths 1–4 years**

From a comparison of the estimates of the numbers for 2009 in Figure 7, it appears as if the adjustment to account for deaths of children aged from 1–4 years not on the NPR exaggerates slightly the estimate of the number that will ultimately be reported by Stats SA and hence the estimate after accounting for incompleteness of registration. A similar bias appears in the numbers for deaths of children aged from 5–14 years, as shown in Figure 8.

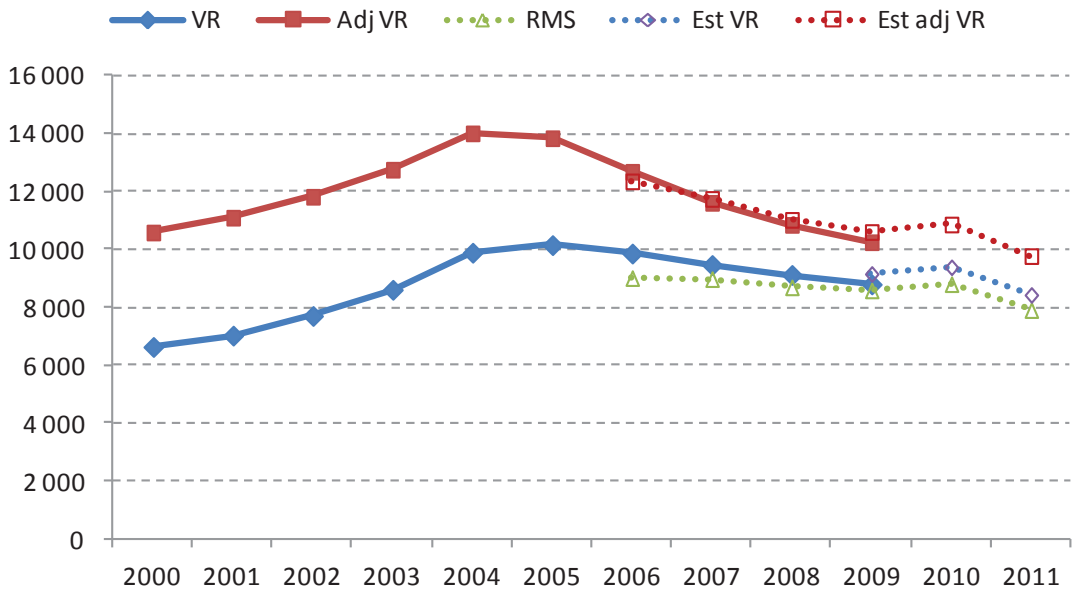


**Figure 8: VR, VR adjusted for incompleteness of reporting, RMS, estimated VR, estimated adjusted VR: Deaths 5–14 years**

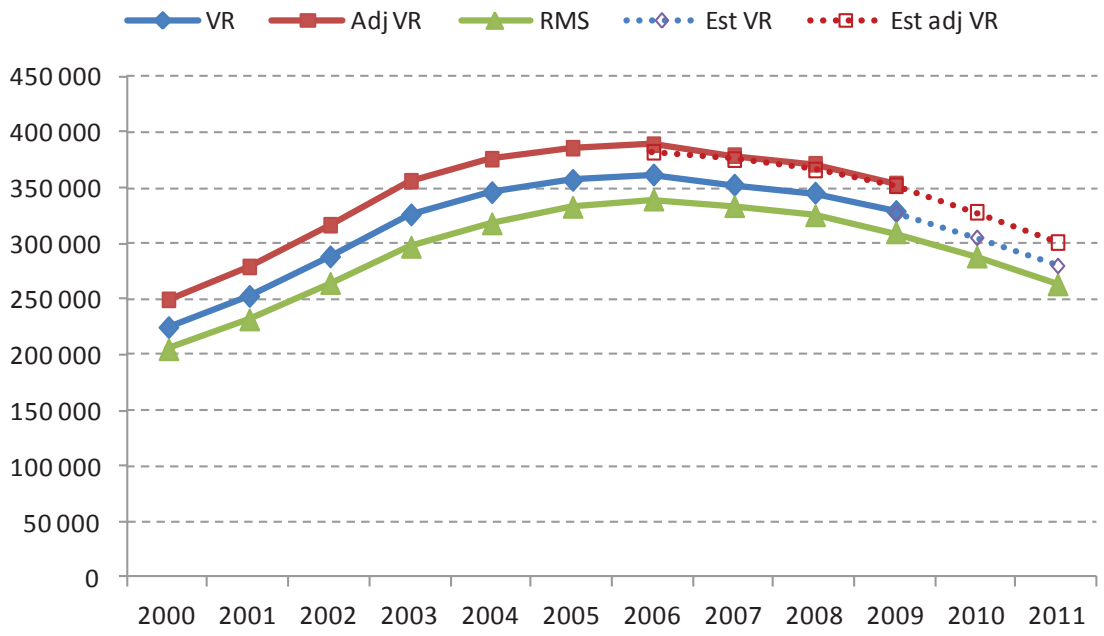


**Figure 9: VR, VR adjusted for incompleteness of reporting, RMS, estimated VR, estimated adjusted VR: Deaths 15–59 years**

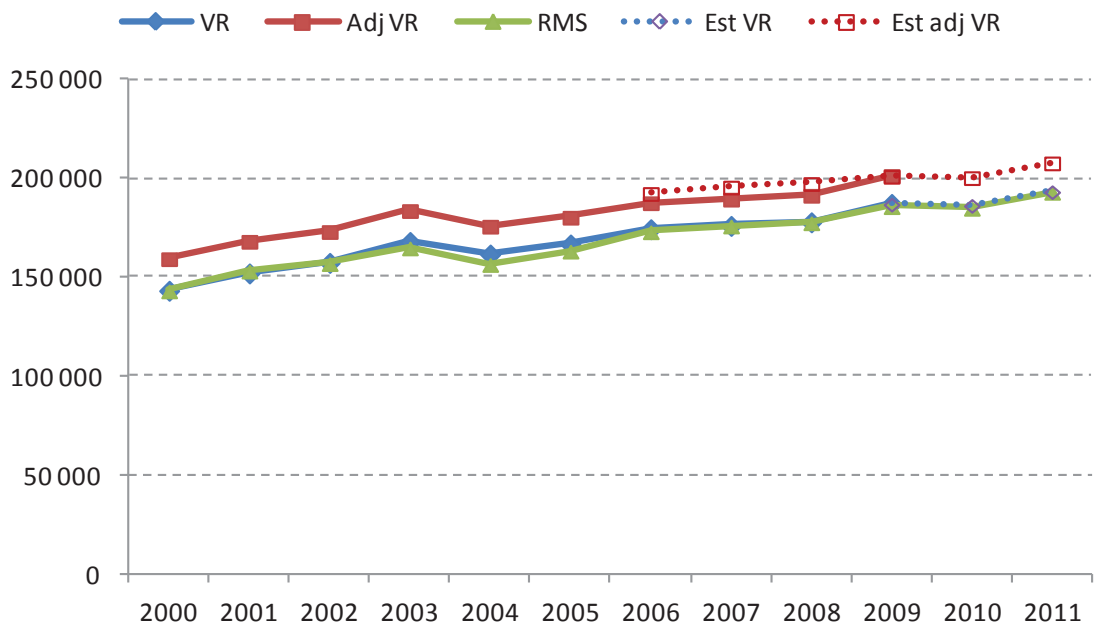


**Figure 10: VR, VR adjusted for incompleteness of reporting, RMS, estimated VR, estimated adjusted VR: Deaths 60+ years**

From the comparisons in Figure 10, it appears as if the number of deaths captured in the RMS is virtually the same as those ultimately reported by Stats SA, suggesting that virtually everyone from the age of 60 onwards is on the NPR.

## LIFE EXPECTANCY AND ADULT MORTALITY

Key indicators are estimated from mortality rates, which are calculated from the adjusted number of deaths divided by the population estimate at each age. The life expectancy at birth as well as adult mortality index, ${}_{45}q_{15}$, representing the probability of a 15-year-old person dying prematurely before the age of 60 years, are shown in Table 3. These are shown against targets recommended by the HDACC. It can be seen from the table that within three years, the targets have, somewhat unexpectedly, already been exceeded with particularly good progress in 2011. This is mainly due to a significant decline in the mortality of children under the age of 1, but also to a decline in adult mortality, probably as a result of greater than expected roll-out of ARVs. The trends in these indicators since 2000 are shown in Figure 11 and Figure 12. In addition, the trend in older age mortality is shown using the average life expectancy for people who have survived to age $e_{60}$. As can be seen from Figure 13, the mortality of older adults appears to have changed little since 2000. The average life expectancy at age 60 is about 14 years for men and 18 years for women.

**Table 3: Estimated life expectancy and adult mortality (${}_{45}q_{15}$), RMS 2009–2011**

| INDICATOR | TARGET 2014 | 2009 | 2010 | 2011 |
|---|---|---|---|---|
| Life expectancy at birth: Total | 58.5 (Increase of 2 years) | 56.5 | 57.8 | 59.6 |
| Life expectancy at birth: Male | 56.0 (Increase of 2 years) | 54.0 | 55.3 | 56.9 |
| Life expectancy at birth: Female | 61.0 (Increase of 2 years) | 59.0 | 60.3 | 62.4 |
| Adult mortality (${}_{45}q_{15}$): Total | 43% (10% reduction) | 46% | 43% | 40% |
| Adult mortality (${}_{45}q_{15}$): Male | 48% (10% reduction) | 52% | 49% | 46% |
| Adult mortality (${}_{45}q_{15}$): Female | 37% (10% reduction) | 40% | 37% | 34% |

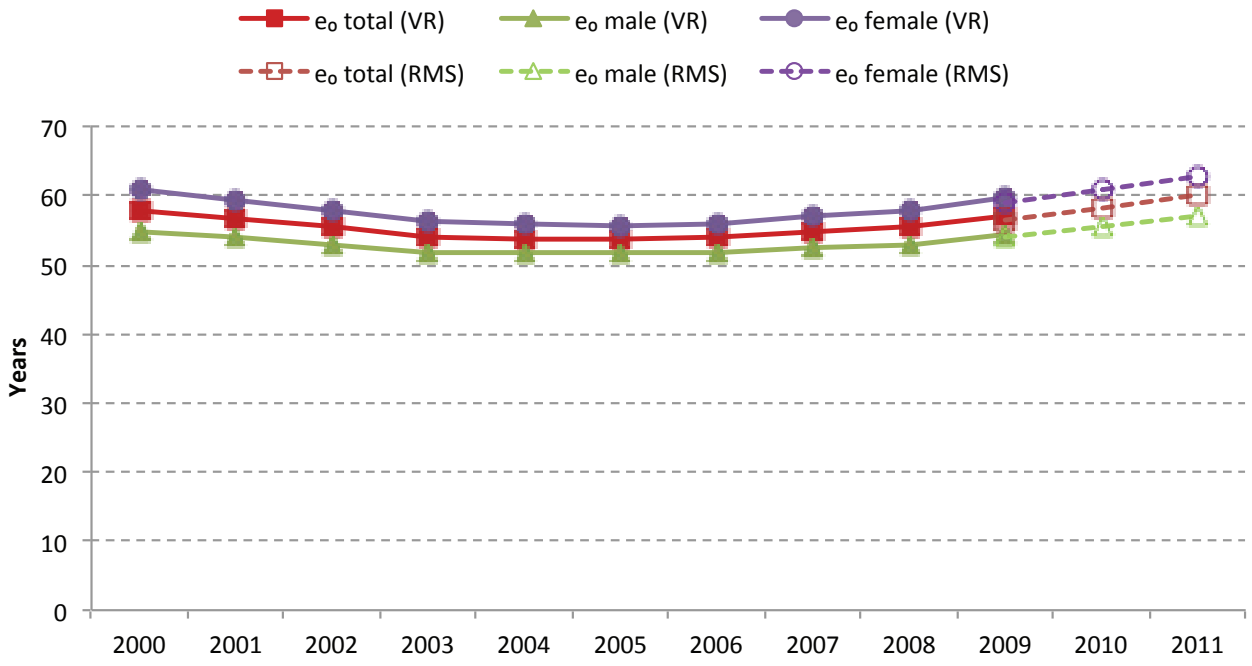


**Figure 11: Life expectancy ($e_0$) from VR and RMS, 2000–2011**

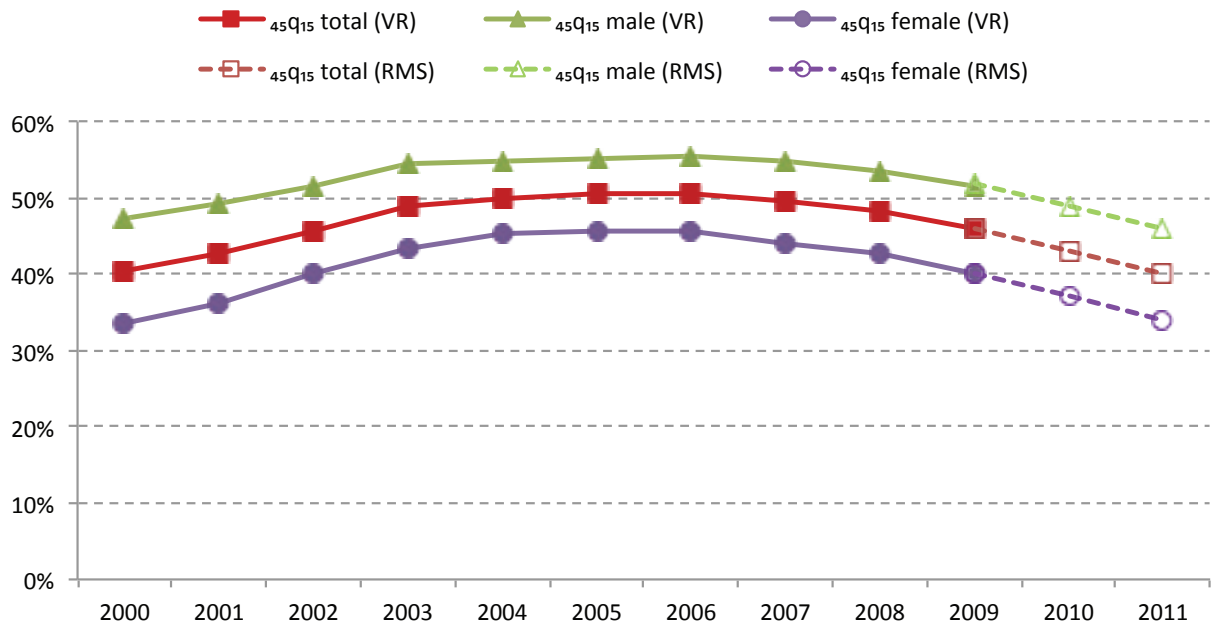


**Figure 12: Adult mortality ($_{45}q_{15}$) from VR and RMS, 2000–2011**

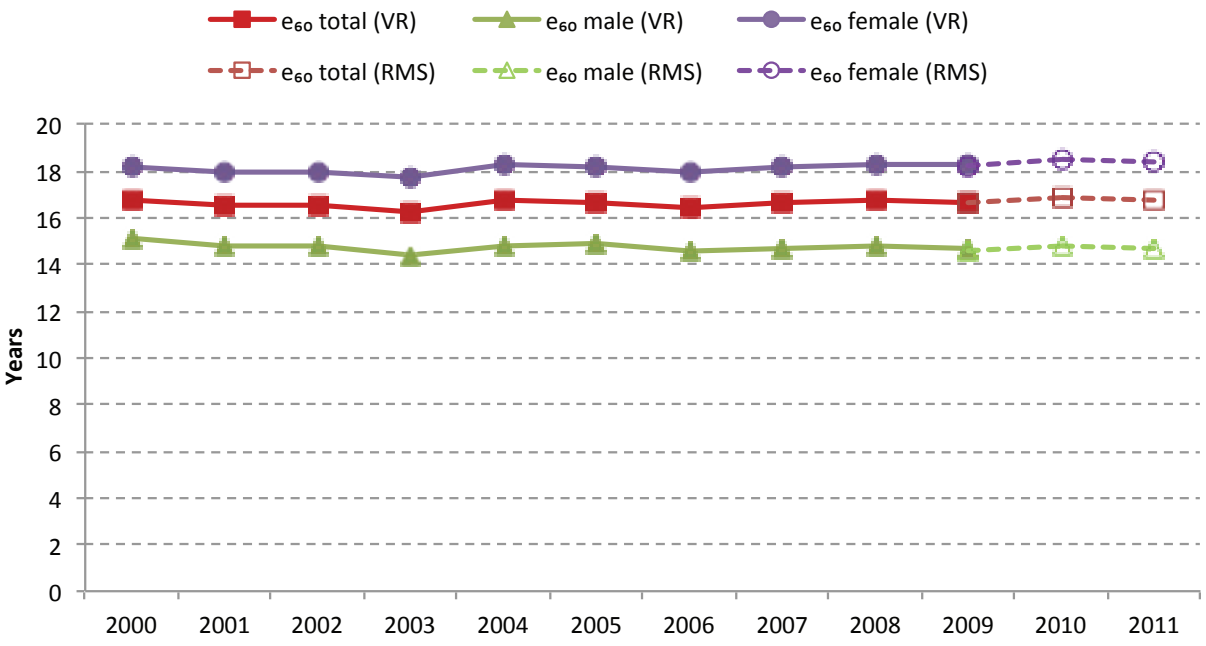


**Figure 13: Life expectancy at age 60 ($e_{60}$) from VR and RMS, 2000–2011**

## CHILD MORTALITY (U5MR, IMR, NMR)

The number of deaths under 5 years of age in the RMS has declined from 34 006 in 2006 to 21 554 in 2011. The number of deaths by month from RMS is shown in Figure 14 compared with the number of deaths reported by Stats SA. It can be seen that there is a high degree of correspondence between the two series with a marked seasonal effect that has become more attenuated as the numbers decline. The seasonal effect is complex with a summer peak early in the year followed by a peak in May/June.

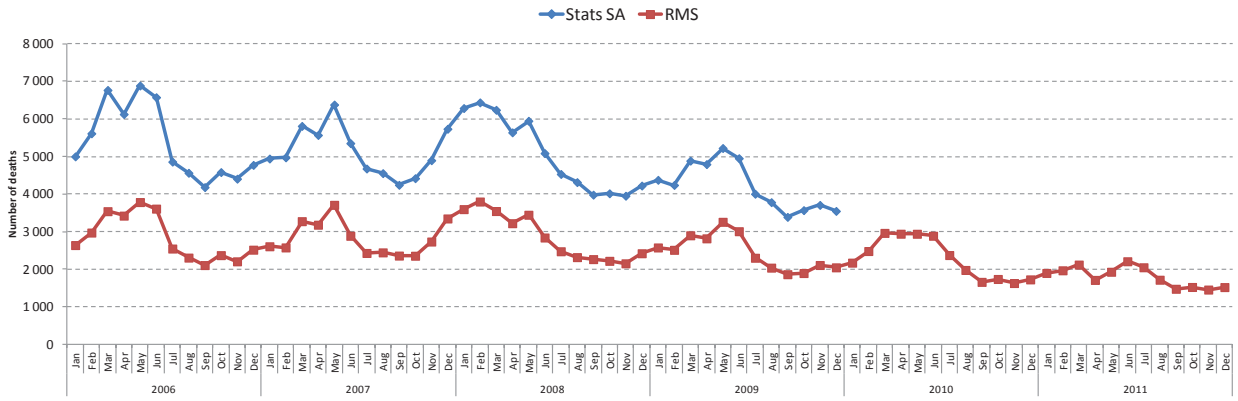


**Figure 14: Monthly number of child deaths under 5 years of age from Stats SA and RMS, 2006–2011**

The trends in selected causes in the Stats SA data for 2006–2009 are shown in Figure 15 indicating that the complex seasonal effect in the total under-5 deaths results from the seasonal trend in diarrhoeal diseases (ICD code A09) and the winter peak from pneumonia deaths (ICD code J18). The deaths from causes originating in the perinatal period (ICD codes P00–P99) do not follow any seasonal trend while the deaths without any cause (ICD code R99) tend to follow the pneumonia pattern with a winter peak. The HIV deaths (ICD codes B20–B24) including pseudonyms (ICD codes B33 and D84) are much lower than expected, reflecting the tendency not to disclose HIV on the death notifications. The trend in the HIV deaths indicates a very mild seasonal effect. Deaths from diarrhoeal diseases showed considerable decline in 2009, with a substantial drop in the summer peak and a smaller drop in the May peak. The May peak is generally associated with rotavirus, indicating that other factors have influenced the major decline in diarrhoeal disease.

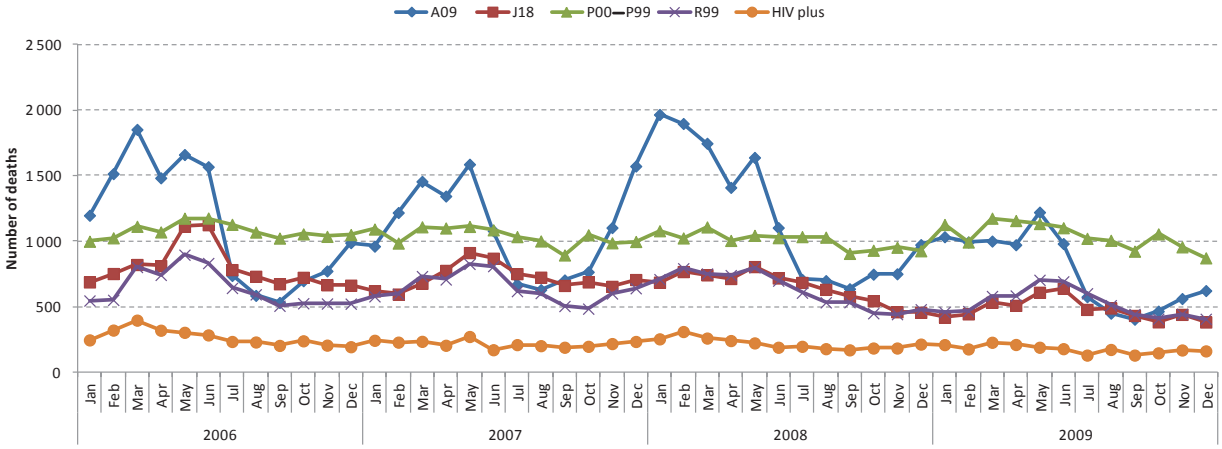


**Figure 15: Number child deaths under 5 years of age by selected causes of death, Stats SA 2006–2009**

Figure 16 shows the monthly number of deaths from the RMS by year indicating the continued decline in the number of deaths of children under 5 years of age. This is accompanied by an attenuation of the seasonal effect that is particularly marked in 2011. This pattern suggests that we can expect to see a drop in diarrhoeal disease and pneumonia deaths in the Stats SA data for these years when they are released. However, it is impossible to know the exact contribution of reductions in HIV infection, the introduction of new vaccines, improved access to water and sanitation or increased breast-feeding, to this decline.

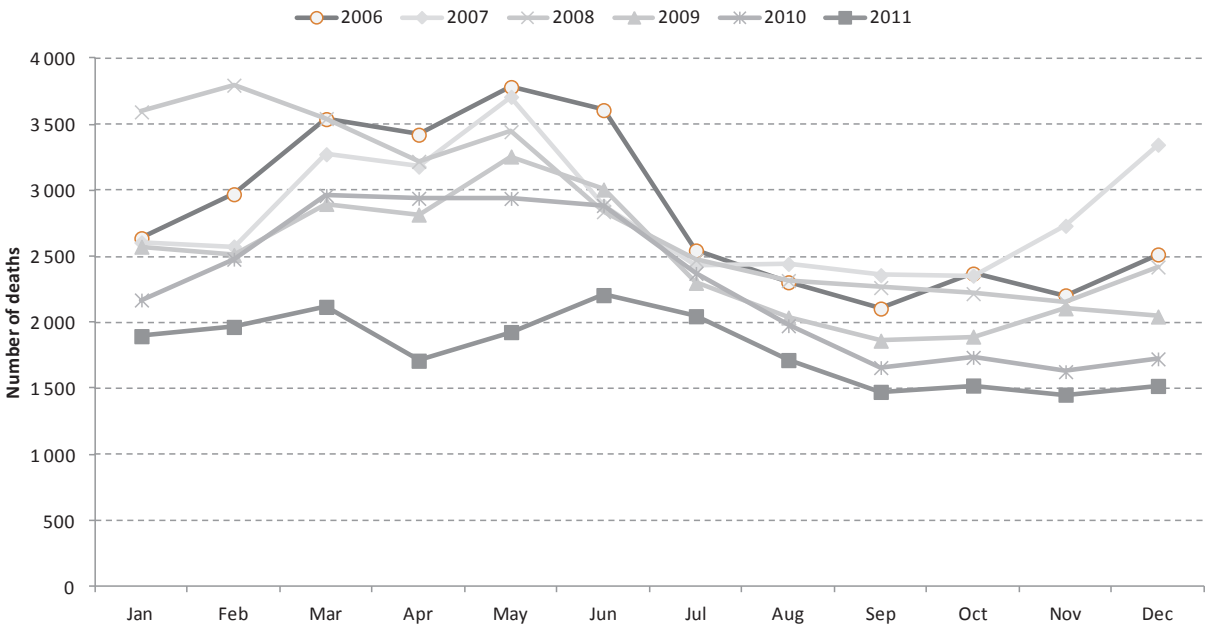


**Figure 16: Number of child deaths under 5 years of age by month of death, RMS 2006–2011**

When compared with the vital registration data from Stats SA, it is found that neonatal deaths in the RMS accounts for only 10% of the registered deaths. For this reason, it was necessary to consider an alternative data source to monitor the level of NMR. Figure 17 shows the numbers of neonatal deaths and stillbirths from the DHIS compared to the number of neonatal deaths from the cause-of-death data from vital registration. It can be seen that the neonatal deaths in the VR data have been fairly steady from 2006–2009, while the number of neonatal deaths in the DHIS have increased from 2008–2011 and the number of stillbirths has remained fairly steady in the DHIS. The VR data for registered stillbirths also showed little change between 2006 and 2009, holding steady at a level of about 15 000. These trends suggest that there is probably an increasing coverage of neonatal deaths in the DHIS over the period.

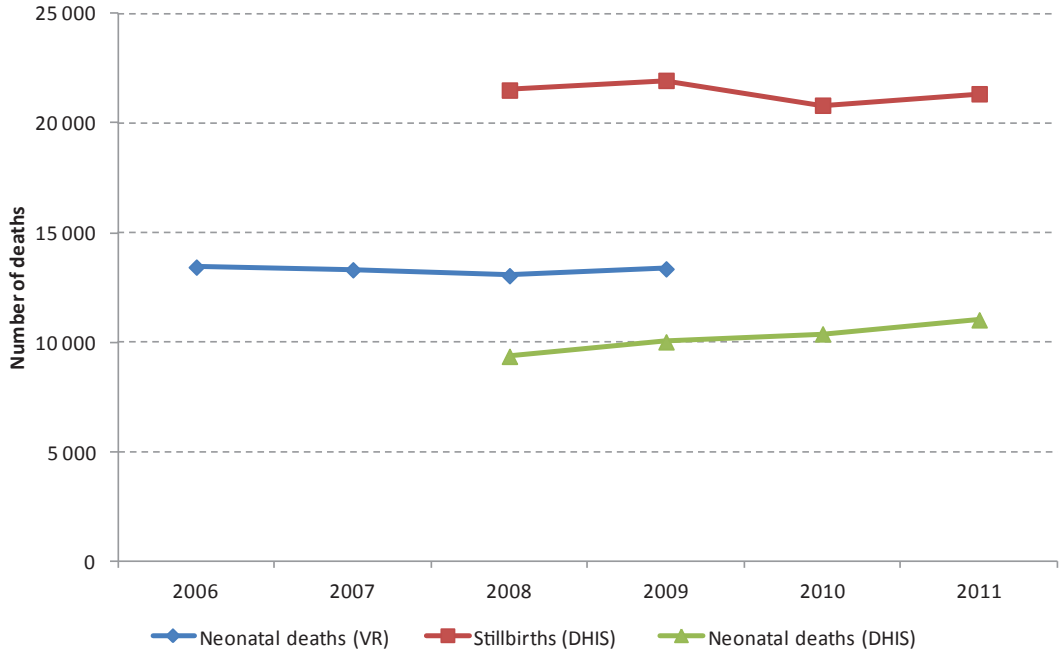


**Figure 17: Stillbirths and neonatal deaths from VR and DHIS**

In 2008, the DHIS accounted for 72% of the VR neonatal deaths and for 75% in 2009. Since both this proportion and the number of neonatal deaths relative the number of stillbirths captured by the DHIS are rising with time, it is possible that part of the increase in numbers of neonatal deaths from the DHIS are due to an increase in coverage. To allow for this, the proportions of DHIS to VR neonatal deaths for 2010 and 2011 were estimated as the proportion for the previous year plus any increase in the ratio of neonatal deaths to stillbirths over the previous year from the DHIS data. As a check of the reasonableness of this method, the estimate for 2009 is 74%.

Estimates of the key indicators of mortality for children are shown in Table 4 for the period 2009–2011 together with the targets recommended by HDACC. Figure 18 compares the U5MR, IMR and NMR. The U5MR and IMR are calculated from VR for the period 2006–2009 and from the RMS for the period 2010–2011, once the data have been adjusted for under-registration. The NMR are estimated from the registered deaths (adjusted for under-registration) for the period 2006–2009 and the DHIS (adjusted for under-coverage, relative to the registered deaths and the incompleteness of the vital registration) for the period 2010–2011. From Figure 18, we see that the estimates of the NMR from the DHIS are consistent with that from the VR, and that the NMR has remained between 13 and 14 per 1 000 live births for the period 2006–2011. In contrast, the IMR and the U5MR have declined rapidly since 2008, and by 2011 have exceeded the targets recommended by HDACC.

**Table 4: Estimated U5MR, IMR and NMR, RMS 2009–2011 and DHIS, 2009–2011**

| INDICATOR | TARGET 2014 | 2009 | 2010 | 2011 |
|---|---|---|---|---|
| Under-5 mortality rate (U5MR) per 1 000 live births | 50 (10% reduction) | 56 | 53 | 42 |
| Infant mortality rate (IMR) per 1 000 live births | 36 (10% reduction) | 40 | 37 | 30 |
| Neonatal mortality rate (<28 days) (NMR) per 1 000 live births | 12 (10% reduction) | 14 | 13 | 14 |

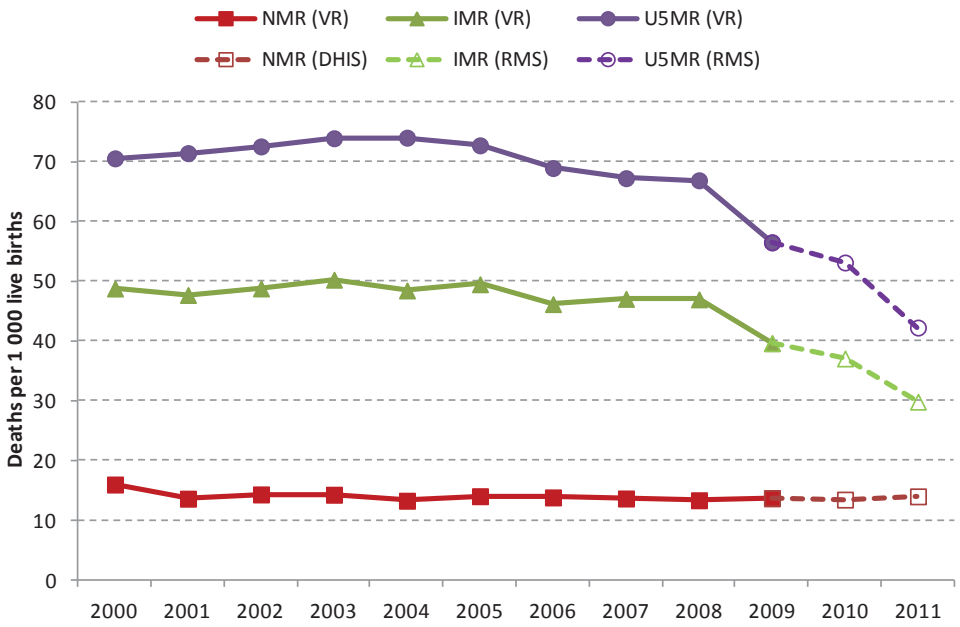


**Figure 18: Under-5 mortality rate (U5MR) and infant mortality rate (IMR) from VR/RMS and neonatal mortality rate (NMR) from VR/DHIS**

## MATERNAL DEATH

The uncertainty about the level of maternal mortality is well recognised (HDACC, 2011; Bradshaw and Dorrington, 2012). The estimate of the MMR based on the method proposed by HDACC reaches 333 per 100 000 live births in 2009 compared with 310 per 100 000 live births in 2008 (Table 5). Maternal deaths in the age range 15–49 years are identified in the Stats SA cause-of-death data as ICD code 000-099. The MMR is calculated from adjusted vital statistics by proportional redistribution of the ill-defined natural causes (ICD codes R00–R99) among the specified natural causes. Thereafter, the number is adjusted to allow for the fact that about 7% of deaths are not registered.

**Table 5: Estimated MMR, Stats SA 2008–2009**

| INDICATOR | TARGET 2014 | 2008 | 2009 |
|---|---|---|---|
| Maternal mortality ratio (MMR) per 100 000 live births | 270 (Reverse increasing trend and achieve 10% reduction) | 310 | 333 |

Figure 19 shows the estimates for maternal mortality ratios (MMRs) and pregnancy-related mortality ratios (PRMRs) produced from different data sources. (The MMR includes direct and indirect maternal causes of death while the PRMR includes, in addition, incidental deaths during the pregnancy risk period.) The values from vital registration and the confidential enquiry increase over the period but provide values that are much lower than the estimates from surveys and the census. Bradshaw and Dorrington (2012) argue that in the context of high adult mortality from AIDS, it can be assumed that there would be a high number of incidental deaths during the pregnancy risk period that would be reflected in estimates from surveys and the census, and may explain the high MMR of 625 for 2007 in the MDG Country Report. The HDACC estimates indicate that in 2009, there is still no sign of a reversal in the upward trend in maternal mortality.

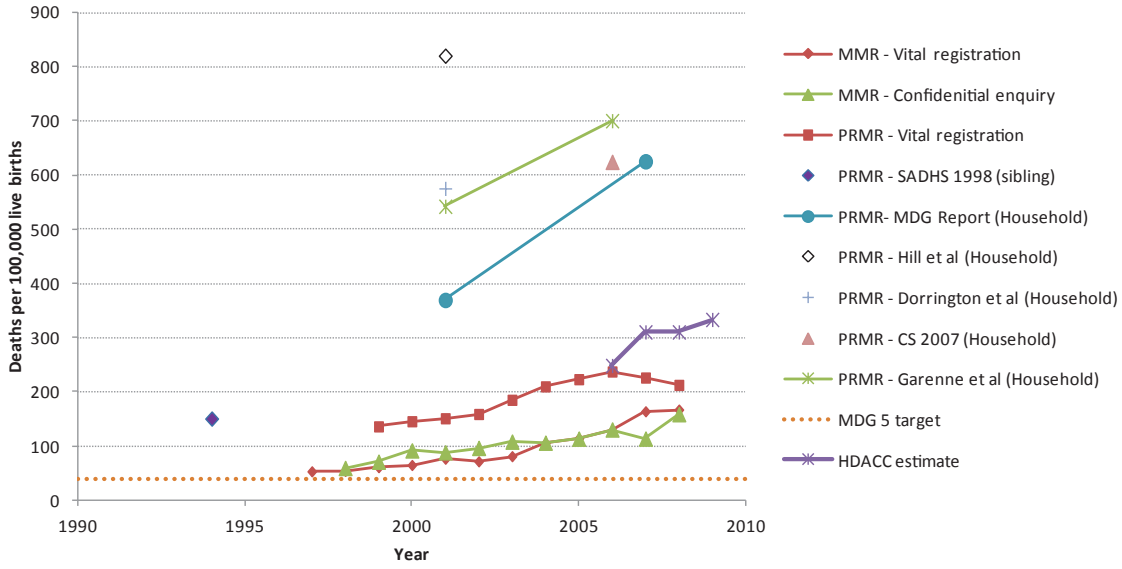


**Figure 19: Estimate of MMR compared with other data sources**
*Source: Adapted from Bradshaw and Dorrington, 2012*

The causes of the registered maternal deaths are shown in Figure 20, indicating a marked increase in the number of indirect maternal deaths since 2003, suggesting that the increase is associated with the AIDS epidemic. As noted by Bradshaw and Dorrington (2012), the timing of the increase in the indirect maternal deaths is possibly unexpected given that the rapid increase in the mortality of women aged 15–49 due to HIV started some 7–8 years and peaked some 2–3 years earlier. Longer exposures to HIV infection, adverse effects of antiretroviral therapy or changed death certification practice are possible reasons for the delayed increase, but needs further investigation.

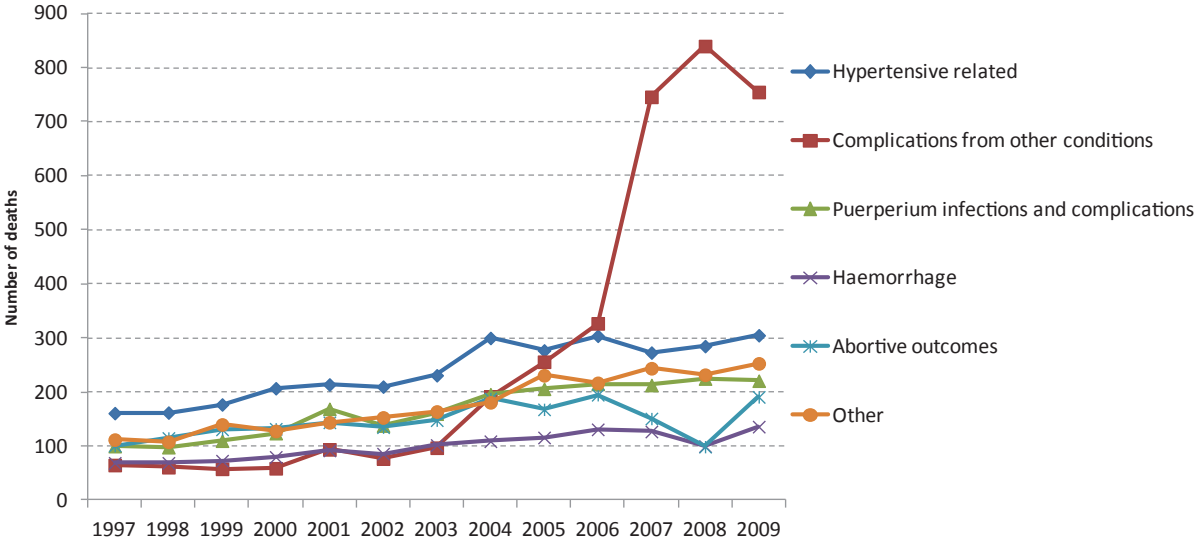


**Figure 20: Trend in the number of maternal deaths by cause, Stats SA 1997–2009**
*Source: Bradshaw and Dorrington, 2012*

## CONCLUSIONS

The report provides empirical estimates based on vital registration. By making adjustments for known bias in the number of deaths recorded in the national population register, it is possible to provide information about key health indicators in a timely fashion.

The estimates show that South Africa is making progress in improving the health status of the nation. Life expectancy started to increase from about 2005. It can be seen that there have been sustained improvements in mortality of young adults and child mortality, largely due to the roll-out of ART treatment and prevention of mother-to-child transmission of HIV. However, neonatal mortality rates have not improved, and by 2009, maternal mortality was still increasing.

Further analysis of the RMS data is needed to explore the possibilities of providing sub-national trends for the provinces and health districts.

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