SIZULU MOYO

MJMSIZ001

MPH DISSERTATION

CHILDHOOD MORTALITY IN THE BOLAND OVERBERG REGION
Declaration

I, Sizulu Moyo, hereby declare that this dissertation is my work and is based on research activities that I have been involved in.

Signature: Signed by candidate

Date:
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Dedication

I would like to dedicate this mini dissertation to the memories of the children in the Boland Overberg region who died during the period 2004 and 2005, personally unknown to us but precious and beloved by their families. I hope their memories will live on in this write up, and that their lives will contribute to an improvement of both the regional and national mortality data for the betterment of child health.
Acknowledgments

I would like to thank my supervisors Dr Hassan Mahomed, Dr Pam Groenewald and Dr Tony Hawkridge for their guidance, encouragement and tireless effort in assisting me with this project. I would also like to thank Dr Frans Krige the Regional Director of the Boland Overberg Department of Health for giving permission for this project, as well as all the Department of Health staff who were involved in this project. Special thanks also go to the regional Department of Home affairs for allowing us access to death certificates. I am also grateful to the staff at SATVI who assisted in copying death certificates and in capturing the data, to Professor Debbie Bradshaw for her input into this project, to Professor Gregory Hussey for giving me the opportunity to work on this project, and to Professor Maurice Kibel who provided guidance and advice in both the BCG RCT mortality follow up and the CMS. I would also like to make special mention of Professor Rodney Ehrlich who provided invaluable guidance and advice during the write up of this project.

Last but not least, I want to acknowledge my family for the support they gave me as I went through the MPH course. I especially thank my daughter for sitting next to me and offering to assist me as I did my assignments and this write up.
Figure 1: Map of the Western Cape Province of South Africa, showing the Boland and Overberg regions.
Child Mortality in the Boland Overberg Region

Abstract

Overall aim
To characterise the profile of infant, childhood and adolescent mortality in three adjacent district municipalities in the Boland region of the Western Cape Province of South Africa

Objectives

1. To describe the age, gender and cause of death profile of childhood mortality, in three district municipalities in the Boland Region (the Breede River Winelands, Breede Valley and Witzenberg municipalities).

2. To validate the causes of mortality recorded on death certificates by comparing these with causes of mortality assigned using verbal autopsy interviews combined with clinical record review with a focus on deaths ascribed to "natural causes" and "cot deaths".

Methods
Sources of routine mortality data in the region for the three district municipalities were identified by contacting the local Department of Health.

Mortality data from a routine surveillance system (the Boland Overberg Mortality Surveillance system) for period 01/01/2004 until 31/12/2005 for children between the ages of zero and 19 years were obtained for analysis. Other data were collected as part of research projects taking place in the area, namely the BCG Randomized Controlled Trial (BCG RCT) and the Childhood Mortality Study (CMS).
The Boland Overberg Mortality Surveillance system utilised the national vital registration system administered by the Department of Home Affairs whereby the Department of Health obtains copies of death certificates from the local Home Affairs offices. Underlying causes of death were coded from copies of death certificates using a mortality coding shortlist based on the International Statistical Classification of Diseases and Related Health Problems, version 10 (ICD 10). These codes were captured electronically and causes of mortality were then grouped according to the Burden of Disease classification, with some adaptation to allow for more detail for deaths that occurred in the neonatal period.

The BCG RCT was a phase four vaccine field trial comparing route of BCG vaccine administration in the prevention of tuberculosis in childhood. All children in this study were followed up for adverse events and severe adverse events including deaths. Deaths in children enrolled in the trial were investigated by verbal autopsy (VA) interview with the parents or caregivers as well as by review of clinical records where available.

The CMS was set up to characterise and amplify causes of childhood mortality in the Boland Overberg region based on the use of verbal autopsies and clinical record review. This study focussed on children who were not enrolled in the BCG RCT. Because the use of VAs and clinical record review in investigating childhood deaths had proved useful in the BCG RCT, it was expanded to investigate deaths of children 18 years and younger in the region. In the CMS, a sample of deaths amongst children aged zero to four years and all deaths amongst children and adolescents between the ages of five and 18 years were eligible for further investigation by VA interviews and clinical record review. The source for this sample of deaths was the Boland Overberg Mortality Surveillance System.
Unnatural deaths were excluded from investigation by VA and clinical record review as post-mortem diagnoses were expected to be available in these cases. Information obtained from VA interviews and clinical record review was used to assign immediate and underlying cause(s) of death by two assessors with a third assessor available for cases where diagnoses from the two principal assessors differed.

The underlying cause(s) of death assigned using the coding shortlist were compared with those assigned by VA interviews combined with review of medical records and agreement was measured using the kappa statistic.

Results

Based on the Boland Overberg Mortality Surveillance System, 667 deaths in children between the ages of zero and 19 years were identified in the three district municipalities in 2004 and 2005. There were more deaths in males (55%) than in females. 76% of deaths occurred in children below the age of 5 years and 17% of all deaths occurred in the early neonatal period. Based on death certificates from this surveillance system, in the neonatal period, prematurity and low birth weight ranked as leading causes of mortality, while in infants diarrhoeal diseases ranked as the leading causes of mortality. In the 1-4 year age group, HIV/AIDS and diarrhoeal diseases were the leading causes of mortality, while traffic accidents and drowning ranked as the leading causes of mortality in children aged 5-14 years.

In the 15-19 year old age group, homicide and road traffic accidents were leading causes of mortality. In children older than 5 years, males had a higher risk of death compared to females (RR 2.6; 95%CI 1.9-3.7).
In the 80 cases where a death certificate, a VA interview and clinical record review were available, the level of agreement between the causes of death diagnoses assigned by the two methods was moderate (kappa coefficient 0.45; P<0.001).

VA interviews combined with clinical record review reduced the proportion of non specific causes of death certified as “natural causes” by 6% from 20% to 14%.

Conclusion

Childhood deaths in these district municipalities were higher in males than in females particularly in the older age groups. The profile is dominated by infectious conditions in children below the age of five years and by external causes in the older age groups. Of particular note is the proportion of deaths due to drowning in children between the ages of 5 and 14 years. Also significant were levels of mortality due to road traffic accidents in children from the age of 5 years to 19 years as well as mortality due to homicide particularly in the age group 15- 19 years.

The use of VAs and clinical record review provided useful additional information which was useful in assigning specific causes of death in some of the cases where certified causes of death were non specific. The overall level of agreement between causes of mortality recorded on death certificates and those assigned by VA and record review was moderate. Therefore, caution is required when interpreting some of the data from the Boland Overberg Mortality Surveillance system, particularly data on deaths certified as being as being due to “natural causes”, HIV/AIDS, malnutrition, diarrhoeal disease and pneumonia.

Recommendations

Because of large the proportion of deaths in the neonatal period, particularly in children between zero and 7 days of age (the early neonatal period), there is need to focus on
neonatal services in these municipalities. Further targeted studies are required to characterize the problems during this period in more detail in order to develop targeted interventions.

Attention should also be directed at improving water safety amongst children in these municipalities as a significant proportion of deaths were due to drowning. This can be done in collaboration with other relevant stakeholders like the Department of Education as well as non-governmental organizations involved in water safety programmes.

Road safety particularly amongst children aged 5-19 years is another area requiring intervention. While a lot has been done with regard to road safety in South Africa as whole, collaboration with the Department of Education and the Department of Transport may enable the identification of new ways of dealing with this issue as it relates to children. Presently because most road traffic related deaths occur during public holidays, the focus on raising awareness on road safety has mainly been heightened at these times. Such awareness may need to be sustained throughout the year with a particular focus on children.

There is also a need to look at ways of reducing violence amongst adolescents. School psychological services could target children from an early school age, engage them in education on violence and the danger of objects like firearms and knives, in an effort to remove these from the culture of adolescents and young adults, and hence reduce deaths related to these objects.
The moderate level of agreement between death certificate diagnoses and VA and record review diagnoses observed in this study needs to be further explored in studies with larger sample sizes. Such studies could also look at a system utilizing multiple underlying causes of death rather than a single underlying cause of death which could be helpful in cases of co-morbidity. Further studies could also look at the possibility of conducting pathological autopsies in cases where no clear cause of death is apparent after review of clinical records and VA interviews.

To improve the quality of death certification in these district municipalities as well as in the entire region, workshops to train health practitioners on the correct completion of death certificates correctly could be organized.
Introduction

Background

Overview of mortality and mortality data

Burden of disease data is an important component of health information required to assess and monitor the health of populations\textsuperscript{1}. In common with other sectors, the health sector has the problem of scarce resources and therefore, priority setting is imperative to ensure optimal use of available resources. Comprehensive, timely and precise health information is therefore vital. Mortality data is often used as a substitute for morbidity data because it is often more easily obtainable than morbidity information\textsuperscript{2}, and premature/ preventable mortality is regarded in general as a more serious outcome than morbidity. Mortality statistics therefore form an important part of burden of disease data and are also essential for policy formulation and for planning and evaluation of health programmes. Such data can be used at local, regional, national as well as at international level to determine health needs of communities and populations. International organizations including the World Health Organisation (WHO) and the United Nations Children Fund (UNICEF) utilise such data to inform their policies, programmes and plans as well as for monitoring their programmes and interventions\textsuperscript{3}.

In many developing countries as is the case in developed countries, legislation requires the collection of vital statistics including mortality statistics\textsuperscript{4}. However, the quality as well as the utility of data from vital registration systems to meet policy purposes varies from country to country\textsuperscript{4}. While the number of countries reporting mortality data to the WHO has increased, the quality of such data remains poor in many countries particularly in the developing world. South Africa is one of the 28 countries noted to have poor quality
mortality data. Mortality data from South Africa (for the years 1990 to 1999) submitted to the WHO showed that completeness of the data was less than 70% and that ill-defined codes were recorded on greater than 20% of registrations. Reasons for poor mortality data in South Africa are varied and include the following: physicians writing death certificates not having access to the medical records of the deceased; concerns about confidentiality of cause of death diagnoses, particularly where HIV/AIDS is concerned; and the frequent unavailability of medical personnel to complete death certificates particularly in rural areas. Other African countries also face similar problems. Furthermore, in South Africa and other developing countries pathological autopsies which can provide information on causes of death where they are unknown or unclear seldom form part of routine mortality investigations for clinical purposes particularly in rural areas. Therefore such causes of death are likely to be incorrectly and inaccurately documented on death certificates.

Childhood and adolescent mortality

Childhood deaths are particularly important in developing countries, where although the trend has been a decline in mortality in the late 20th century, this decline has been slow, with mortality rates remaining high. The infant mortality rate (IMR) and under-5-mortality rate (U-5MR) are commonly used as indicators of health status in children. Sub-Saharan Africa had the highest IMR and U-5MR in 2000 and 2002 with approximately 41% of all child deaths occurring in Sub-Saharan Africa. In 2000, the IMR and the U-5MR figures for Sub-Saharan Africa were 104/1000 live births and 176/1000 live births respectively, while in the developed world the corresponding figures were 6/1000 live births and 8/1000 live births respectively. In 2002 the figures for Sub-Saharan were: IMR 104/1000 live births and the U-5MR 174/1000 live births while in the developed world the rates were: IMR 6/1000 live births and U-5MR 8/1000 live births. Of the 10.8 million
deaths amongst under fives world wide, about 36% (3.9 million) occur in the neonatal period, thus confirming the vulnerability of children at this stage of life\textsuperscript{10}. Also of significance and concern is the paucity of information on the cause of these deaths in low income countries\textsuperscript{10}. An article by Jones et al demonstrated that large reductions (up to a 3/5 reduction of current levels) of childhood mortality could be achieved by preventive and treatment interventions that are currently available, and can be delivered through the health sector\textsuperscript{12}.

The WHO estimates that about 20% of the world population are adolescents aged between 10 and 19 years with about 85 % of them living in developing countries\textsuperscript{13}. While they are thought to be healthy, about 1.7million adolescents die annually from accidents, suicide, violence, pregnancy-related complications and other illnesses\textsuperscript{13}. Violence to and by young people is a severe problem in some regions, with homicide being one of the most important causes of death among young males worldwide\textsuperscript{13}. In some countries road traffic accidents are the leading cause of death among boys and account for 5% of all Disability Adjusted Life Years (DALYS) lost among adolescents\textsuperscript{13}. In South Africa the proportion of deaths due to external causes based on Home Affairs data and Statistics South Africa data from 1996, amongst males aged 5-14 years and 15-24 years was 57% and 77% respectively\textsuperscript{1}. The figures for females were 46% and 32% respectively\textsuperscript{1}. Although these data include deaths up to the age of 24 years, it is clear that there is a significant burden of injury related deaths amongst adolescents in South Africa as well. Also important in South Africa and other African countries is the threat of HIV/AIDS deaths amongst adolescents. A study on mortality in the late 90s in Uganda showed that up to 9.9% of males and up to 20.3 % of female deaths in adolescents were due to AIDS and AIDS related diseases, with corresponding values of 10.9% and 12% respectively in children\textsuperscript{14}. In Central Africa, of the
49 deaths of children aged between 5 and 14 years seen at three morgues in Brazzaville as part of a study, 8.2% were due to AIDS. In South Africa HIV/AIDS deaths in children have also been shown to be increasing.
Improving/supplementing mortality data in countries with poor quality data

The Verbal Autopsy (VA) Method

A number of countries with poor vital registration systems have adopted the verbal autopsy (VA) method as a means of documenting probable causes of death\textsuperscript{3,16}. The VA method involves structured interviews being conducted with the bereaved next of kin or other caregivers of the deceased to find out the likely cause(s) of death\textsuperscript{17}. Because rapid improvements in the quality and completeness of mortality statistics are not realistic for most of these countries, the VA method is regarded as a reliable interim measure in the long term goal of attaining good quality vital registration data\textsuperscript{16}. Current interest in VAs has been in the context of disease surveillance and sample registration systems particularly for adult deaths\textsuperscript{16}. (Sample registration systems refer to community-based vital event registration systems implemented in a nationally representative cluster sample). Data from such systems compliment other data and are useful in countries where systems to generate complete vital events data are inadequate\textsuperscript{18}. Over 18 countries including India, China and Kenya regularly use the VA on a large scale in various contexts (e.g. Demographic Surveillance Sites, Sample Registration Sites in India etc); to assess causes of death in defined populations\textsuperscript{16}. VAs have also been used in various clinical studies where they have proved to be a valuable tool\textsuperscript{9,19,20}. They have also been used to investigate childhood deaths and have also been validated in various studies\textsuperscript{21,22}. In one validation study in Kenya, where medically confirmed diagnoses were used as gold standard VAs detected common causes of death with specificities greater than 80%\textsuperscript{21}. However, because an underlying assumption of the VA method is that different causes of mortality have distinct features (symptoms and signs) which can be recalled during an interview\textsuperscript{17}, conditions with common symptoms, including malnutrition, acute respiratory tract infections, gastroenteritis and meningitis were detected with sensitivities of less than 50%. In another
validation study looking at the major causes of child deaths in Namibia a questionnaire including signs and symptoms of diagnoses of interest was administered to caretakers of children less than 5 years who were identified from hospital records. Algorithms for malnutrition, diarrhoea and pneumonia had sensitivities of 73%, 89% and 72% respectively with corresponding specificities were 76%, 61% and 64% respectively. The authors concluded that VA data could be used to ascertain leading causes of death in childhood.

In South Africa, Kahn et al showed that a single VA instrument (with hospital diagnoses considered the gold standard) provided a reasonable estimate of the frequency of causes of death amongst adults and children. For communicable diseases the sensitivity of VA diagnoses among children was 69%, specificity was 96% and the positive predictive value (PPV) was 90%. Lower values were obtained for non-communicable diseases. In an earlier study using VA in the same area, Kahn et al had described a mortality profile for both adults and children that closely approximated that derived from hospital records that had been used for validation. They concluded that such data could be used with confidence for policy and planning purposes.

Problem statement

In South Africa, national death statistics are compiled by Statistics South Africa. While there have been improvements in the death registration system, there is however a four to five year delay before these data are available for use at both national and provincial levels. Since 1996 these data have not been available at regional or local level. This delay in the availability of the data compromises their usefulness for monitoring public health, allocating resources and developing public health policy.
Since the most recent complete mortality statistics, from Statistics South Africa, available for the Boland Overberg region date back to 1996, there is therefore a lack of recent regional childhood mortality data. This study looks at data from a mortality surveillance system set up to look into this problem. In addition verbal autopsies and review of clinical records were added to validate this data.

Aim and objectives

Overall aim

To characterise the profile of infant, childhood and adolescent mortality in three adjacent district municipalities in the Boland region of the Western Cape Province of South Africa

Objectives

1. To describe the age, gender, and cause of death profile of childhood mortality, in three district municipalities in the Boland Region (the Breede River Winelands, Breede Valley and Witzentberg municipalities).

2. To validate the causes of mortality recorded on death certificates by comparing these with causes of mortality assigned using verbal autopsy interviews combined with clinical record review with a focus on deaths ascribed to “natural causes” and “cot deaths”

Methods

Mortality data for three district municipalities in the Boland were obtained from the Boland Overberg Regional Mortality Surveillance System. Other data were collected as part of
research projects taking place in the area, namely the BCG Randomised Controlled Trial (BCG RCT) and the Childhood Mortality Study (CMS).

**Routinely collected data-The Boland Overberg Mortality Surveillance Program**

In 2004 a mortality surveillance system was set up in the Boland Overberg region\(^2^8\). The main aim of this surveillance system was to pilot a system of compiling death statistics using an abridged classification system of deaths to enable the region to obtain timely mortality information for policy formulation, priority setting and planning purposes\(^2^8\). This system is based on a system which has been successfully implemented in the City of Cape Town\(^2^5\) and has allowed the City of Cape Town access to accurate and timely mortality data which can be used for health planning and assessment. As in the Cape Town system, in the Boland-Overberg Mortality Surveillance System, copies of all death certificates received by the police at the local Home Affairs offices are made. Causes of death recorded on death certificates are then coded by trained coders using a mortality shortlist (The Boland Overberg Mortality Coding Shortlist. See Appendix 1). This short list is based on the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD 10)\(^2^9\). The assigned codes together with other demographic data are then captured into a database. For this mortality study, data from the Mortality Surveillance System for three district municipalities (Breede River Winelands, Breede Valley and Witzenberg municipalities) for the period 01/01/2004 until 31/12/005 were analysed to describe the profile of childhood deaths in these areas. The Breede River Winelands, Breede Valley and Witzenberg municipalities were chosen for analysis because they had the most complete surveillance data and because areas which were included in the BCG RCT study largely fell within these municipalities.
BCG RCT and the CMS (Research activities undertaken by the South African Tuberculosis Vaccine Initiative)

The BCG RCT was a phase four randomized controlled vaccine field trial which compared route of BCG vaccine administration in the prevention of tuberculosis in childhood. As part of the BCG RCT mortality surveillance, trial participants' deaths were investigated by VA interview with family members/caregivers and clinical record review. This was in addition to attempts to obtain a copy of the death certificate. The BCG RCT began in 2001 and all children were followed up for at least two years. All deaths amongst the BCG RCT participants included in this study occurred in children below the age of 5 years. The VA questionnaire used was based on the WHO VA questionnaire for neonatal and childhood deaths which was adapted for use in the trial (See Appendix 2). Information obtained from VA interviews and medical record review was used to assign cause(s) of death. This was done by two assessors with a third assessor available for cases where cause of death diagnoses from the two principal assessors differed. The underlying causes of death obtained by this method for trial participants who died between 2004 and 2005 were compared to underlying causes of death recorded on death certificates obtained as part of the Boland Overberg Mortality Surveillance System.

Because the BCG trial only investigated deaths of trial participants, a sample of deaths of children aged zero to four years and all deaths of children and adolescents between the ages of five and 18 years who were not part of the BCG trial in the three district municipalities mentioned above were also investigated by conducting VA interviews and record review. This was the CMS. Monthly lists of all child deaths registered at the local Home Affairs offices were compiled from copies of death certificates by Department of Health staff.
These lists were sent to investigators at SATVI who compiled a database of children to be investigated as part of the CMS. Systematic sampling was used to sample every fifth death for inclusion in the study for deaths in children below the age of five years during the period 01/01/2004 and 31/12/2005. Children who were enrolled in the BCG RCT were identified and excluded from the sampling lists. All deaths in children aged 5 years to 18 years were included in the CMS. No VA interviews were conducted where deaths were due to unnatural causes, since post mortem diagnoses were expected to be available. All personal identifiers were kept strictly confidential. For deaths in children older than five years, selected questions from the VA questionnaire for Childhood deaths were used during the interview process.

For both the BCG RCT and the CMS, definitions of cause of death diagnoses assigned after VA interview and record review, were based on the WHO recommended definitions for the completion of death certificates. These definitions are:

- Immediate cause of death - the final disease or condition resulting in death
- Underlying cause of death - disease or injury which initiated the train of events leading to death, or the circumstances of the accident or violence which produced the fatal injury
- Contributing causes of death – other significant conditions contributing to death but not resulting in the underlying cause of death

Data was captured into a Microsoft Access database and an Excel spreadsheet.

All childhood mortality data obtained from the surveillance system were analysed on age and gender as well as cause of death. The neonatal, infant and 1-4 year child mortality rates for the study period were calculated. The number of births collected routinely in the region
from all birthing centres and hospitals, and collated by Information management Department at the Boland Overberg Regional office were used for these calculations (the figures were obtained from Dr P. Groenewald). Population estimates were obtained from a report on Causes of death and premature mortality in the Boland Overberg Region 2004-2005\textsuperscript{28}. The relative risk of death by gender was calculated for children older than 5 years.

Underlying cause(s) of death recorded on death certificates and the underlying cause(s) of death assigned by VA interviews combined with review of medical records for children enrolled in the BCG RCT and the CMS were compared. The level of agreement between the underlying causes of death assigned by these two methods was measured using the kappa statistic.

STATA v. 8 and Microsoft Excel were used for data analysis

Permission to conduct these studies was obtained from the UCT Research Ethics Committee.

Results

Mortality profile based on death certificate data

A summary of the sources of mortality data used in this study is given in figure 2. From a total of 667 deaths that occurred in the study municipalities in children between zero and 19 years during the period 2004 and 2005, 93 were enrolled in the BCG RCT and 107 deaths were sampled for inclusion in the CMS. Of the deaths occurring in children enrolled in the BCG RCT, 62 were investigated by VA and clinical record review. Amongst child deaths sampled for inclusion in the CMS, 18 were investigated by VA and record review.
Amongst deaths in children enrolled in the RCT, 15/93 (16%) were lost to follow-up and in the CMS 29/107 (27%) were lost to follow-up. Children who were considered lost to follow-up had no death certificate (the death certificate was not seen by SATVI investigators), no clinical records and no VA interview data. For children with no VA interview, consent to conduct the interview was declined by the family or the family could not be located for the interview. These children (with no VA) may have had one or both of the following; a death certificate seen by SATVI investigators and clinical records. More than a fifth 25/107 (23%) of deaths in children enrolled in the CMS study died from unnatural causes. No deaths from unnatural causes were recorded amongst children enrolled in the BCG RCT during the period 2004 and 2005.

Figure 2: Summary of sources of mortality data

# BCG RCT- BCG Randomized controlled trial
*LFU- Loss to follow-up
$VA- Verbal autopsy
###DC- death certificate
**CMS- Childhood Mortality Study
Age and gender profile

Of the 667 deaths of children aged 0-19 years recorded in the Boland Overberg Mortality Surveillance System database (which will now be called the source database) during the period 2004 to 2005, 343 were recorded in 2004 and 324 in 2005 (Table 1). 76% (508/667) were deaths of children between the ages of 0 and 4 years with 17% (116/667) of all deaths occurring during the early neonatal period (between 0 and 7 days). The number of deaths during this early neonatal period (116) is 15 times the weekly average number of deaths (7.6) in children below the age of one year. 59% (396/667) of deaths occurred in children below the age of one year, with 17% (112/667) of deaths occurring in children between 1 and 4 years. Overall there were more deaths in males (55%) than in females. The difference in the proportion of deaths occurring in males and females was most marked in children 5 years and older with 72% (115/159) and 28% (44/159) of deaths occurring in males and females respectively for the age group 5-19 years combined.

The relative risk of death in males compared to females in children older the 5 years (age groups 5-19 years combined) was 2.6 (95% CI 1.9-3.7).

Table 1: Age and gender: Childhood deaths in the Boland Overberg Mortality Surveillance System database: 2004 and 2005

<table>
<thead>
<tr>
<th>Age group</th>
<th>Persons</th>
<th>%</th>
<th>Male</th>
<th>%</th>
<th>Female</th>
<th>%</th>
<th>%Total</th>
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<tr>
<td>0-7days</td>
<td>116</td>
<td>17.4</td>
<td>66</td>
<td>57</td>
<td>50</td>
<td>43</td>
<td></td>
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<tr>
<td>8-28days</td>
<td>49</td>
<td>7.3</td>
<td>17</td>
<td>35</td>
<td>32</td>
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<td>1-11 months</td>
<td>231</td>
<td>34.6</td>
<td>111</td>
<td>48</td>
<td>120</td>
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<tr>
<td>1-4 years</td>
<td>112</td>
<td>16.8</td>
<td>58</td>
<td>52</td>
<td>54</td>
<td>48</td>
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<tr>
<td>5-9 years</td>
<td>39</td>
<td>5.8</td>
<td>28</td>
<td>72</td>
<td>11</td>
<td>28</td>
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<tr>
<td>10-14 years</td>
<td>34</td>
<td>5.1</td>
<td>27</td>
<td>79</td>
<td>7</td>
<td>21</td>
<td></td>
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<tr>
<td>15-19 years</td>
<td>86</td>
<td>12.9</td>
<td>60</td>
<td>70</td>
<td>26</td>
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<tr>
<td>Total</td>
<td>667</td>
<td>100</td>
<td>367</td>
<td>55</td>
<td>300</td>
<td>45</td>
<td>100</td>
</tr>
</tbody>
</table>
Mortality rates

The neonatal mortality rate for the study period in these district municipalities was 12/1000 live births. The IMR was 30/1000 live births while the 1-4 child mortality rate was 207/100 000 population.

BCG RCT

During the same period 2004 to 2005, 93 deaths were documented under the BCG RCT mortality surveillance system (77 in 2004 and 16 in 2005). In this subgroup, 54 % (50/90) of deaths occurred in males. (Table 2).

Table 2: Age and gender: Deaths in the BCG RCT: 2004 and 2005

<table>
<thead>
<tr>
<th>Age group</th>
<th>Persons</th>
<th>%</th>
<th>Male</th>
<th>%</th>
<th>Female</th>
<th>%</th>
<th>% (Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-7days</td>
<td>5</td>
<td>5.4</td>
<td>1</td>
<td>20</td>
<td>4</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>8-28days</td>
<td>6</td>
<td>6.5</td>
<td>4</td>
<td>67</td>
<td>2</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>1-11 months</td>
<td>49</td>
<td>52.7</td>
<td>27</td>
<td>55</td>
<td>22</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>1-4 years</td>
<td>33</td>
<td>35.5</td>
<td>18</td>
<td>55</td>
<td>15</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>93</td>
<td>100</td>
<td>50</td>
<td>54</td>
<td>43</td>
<td>46</td>
<td>100</td>
</tr>
</tbody>
</table>

CMS

From the source database, 107 deaths were sampled for investigation as part of the CMS. Of these, 102 deaths were followed up and investigated with five not being followed up due to administrative errors. In this sample there were more female deaths 55 % (28/51) than male deaths in children between zero and 4 years. In children 5 years and older, there were more male deaths; 90 % (46/51) and 10 % (5/51) male and female deaths respectively. (Table 3).
Table 3: Age and gender: Deaths sampled for investigation in the CMS: 2004 and 2005

<table>
<thead>
<tr>
<th>Age group</th>
<th>Persons</th>
<th>%</th>
<th>Male</th>
<th>%</th>
<th>Female</th>
<th>%</th>
<th>% (Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-7 days</td>
<td>12</td>
<td>12</td>
<td>6</td>
<td>50</td>
<td>6</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>8-28 days</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>50</td>
<td>3</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>1-11 months</td>
<td>26</td>
<td>25</td>
<td>12</td>
<td>46</td>
<td>14</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>1-4 years</td>
<td>7</td>
<td>7</td>
<td>2</td>
<td>29</td>
<td>5</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>5-9 years</td>
<td>12</td>
<td>12</td>
<td>9</td>
<td>75</td>
<td>3</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>10-14 years</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>15-18 years</td>
<td>25</td>
<td>24</td>
<td>23</td>
<td>92</td>
<td>2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>102</td>
<td>100</td>
<td>69</td>
<td>68</td>
<td>33</td>
<td>32</td>
<td>100</td>
</tr>
</tbody>
</table>

*Percentage adds to >100% due to rounding off error.

Cause of mortality profiles by age (based on death certificate data from the Boland Overberg Mortality surveillance System)

The leading causes of mortality as coded and entered in the source database using the Boland Overberg Mortality Coding Shortlist were ranked for the various age categories. (Figures 3 – 8).

No gender breakdown is given for the causes of deaths in the age groups 1-7 days, 8-28 days, 1-11 months and 1-4 years because there were no gender differences in the proportion of mortality between males and females, for these ranked causes of deaths.
a) Profiles of leading causes of mortality (for age categories early neonatal, late neonatal, infants and children 1-4 years)

Ranked causes of early neonatal deaths, Boland Overberg 2004 - 2005 
(N=116)

- Short gestation and Low birth weight: 48.6
- Other perinatal: 18.1
- Congenital abnormalities: 7.8
- Ill defined natural: 6.9
- RDS: 4.3
- Homicide: 3.4
- Septicaemia: 1.7
- Lower respiratory infections: 1.7
- Neonatal infection: 1.7
- Cot death: 1.7
- Tuberculosis: 0.9
- HIV/AIDS: 0.9
- Diarrhoeal Diseases: 0.9
- Other Infectious and parasitic diseases: 0.9
- Stroke: 0.9
- Other unintentional injuries specified: 0.9
- Injuries undetermined whether intent or unintent: 0.9

Figure 3
Ranked causes of late neonatal deaths, Boland Overberg 2004 - 2005
(N=49)

Figure 4
Ranked causes of deaths in infants between 1 and 11 months, Boland Overberg 2004 - 2006 (N=231)

- Diarrhoeal Diseases: 23.8%
- Ill defined natural: 16.9%
- Other unintentional injuries specified: 13.0%
- HIV/AIDS: 12.6%
- Short gestation and Low birth weight: 3.9%
- Protein-energy malnutrition: 3.5%
- Bacterial Meningitis and meningococcaemia: 2.6%
- Congenital abnormalities: 2.6%
- Cot death/Sudden infant death syndrome: 2.2%
- Septicaemia: 1.7%
- Other respiratory: 0.9%
- Homicide: 0.9%
- Other Infectious and parasitic diseases: 0.4%
- Stroke: 0.4%
- Remainder of diseases of digestive system: 0.4%
- RDS: 0.4%
- Neonatal infections: 0.4%
- Other perinatal: 0.4%
- Road traffic pedestrian: 0.4%
- Drowning: 0.4%
- Ill defined resp: 0.4%

Figure 5
b) Profiles of leading causes of mortality by age and gender (for age categories 5-14, and 15-19 years)

Ranked leading causes of deaths in children 5-14 years, Boland Overberg 2004 - 2005 (N=73)

Figure 7
Figure 6
The mortality profile is mainly dominated by infectious diseases in the younger children; up to the age of 4 years. (Figures 3 to 6). In older children the profile is dominated by external causes of various types. (Figures 7 to 8).

In both the early neonatal and the late neonatal deaths short gestation and low birth weight were the leading causes of mortality. Cot death and sudden infant death syndrome accounted for 2% and 1.7% of deaths in these age groups respectively. Amongst infants, diarrhoea ranked as the leading cause of mortality. This was followed by ill-defined natural causes, which were also important in the early and late neonatal deaths. The proportion of deaths due to ill-defined natural causes was largest amongst infants. Of note is that HIV/AIDS ranked as the fourth leading cause of mortality amongst infant deaths (Figure 5).

In the age category 1-4 years HIV/AIDS was the leading cause of death followed by diarrhoea. Drowning was an important cause of death in this age group as well as in children between 5 and 14 years where it was the second leading cause of mortality. (Data for children aged 5-9 and 10-14 years was combined due to small sample sizes when grouped separately). In the group 5-14 years combined (figure 7), road traffic accidents and drowning were the leading causes of death accounting for 28.8% and 20.5% of deaths in this group. TB was also an important cause of mortality in the in the 5-9 year age group, with 5% of deaths in this group certified as being due to tuberculosis (data not shown).

In the 15-19 year age group a high level of external causes of mortality particularly homicide and road traffic accidents is evident (Figure 9). These two causes accounted for just over half (53.5%) of the total deaths in this age group.
In children 5 years and older there were marked gender differences in the proportion of mortality between males and females, with males dominating the profile. This gender difference is particularly striking for both drowning and road traffic accidents in children aged 5-14 years, as well as for deaths due to homicide and road traffic accidents in the 15-19 year age group. (Figures 7 and 8). Amongst deaths in children aged 5-14 years the proportion of male deaths due to drowning was 13.7 times that of females. Deaths due to road traffic accidents in males were 4.2 times and 5 times greater than female deaths due to the same cause in the age groups 5-14 years and 15-19 years respectively. The proportion of male deaths due to homicide and violence was 4.6 times that of female deaths due to homicide.

The proportion of deaths certified as being due to HIV/AIDS in the different age groups increased from 12.5% in infants to 17.1% in those age 1-4 years. It then dropped to 5.1% in the 5-9 year age group, to 0% in the 10-14 year age group and then rose to 3.5% in the 15-19 age group.

**Verbal autopsies-BCG RCT and CMS**

A total of 93 children enrolled in the RCT died between 2004 and 2005. Of these 93 children, 15 were lost to follow-up, one had no death certificate and 15 had VA. In the CMS, of the 107 children sampled for investigation, 29 (24 plus the 5 that were lost due to administrative errors) were lost to follow-up, 35 did not have a VA, and 25 died from unnatural causes. Post-mortem report diagnoses for those children who died from external traffic causes were excluded from the agreement/comparison analysis.
Therefore 62 deaths amongst participants in the RCT and 18 deaths amongst participants in the CMS were included for validation of causes of mortality recorded on death certificates with those assigned by VA and clinical record review.

Profile of deaths in the BCG RCT and the CMS based on VA and record review

a) BCG RCT

The median age at death for children who had VAs in the RCT was 8 months (IQR 2.6 to 15.1). There were 29/62(47%), females in this sub group. Table 4 sets out cause of death as determined by VA and clinical records, in this group.

<table>
<thead>
<tr>
<th>COD diagnosis</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS</td>
<td>15</td>
<td>24</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>13</td>
<td>21</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>SUD(Sudden unexplained death)</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Septicaemia</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Prematurity</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>62</td>
<td>100</td>
</tr>
</tbody>
</table>

HIV/AIDS, malnutrition and diarrhoea were the leading causes of mortality in this RCT cohort as determined by VA and clinical record review. 10% of deaths were determined to be sudden and unexplained by VA interview and record review. Sudden and unexplained deaths in this study were defined as deaths in children who were well, went to sleep and were found deceased by their guardians or caregivers.

b) CMS

The median age at death in the CMS was 1.8 months (IQR 0.5 to 6.2). There were equal numbers of males and females in this subgroup. Sudden unexplained deaths, septicaemia, and prematurity were among the leading causes of mortality in this group. Table 5 sets out the cause of death as determined by VA and clinical records in this sub group of CMS deaths.
Table 5: CMS Mortality profile (N=18)

<table>
<thead>
<tr>
<th>COD diagnosis</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUD (Sudden unexplained death)</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>Septicaemia</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Prematurity</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100*</td>
</tr>
</tbody>
</table>

*Percentage adds to >100% due to rounding error.

Comparison of cause of mortality recorded on death certificates and those assigned by VA and record review

Table 6: Causes of mortality assigned by death certificates and by VA combined with record review (N=80)

<table>
<thead>
<tr>
<th>Death Certificate</th>
<th>HIV/AIDS</th>
<th>Diarrhoeal disease</th>
<th>Malnutrition</th>
<th>Natural causes</th>
<th>Pneumonia</th>
<th>Septicaemia</th>
<th>Prematurity</th>
<th>Renal failure</th>
<th>#HDN</th>
<th>**TB</th>
<th>***Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal autopsy and record review</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Diarrhoeal disease</td>
<td>1</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Malnutrition</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>*SUDS</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Septicaemia</td>
<td>1</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Prematurity</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Renal failure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td></td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>#HDN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>**TB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>***Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>18</td>
<td>9</td>
<td>16</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>6</td>
<td>80</td>
<td></td>
</tr>
</tbody>
</table>

*SUD-Sudden unexplained death
#HDN- Haemolytic Disease of the Newborn
**TB-includes TBM
***Other-refers to diagnoses not included in this table
1 Natural causes and Sudden unexplained deaths were assigned the same code in the mortality short list
Shaded cells indicate agreement between VA and record review with death certificates
*There is no agreement in this cell because the cause of death diagnosis is different for the two methods
4 Data are expressed as numbers

34
For the 80 cases (62 BCG RCT and 18 CMS) included in the comparison analysis, the leading causes of mortality by VA and record review were HIV/AIDS (19%), diarrhoea (18%) and malnutrition (18%), Table 6 summarizes the causes of death assigned by the two methods for these 80 cases. There was agreement on cause of death diagnoses assigned by death certificates and VA with record review in 42/80 (52.5%) cases, giving a moderate level of agreement and a kappa coefficient of 0.45 (p<0.001)\textsuperscript{30}. Expected agreement was 12.9%. Of the 15 deaths certified as being due to natural causes 12/15 (80%) occurred at home.

15/80 (19%) deaths were determined to be due to HIV/AIDS by verbal autopsy combined with record review. 8/80 (10%) of these were also certified as being due to HIV/AIDS. The 7 discordant cases were certified as being due to natural causes 1 (1%); Pneumonia 2 (3%); tuberculosis 2 (3%); diarrhoeal disease 1 (1%) and other 1 (1%).

10/80 (13%) cases were determined to be due to diarrhoeal disease by both methods. Verbal autopsy and clinical record review assigned 14/80 (18%) deaths to diarrhoea while 18/80 (23%) deaths were certified as being due to diarrhoea. Of the additional 4 deaths assigned to diarrhoea by VA and record review, 2 (3%) were certified as being due to natural causes, 1 (1%) each as being due to HIV/AIDS and other. The additional 8 cases certified as being due to diarrhoea were classified as follows by VA and record review: malnutrition 3 (4%); pneumonia 2 (3%) and 1 (1%) each to HIV/AIDS, sepsis, and sudden unexplained causes.

Only 3 deaths were determined to be due to pneumonia by both methods. Of the 6 discordant cases based on the death certificates, 2 (3%) were determined to be due to HIV/AIDS, 2 (3%) to malnutrition and 1 (1%) each to prematurity and sudden unexplained
causes by VA and clinical record review. The 6 discordant cases by VA and record review were certified as being due to diarrhoea 2(3%), tuberculosis 2(3%), malnutrition 1 (1%) and natural causes 1 (1%).

Excluding all sudden unexplained deaths, deaths due to natural causes and ill defined causes, there was agreement on cause of death diagnoses by the two methods in 35/60(58%) deaths with a kappa coefficient of 0.51 (p<0.001), which is also a moderate level of agreement. Expected agreement was 15.5%.

In children below the age of one year, 29/52(56%) cases were assigned the same cause of death diagnoses by the two methods. The level of agreement was moderate with a kappa coefficient of 0.47(P<0.001), and an expected agreement of 15%. In this group discordance was largely in cases determined to be due to septicaemia, pneumonia and prematurity by VA and record review.

In children aged 1 year and above agreement on cause of death diagnoses was obtained in 13/28(46%) of cases, giving a kappa coefficient of 0.33(p<0.001), which is considered to be a fair level of agreement. The expected agreement was 19.9%. In this group disagreement in cause of death diagnoses was largely due to differences in deaths assigned to HIV/AIDS, malnutrition and pneumonia by the two methods.

Deaths certified as “natural causes” or “cot deaths”

Amongst the 80 deaths with a VA a total of 16 deaths were certified as being due to “natural causes” and one death was certified as being a “cot death”.

36
Table 7 shows the underlying cause of death diagnoses assigned by VA and clinical record review for these 16 cases.

<table>
<thead>
<tr>
<th>Death Certificate COD*</th>
<th>VA and clinical record review COD*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural causes N=15</td>
<td>Sudden unexplained = 6</td>
</tr>
<tr>
<td></td>
<td>Diarrhoeal disease = 2</td>
</tr>
<tr>
<td></td>
<td>Septicaemia = 2</td>
</tr>
<tr>
<td></td>
<td>HIV/AIDS = 1</td>
</tr>
<tr>
<td></td>
<td>Malnutrition= 1</td>
</tr>
<tr>
<td></td>
<td>Pneumonia = 1</td>
</tr>
<tr>
<td></td>
<td>Low birth weight/ prematurity=1</td>
</tr>
<tr>
<td></td>
<td>Aspiration=1</td>
</tr>
<tr>
<td>Cot death N=1</td>
<td>Sudden unexplained death= 1</td>
</tr>
</tbody>
</table>

*COD- Cause of death

Of the 15 deaths certified as being due to “natural causes”, 6/15 (40%) were not assigned a specific cause of death by VA and record review. All 6 were determined to be sudden and unexplained deaths.

No specific cause of death diagnosis could be assigned to the case certified as being due to “cot death”. It was determined to be a sudden and unexplained death by VA and clinical record review.

Using VA and clinical record review, the proportion of cases with non specific cause of death (based on death certificates) diagnosis dropped from (16/80)20% to (11/80)14%. The remaining cases with non specific causes of death were determined to be sudden and unexplained in the absence of pathological autopsies.

Discussion

The childhood mortality profile in the three district Municipalities of the Boland Overberg region in 2004 and 2005 based on the Boland Overberg Surveillance System or death
certificates, showed that the largest proportion of the deaths in children below the age 19 years occur in the less than one and the 1-4 year age groups (59.4% and 16.8% respectively). Deaths in the 15-19 year age groups also accounted for a high proportion (12.9%) of deaths. Three quarters of all childhood mortality in these municipalities in 2004 and 2005 occurred in children less than five years of age (Table 1). The IMR of 30/1000 live births for these three districts during 2004 and 2005 compares with the rate for the entire Boland Overberg Region which was 29/1000 live births in 2005. It is however higher that the IMR for the City of Cape Town which was 23.5/1000 live births in 2004. The neonatal and infant mortality rates for South Africa in 2005 were 21/1000 live births and 55/1000 live births respectively. Therefore, while both the neonatal and the infant mortality rates in this study were lower than the figures for South Africa as a whole, they are however high when compared to rates in developed countries. These rates together with the high proportion of under-five deaths point to the challenges that still exist in the area of early child care and possibly childhood disease management in the study areas. The high proportion of under five deaths compares with literature on childhood mortality in Africa, where under five mortality has been shown to remain at high rates. HIV/AIDS, diarrhoeal disease and ill-defined natural causes were amongst the major contributors to causes of mortality in infants based on both the death certificates and VA combined with record review. The large proportion of deaths due to ill-defined natural causes during the neonatal period and infancy may reflect the need for increased availability of specialised neonatal care and early childhood services in these municipalities. Such improved services could identify specific causes of these deaths as well as reduce the prevalence of these ill defined deaths.
In the 1-4 year age group, HIV/AIDS ranked as the leading cause of death based on death certificates. This was in line with findings in the BCG RCT participants included in this thesis, where HIV/AIDS accounted for 24% of deaths based on VA and record review in the BCG RCT subgroup (Table 4). Drowning accounted for 11.6% of all deaths in the 1-4 year age group, and 20.5% of all deaths in children aged between 5 and 14 years. These figures suggest inadequate levels of water safety amongst children in these districts.

In children between 5 and 14 years, road traffic accidents ranked as leading causes of mortality. In the 15-19 year age group deaths due to violence and road traffic accidents were very high. Also of significance is the gender differential in mortality in children older than 5 years. There many more male deaths, particularly in deaths due to homicide, in the age group 15-19 years. These results clearly suggest that there are high levels of violence amongst male adolescents and youths. This is in agreement with the findings in data published by Statistics South Africa which showed that between 1997 and 2001, unnatural deaths were the leading causes of mortality amongst males aged 15-24 years.\textsuperscript{34}

VAs and record review helped reduce the number of deaths with non specific causes by 6% from 20% to 14%. Some cases with non specific causes of death recorded on death certificates could not be assigned more specific cause of death diagnoses by the VA and record review as has been found in other studies.\textsuperscript{9,20} However, these deaths were characterized and described as being sudden and unexplained based on the extra information obtained from VA interviews and clinical records. Up to 30% of cases could not be assigned specific diagnoses by the VA method in a study on maternal mortality using VAs in Guinea-Bissau.\textsuperscript{20}
Possible reasons for the moderate level of agreement observed in this study include discordance arising from the recording by medical practitioners and subsequent coding of immediate causes rather than the underlying causes of death in death certificates. In the case of HIV/AIDS deaths for example, some of the discordant cases by VA were certified as being due to diarrhoeal disease, pneumonia, tuberculosis and diarrhoeal disease (Table 6), all of which are involved in the sequence if events in HIV/AIDS deaths. In addition, in the case of HIV/AIDS in particular this diagnosis may not have been recorded on the death certificates due to concern around issues of confidentiality as had been described in other studies\textsuperscript{6,7}. Other reasons for the moderate level of agreement observed could be related to the difficulty of choosing immediate and underlying causes of death in cases where children had co-morbidity. These factors may have lead to both an underestimation and an overestimation of certain causes of death based on death certificates in this population. In addition, deaths that occurred at home may have been certified as non specific causes of death because the persons completing the death certificates may have not known the deceased and clinical records may not have been available at the time when the death was certified as has been suggested in the literature\textsuperscript{5}. These non specific causes are likely to have lowered the level of agreement as for some of these cases specific causes were assigned by VA and record review.

The number of cases for which a VA was available was higher in the BCG RCT cohort than in the CMS cohort. The quality and completeness of the information was also superior in the BCG RCT cohort. The factors may have affected the level of agreement observed as in cases from both studies were combined for assessing the level of agreement between death certificates and VA with record review. The sample size used for the assessing agreement relative to the total number of deaths reported was small and therefore was not
necessarily representative of all the deaths particularly given how the sample was obtained (The BCG RCT enrolled healthy children only and in the CMS not all families agreed to have a VA interview).

The exclusion of deaths due to unnatural causes is also likely to have lowered the level of agreement as both methods would have probably assigned these cases to similar codes.

While the number of cases used to compare causes of death based on death certificates with those assigned by VA and record review was low, this study suggests that caution is required when interpreting some of the data from the Boland Overberg Mortality Surveillance System. Caution should applied particularly on data relating to deaths certified as being as being due to "natural causes", HIV/AIDS, malnutrition, diarrhoeal diseases and pneumonia. This is also important because the causes of death with the highest discordance constitute the bulk of causes of mortality in young children, especially those below the age of 5 years.

Limitations

This study had a number of limitations. Only data from three district municipalities in the region were included in the study because participants in the BCG RCT mainly came from these municipalities. Based on the 1996 population census, the population of children aged 0-19 years in these municipalities represent 51% of the total population in this age group in the Boland District Municipality. However the district municipalities included in this study were identified as some of the areas experiencing severe poverty in the Western Cape Province, hence these findings may not represent a complete mortality picture for the entire region. However, findings from this study can still be used to address issues specific to the three municipalities that were included.
A large number of participants did not have a verbal autopsy interview particularly in the CMS. Therefore the number of cases available for measurement of the level of agreement between the certified causes of death and the causes of death assigned after VA and clinical record review was much lower than initially expected. Therefore these findings may not be generalizable to the total sample. Because the CMS was not well known in the area and because parents/guardians of deceased children in the CMS only met with study staff for the first time when they were approached for a VA both the quality and completeness of VAs from this study was inferior to that obtained for the BCG RCT cases. This therefore compromised the usefulness of the CMS data because it was less complete, less detailed and more cases were lost to follow up. In contrast many people in the study area were aware of the BCG trial and had contact with trial staff at birth centres as well at scheduled visits when trial participants were seen between 10 and 14 weeks of age. They were therefore more willing to talk to interviewers in the event of a death.

Incomplete clinical records particularly in cases investigated as part of the CMS could have also resulted in misclassification of cause of death diagnoses by VA and record review. The use of a single code for “signs and symptoms not elsewhere classified”, in the mortality short list also limited the exploration of discordance in the assessment of agreement. In the case of HIV/AIDS, not all cases had HIV test results; hence the diagnosis of HIV/AIDS was based on VA interviews and clinical history. While diagnoses were assigned by two and at times three assessors, the proportion of HIV/AIDS deaths by VA and record review could have been over estimated.
It was not possible to assess the utility of VAs or clinical records separately and to compare results to other studies that have utilised VAs only because this study utilized VAs combined with record review.

**Conclusion**

Childhood mortality in the Breede River Winelands, Breede Valley and Witzenberg district municipalities of the Boland region is dominated by high levels of mortality in children less than five years and in children between the ages of 15 and 19 years. Almost 20% of deaths occurred in children between zero and 7 days of age, and 76% of all child deaths occurred in children below the age of 5 years. While the IMR in the municipalities included in the study was lower than that the rate for South Africa as a whole, it was however higher than the rate for the City of Cape Town.

Infectious diseases were the main causes of mortality in the younger age groups, while drowning and injuries were leading causes of mortality in older children. In the children between 15 and 19 years of age, homicide was a leading cause of mortality. Prevention of early childhood and other childhood deaths due preventable infectious diseases, drowning, road traffic accidents and violence was highlighted as a possible priority area in these municipalities.

The use of VAs and clinical record review provided useful additional information for assigning specific causes of death in some of the cases where certified causes of death were non specific. Deaths which were not assigned specific cause of death diagnoses were
however further described by the additional information available from VA interviews and clinical records.

The level of agreement between causes of mortality recorded on death certificates and those assigned by VA and record review was moderate. Therefore caution is required when interpreting some of the data from the Boland Overberg Mortality Surveillance System, particularly data on deaths certified as being as being due to “natural causes”, HIV/AIDS, malnutrition, diarrhoeal disease and pneumonia.

**Recommendations**

Areas of concern raised by this study include the high number of early childhood deaths particularly in the neonatal period. While early childhood particularly the neonatal period is a period of high vulnerability associated with higher levels of mortality, there is a need to look more closely the neonatal services in these municipalities in order to identify areas that may need augmentation to reduce the number of early childhood deaths.

A large proportion of deaths occurred during infancy with diarrhoea being the leading cause of death. Deaths due to infectious causes of death in infancy need to be addressed through the evaluation, monitoring and possibly the local adaptation of programmes like the IMCI (Integrated Management of Childhood Illness) and others that have been implemented in the region.

There is a need to look at strategies to increase the level of water safety amongst children in these municipalities as drowning was a cause of death that ranked high in various age
categories. This can be done in conjunction with the Department of Education and non
governmental organisations involved in such projects.

Similar to other areas of the country there is also a need to look at road safety. Both adults
and children need to be educated and constantly reminded about road safety issues. The
high level of awareness around road safety which at present is largely focused around
public holidays needs to be maintained throughout the year. Collaboration with the
Department of Education and the Department of Transport may identify strategies or
activities that could target children. Such strategies could be implemented through schools
or other adolescent/youth organisations in the area.

Homicide amongst young adult males is also an area that needs to be addressed. This could
be done through psychological services targeting children in schools. From early school
age, children could be educated about violence and the danger of objects like knives and
firearms. This may assist in removing these objectives from the culture of adolescents and
young adults and hence help reduce deaths due to homicide.

The moderate level of agreement between death certificate diagnoses and VA and record
review diagnoses observed in this study needs to be further explored in studies with larger
sample sizes. Such studies could also look at systems utilizing multiple underlying causes
of death rather than a single underlying cause of death utilized in this study. The use of
multiple underlying causes of death could be helpful in cases with co-morbidity as these
were identified as a potential problem area in this study. These studies could also further
investigate discordance related to deaths due to pneumonia as pneumonia can be an
underlying cause of various conditions. Further studies could also look at the possibility of
conducting pathological autopsies in cases where were no clear cause of death is apparent after review of clinical records and VA interviews.

To ensure that immediate and underlying cause of deaths are recorded correctly on death certificates, workshops to train health practitioners on how to complete death certificates correctly could be organized regularly in the region. Attendance could be encouraged by awarding CPD (Continuing Professional Education) points for these workshops.
References


8. Taggart M W, Craver R. Cause of death, determined by autopsy in previously healthy(or near-healthy children) presenting to a children' hospital Arch Path Lab Med 2006; 130:1780-1785


Appendixes:

Appendix 1
Boland Overberg Mortality Short List

Appendix 2
Verbal autopsy questionnaires
### Boland Overberg Mortality Short List: Version 1 February 2004

<table>
<thead>
<tr>
<th>Code</th>
<th>Disease/Condition</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Diarrhoea and gastro-enteritis, presumed infectious</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Schistosomiasis / Bilharzia</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Other intestinal infectious diseases</td>
<td>includes typhoid, salmonella, shigellosis</td>
</tr>
<tr>
<td>4</td>
<td>Pulmonary tuberculosis</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>TB meningitis</td>
<td>includes pleural effusion</td>
</tr>
<tr>
<td>6</td>
<td>Other TB</td>
<td></td>
</tr>
</tbody>
</table>

**SYNONYMS FOR HIV/AIDS: Immune-deficiency syndrome/disease, Retroviral disease, Acquired Immune Deficiency Syndrome**

<table>
<thead>
<tr>
<th>Code</th>
<th>Disease/Condition</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>HIV/AIDS and TB</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>HIV/AIDS and other infectious disease</td>
<td>includes pneumonia with HIV /AIDS and Pneumocystis carinii pneumonia</td>
</tr>
<tr>
<td>9</td>
<td>HIV/AIDS and cancer</td>
<td>includes Kaposi's sarcoma, lymphoma with HIV/AIDS</td>
</tr>
<tr>
<td>10</td>
<td>HIV/AIDS and other chronic disease</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>HIV/AIDS</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Malaria</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Meningococcal infection</td>
<td>includes meningococcal septicaemia and meningococcal meningitis</td>
</tr>
<tr>
<td>14</td>
<td>Septicaemia</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Other Infectious and parasitic diseases</td>
<td>includes measles, hepatitis</td>
</tr>
</tbody>
</table>

**Neoplasms**

<table>
<thead>
<tr>
<th>Code</th>
<th>Disease/Condition</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Malignant neoplasm of the oesophagus</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Malignant neoplasm of the stomach</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Malignant neoplasm of colon, rectum and anus</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Malignant neoplasm of liver and intrahepatic bile ducts</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Malignant neoplasm of pancreas</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Malignant neoplasms of the trachea, bronchus and lung</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Malignant melanomas of skin</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Malignant neoplasm of breast</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Malignant neoplasm of ovary</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Malignant neoplasm of ovary</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Malignant neoplasm of prostate</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Malignant neoplasm of bladder</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Malignant neoplasm of meninges, brain and other parts of central nervous system</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Leukaemia</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Other malignant neoplasm of lymphatic and haematopoietic system</td>
<td>includes Hodgkin's lymphoma, non-Hodgkin's lymphoma, multiple myeloma</td>
</tr>
<tr>
<td>31</td>
<td>Malignant neoplasm of kidney</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Remainder malignant neoplasms</td>
<td>includes primary site unknown</td>
</tr>
<tr>
<td>33</td>
<td>Benign neoplasms</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Other neoplasms, not elsewhere classified</td>
<td></td>
</tr>
</tbody>
</table>

**Diseases of blood and blood forming organs and certain disorders involving the immune mechanism (excludes HIV)**

<table>
<thead>
<tr>
<th>Code</th>
<th>Disease/Condition</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>Anaemias and other diseases of blood and blood forming organs</td>
<td></td>
</tr>
</tbody>
</table>

**Endocrine, nutritional and metabolic diseases**

<table>
<thead>
<tr>
<th>Code</th>
<th>Disease/Condition</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>Diabetes mellitus</td>
<td>with or without heart disease, stroke / CVA or renal failure</td>
</tr>
<tr>
<td>37</td>
<td>Diabetes and hypertension</td>
<td>with or without heart disease, stroke / CVA or renal failure</td>
</tr>
<tr>
<td>38</td>
<td>Malnutrition</td>
<td>includes kwashiorkor, marasmus, failure to thrive. underweight for age</td>
</tr>
</tbody>
</table>

**Mental and behavioural disorders**

<table>
<thead>
<tr>
<th>Code</th>
<th>Disease/Condition</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>Remainder of endocrine, nutritional and metabolic disorders</td>
<td></td>
</tr>
</tbody>
</table>

**Diseases of the nervous system**

<table>
<thead>
<tr>
<th>Code</th>
<th>Disease/Condition</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>Meningitis</td>
<td>excludes TB and meningococcal meningitis</td>
</tr>
<tr>
<td>41</td>
<td>Alzheimer's disease</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Parkinson's disease</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Epilepsy</td>
<td></td>
</tr>
</tbody>
</table>

**Diseases of the eye and adnexa**

<table>
<thead>
<tr>
<th>Code</th>
<th>Disease/Condition</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>Diseases of the eye and adnexa</td>
<td></td>
</tr>
</tbody>
</table>

**Diseases of the ear and mastoid process**

<table>
<thead>
<tr>
<th>Code</th>
<th>Disease/Condition</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>Diseases of the ear and mastoid process</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>1801 Acute rheumatic fever and chronic rheumatic heart disease</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>1810 Hypertensive disease</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>1811 Hypertension and CVA</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>1830 Ischaemic heart disease</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>1840 Heart failure</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>1850 Pulmonary heart and circulatory disease</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>1860 Other heart disease</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>1870 Cerebrovascular diseases</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>1899 Remainder of the diseases of circulatory system</td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>1901 Pneumonia</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>1910 Bronchitis</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>1920 Chronic obstructive airways disease</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>1930 Asthma</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>1940 Emphysema</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>1950 Respiratory failure</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>1999 Other diseases of the respiratory system</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>2001 Gastric and duodenal ulcer</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>2010 Cirrhosis of the liver</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>2020 Diseases of liver</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>2030 Diseases of the pancreas</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>2040 Diseases of the oesophagus</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>2050 Appendicitis, abdominal hernia, cholecystitis</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>2099 Remainder of diseases of the digestive system</td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>2199 Diseases of the skin and subcutaneous tissue</td>
<td></td>
</tr>
<tr>
<td>73</td>
<td>2299 Diseases of the musculoskeletal system and connective tissue</td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>2301 Renal failure</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>2399 Remainder of diseases of the genitourinary system</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>2499 Pregnancy, childbirth and the puerperium</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>2501 Short gestation and low birthweight</td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>2510 Respiratory distress syndrome</td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>2520 Infections in the perinatal period</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>2599 Other perinatal conditions not elsewhere classified</td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>2601 Fetal alcohol syndrome (FAS)</td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>2699 Congenital malformations, deformations and chromosomal abnormalities</td>
<td></td>
</tr>
<tr>
<td>83</td>
<td>2701 Child death / Sudden infant death syndrome</td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>2799 Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>2801 Motor vehicle accidents involving pedestrians</td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>2809 Motor vehicle accidents other</td>
<td></td>
</tr>
<tr>
<td>87</td>
<td>2810 Railway</td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>2820 Other transport</td>
<td></td>
</tr>
<tr>
<td>89</td>
<td>2830 Accidental drowning</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>2840 Exposure to smoke, fire or flames or explosion</td>
<td></td>
</tr>
<tr>
<td>91</td>
<td>2845 Poisoning agricultural chemicals</td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>2846 Poisoning paraffin</td>
<td></td>
</tr>
<tr>
<td>93</td>
<td>2847 Poisoning other</td>
<td></td>
</tr>
<tr>
<td>94</td>
<td>2850 Suicide/Intentional self-harm</td>
<td></td>
</tr>
<tr>
<td>95</td>
<td>2860 Assault by firearm</td>
<td></td>
</tr>
<tr>
<td>96</td>
<td>2861 Assault by sharp object</td>
<td></td>
</tr>
<tr>
<td>97</td>
<td>2869 Assault by other/unspecified</td>
<td></td>
</tr>
<tr>
<td>98</td>
<td>2880 Iatrogenic/misadventures during surgical and medical care</td>
<td></td>
</tr>
<tr>
<td>99</td>
<td>2890 Injury unspecified means, undetermined cause</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>2899 Other external causes</td>
<td></td>
</tr>
</tbody>
</table>

Includes hypertension with heart disease or renal failure.
Includes myocardial infarction, atherosclerosis, coronary heart disease, angina.
Includes pulmonary embolism.
Includes cardiomyopathy.
Includes stroke/CVA/intracerebral haemorrhage/bleeding.
Excludes Pneumocystis carinii pneumonia.
Includes chronic and acute.
Excludes Prematurity.
Includes hyaline membrane disease.
Excludes HIV.
Includes senility, sudden death, natural causes.
Excludes homicide.
Includes pesticides and other agricultural chemicals.
VERBAL AUTOPSY QUESTIONNAIRE

PART 1: NEONATAL DEATHS

SECTION 1

Background information on the deceased

1.1 Name..............................................
   Family name......................................
   Mother’s family name................................
   Mother’s first name................................
   Study no. of child (if applicable)
   
   T .............................................

1.2 Identity number of child
   
   □ □□ □□□□□□□□□□

1.1.1 Address.............................................
   ................................................................

   1. Farm □                           2. Formal settlement (urban) □

3. Informal settlement – a) peri-urban □                           4. Other (Specify) □
   b) rural □

1.2 Date of birth of child.........................
1.3 Date of death of child.........................

1.4 Sex of child 1. Male □                           2. Female □
1.5 Race of child

SECTION 2

Background information about the interview

2.1 Language of interview: Afrikaans / Xhosa / English
2.2 Date of interview.........................(dd/mm/yy)
SECTION 3

Information about the respondent

3.1 What is the name of the respondent?

3.2 What is the relationship of main respondent to the deceased child?

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Grandfather</td>
<td>6. Grandmother</td>
<td>7. Other (specify)</td>
<td></td>
</tr>
</tbody>
</table>

3.3 What is the date of birth of the respondent

3.4 What is the first language of main respondent

<table>
<thead>
<tr>
<th>1. Afrikaans</th>
<th>4. Suthu</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Xhosa</td>
<td>5. Other</td>
</tr>
<tr>
<td>3. English</td>
<td></td>
</tr>
</tbody>
</table>

3.5 Highest level of education of respondent


3.6 Are other people present at the interview?

| 1. Yes | 2. No |

3.5.1 If mother is not present at the interview, is she alive?

| 1. Yes | 2. No |

3.5.2 If yes, why is it not possible to interview her?

SECTION 4

ACCIDENTS AND INJURIES

4.1 Did .......... die from an injury or accident?

If "No" or "Don't know", go to section 5

If "Yes", what kind of injury or accident? Allow respondent to answer spontaneously

<table>
<thead>
<tr>
<th>1. RTA (pedestrian)</th>
<th>2. RTA (passenger)</th>
<th>3. Fall</th>
<th>4. Drowning</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Sharp object e.g. knife</td>
<td>10. Circumcision</td>
<td>11. Assault/abuse</td>
<td>12. Other (specify)</td>
</tr>
</tbody>
</table>
Specify below

4.2 Did s/he die at the site where the accident or injury occurred?
   1. Yes  2. No  3. Don’t know

4.3 How long after the accident or injury did s/he survive……… (days)

4.4 Did s/he receive medical care before death?
   1. Yes  2. No  3. Don’t know

4.5 Did s/he have an ongoing chronic illness or was sick in the month before death?
   1. Yes  2. No  3. Don’t know

4.5.1 If “Yes”, give details

SECTION 5

5.1 Where did (name of child) ………………… die?

<table>
<thead>
<tr>
<th>1. Hospital (Level 1)</th>
<th>2. Hospital (Level 2)</th>
<th>3. Clinic/CHC</th>
<th>4. Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. En route to health facility by ambulance</td>
<td>6. En route to health facility by other transport</td>
<td>7. Other³ (specify)</td>
<td></td>
</tr>
</tbody>
</table>

1.7 Name of hospital or health facility (For deaths at hospital or clinic/CHC)

5.2 Open history question
Could you tell me about his/her illness that lead to death⁴? (Try as much as possible to record the respondent’s own words)

---

¹ Level 1 Hospitals e.g. Ceres, Robertson, Montague Hospitals
² Level 2 Hospitals e.g. Eben Donges Hospital
³ Other e.g. Breukskooof Hospital
⁴ From now on this will be referred to as the illness
**Record all items mentioned spontaneously in the open history question. Use this to guide you through the rest of the questionnaire.**

<table>
<thead>
<tr>
<th>5.2 Symptom</th>
<th>Duration of symptom (days)</th>
<th>Severity (mild-moderate/severe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.3</td>
<td></td>
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<tr>
<td>5.2.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.3 Is there anything else?  
1. Yes  2. No  3. Don’t know

5.3.1 If “Yes” give details

5.4 Was care sought outside the home while he/she had this illness?  
(If “No” or “Don’t know”, go to section 6)  
5.4.1 If “Yes”, where did you seek care? (Prompt respondent and record all responses)

1. Health centre or clinic  
2. Hospital  
   a) General consultation  
   b) Specialist consultation  
3. Private doctor  
4. Pharmacist
5. Community health worker ☐ 6. Traditional healer ☐
(or counsellor) (herbalist/sangoma / inyanga)

7. Pharmacist ☐ 8. Other e.g. faith healer ☐

5.4.2 What diagnosis was made at that visit? (Record all the diagnoses if there was more than one).

(SECTION 6)

Treatment

6.1 Did s/he receive any medication\(^5\) during the illness?

If “No” go to 6.1.3

6.1.2 “Yes” what medication did she/he receive?

<table>
<thead>
<tr>
<th>Indication e.g. diarrhoea</th>
<th>Name e.g. Gastrolyte</th>
<th>Dose e.g. 1 cup after each loose stool</th>
<th>Duration used e.g. 3 days</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

6.1.3 Did she/he receive any other treatment?

If “No”, go to section 7

If “Yes”, give details

1. Surgical (specify and give details) ☐

........................................................................................................................................................................

2. Nutritional (specify and give details) ☐

........................................................................................................................................................................

\(^5\) includes prescribed, over the counter, herbal and homeopathic medicines
3. Physiotherapy/occupational therapy/speech therapy

4. Home based care

5. Other (specify)

SECTION 7
Past medical history

7.1 Had s/he previously been seen at a health facility prior to the illness that lead to death?
If “No” or “Don’t know” go to question 7.1.3

| 1.Yes | 2.No | 3.Don’t know |

If “Yes” Details of the consultation(s)

<table>
<thead>
<tr>
<th>Age (M)</th>
<th>Health Facility</th>
<th>Complaint</th>
<th>Diagnosis</th>
<th>Admitted Yes/No</th>
<th>Treatment</th>
<th>Duration of complaint (days)</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

7.1.3 Were his/her vaccinations up to date for age at the time of death?
(Check on the RTHC if it is present)

1.Yes 2.No 3.Don’t know

7.1.4 If “No”, which vaccinations were not given?

BCG OPV

SECTION 8
Pregnancy, delivery and neonatal history

8.1 How long did pregnancy last? ....... months

8.2 Were there problems during pregnancy?

1.Yes 2.No 3.Don’t know

8.2.1 If “Yes”, give details

.................................................................
.................................................................

Version 2
8.3.1 Where was................ born?

<table>
<thead>
<tr>
<th>Health facility</th>
<th>Home</th>
<th>Other (specify)</th>
</tr>
</thead>
</table>

8.3.2 Type of health facility where delivered (if delivered at a health facility)

1. MOU (Mobile Obstetric Unit)  
2. District Hospital  
3. Referral hospital  
4. Private hospital

8.4 Was................ a singleton or one of a multiple birth?
(If two or more babies are born at the same time, it is counted as a multiple birth, even if one or more babies are born dead)

Singleton  Multiple

8.5.1 Were there problems during labour and or delivery?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Don’t know</th>
</tr>
</thead>
</table>

8.5.2 If “Yes” specify problems


8.6 Who attended the delivery?

<table>
<thead>
<tr>
<th>Doctor</th>
<th>Midwife/nurse</th>
<th>Other (specify)</th>
<th>Don’t know / not sure</th>
</tr>
</thead>
</table>

8.7.1 Type of delivery

1. Normal delivery  
2. Operative / assisted delivery

8.7.2 If operative/assisted delivery specify type

1. Caesarean section  
2. Vacuum delivery  
3. Forceps delivery

8.8 After respondent finishes prompt: Was there anything else? (i.e. problems during pregnancy, labour and delivery)


(K)ee(p using this prompt until respondent replies that there were no other complications)

8.9 Record the Apgar scores from the RTHC

1. 1 minute  
2. 5 minutes  
3. 10 minutes

8.10 Mother’s obstetric history (Take a brief obstetric history of the mother)

<table>
<thead>
<tr>
<th>No. of pregnancies</th>
<th>No. of miscarriages</th>
<th>No. of deliveries</th>
<th>Children alive</th>
<th>Children died</th>
<th>Age at death</th>
<th>Cause of death</th>
</tr>
</thead>
</table>

Version 2
8.11.1 At birth was ..................?

|----------------|--------------------------|-------------------|------------------------|----------------|

8.11.2 Birth weight (read from road to health card if available)......................kg / g

8.12 Were there any bruises or signs of injury on .....................’s body after birth?

1. Yes  2. No  3. Don’t know

8.13.1 Did .................. have malformations (defects) at birth?

1. Yes  2. No  3. Don’t know

8.13.2 If “Yes” briefly describe..............................................................

8.14.1 Was .................... able to breathe normally after birth?

1. Yes  2. No  3. Don’t know

8.14.2 Did ..................... ever stop breathing normally?

1. Yes  2. No  3. Don’t know

8.14.3 If “Yes”, how long after birth did s/he stop breathing normally? ............days

8.15.1 Was ..................... able to suck normally by the end of the first day?

1. Yes  2. No  3. Don’t know

8.15.2 Did s/he ever stop being able to suck normally?

1. Yes  2. No  3. Don’t know

8.15.3 If “Yes” How long after birth did s/he stop sucking normally? ............days

8.16.1 Was..................... able to cry normally after birth?

1. Yes  2. No  3. Don’t know

8.16.2 Did ..................... ever stop being able to cry normally?

1. Yes  2. No  3. Don’t know

8.16.3 How long after birth did s/he stop crying... days

8.17 Dietary history

1. Breast milk only  
2. Milk formula only  
3. Combined milk formula and breastfeeding  
4. Other (specify) e.g. started with breast milk and changed to milk formula  

............................................................................................................................
8.18.1 Since birth did s/he gain weight satisfactorily?

1. Yes 2. No 3. Don’t know

8.18.2 If RTHC is available, look at the weight chart and tick appropriate response

1. Gaining weight satisfactorily  2. not gaining weight satisfactorily

8.19 Describe the BCG vaccination site just before death

1. Nothing to see or feel  2. Scar

3. Ulcerating  4. Swollen

5. Discharging

8.20.1 During the illness did s/he have swelling in the armpit(s)?

1. Yes 2. No 3. Don’t know

If “No” go to question 8.21.1

8.20.2 If “Yes”, which armpit was the swelling in?

<table>
<thead>
<tr>
<th>1. Right</th>
<th>2. Left</th>
<th>3. Both</th>
<th>4. Don’t know/ not sure</th>
</tr>
</thead>
</table>

8.20.1 If “Yes” what was the size of the swelling?( in finger-breadths)

1. one 2. two 3. ≥three

8.20.2 Characteristics of the swelling

1. Red 2. Hot 3. Tender


8.21.1 During the illness did s/he have oral thrush?

1. Yes 2. No 3. Don’t know

8.22.2 If “Yes”, was it

1. severe (covering most of the inside of the mouth)

2. persistent (never got better or kept reappearing, despite treatment)

8.22.1 During the illness did ………….. have a fever?

1. Yes 2. No 3. Don’t know

8.22.2 “Yes”, for how many days did the fever last? …… days

8.23 During the illness did ………….. have yellow eyes or skin?

1. Yes 2. No 3. Don’t know
8.24 During the illness did .......... have a skin rash with blisters containing pus?

1. Yes  2. No  3. Don't know

8.25 During the illness did s/he have areas of skin that were red and hot?

1. Yes  2. No  3. Don't know

8.26.1 During the illness did .......... have redness around the umbilical stump?

1. Yes  2. No  3. Don't know

8.26.2 Was there a smelly discharge from the umbilical stump?

1. Yes  2. No  3. Don't know

8.27 During the illness did .......... have spasms (went stiff), or convulsions (had shaking)

1. Yes  2. No  3. Don't know

8.28 During the illness did .......... become unresponsive or unconscious?

1. Yes  2. No  3. Don't know

8.29 During the illness did .......... have a bulging fontanel?

1. Yes  2. No  3. Don't know

8.30 During the illness did ..........'s body feel cold when touched?

1. Yes  2. No  3. Don't know

8.31.1 During the illness did .......... have any vomiting?

1. Yes  2. No  3. Don't know

8.31.1 If “Yes”, for how many days did the vomiting last? ...... days

8.32 During the illness did .......... have diarrhoea? (more frequent and/or more liquid stools than usual)

1. Yes  2. No  3. Don't know

8.33.1 If “Yes”, how frequently were stools passed? .......... times per day

8.33.2 For how many days did the diarrhoea last? .......... days

8.33.3 Did s/he have signs of dehydration (prompt respondent)

1. Dry mouth/mucosa  2. Sunken eyes  3. Sunken fontanel

Tell respondent that you would like to ask some questions pertaining to sleeping arrangements for the child

8.34.1 Where did the child normally sleep
1. Parents’ room on parental bed  
2. Parents room on own cot/bed/mattress

3. Alone in separate room

4. Other (specify) ....................................

8.34.2 Type of bed/cot/mattress
1. Foam rubber  
2. Feather  
3. Other  
4. Don’t know

8.34.3 Covering on mattress
1. Plastic  
2. Other material  
3. Don’t know

8.34.4 Sleeping position of child
1. Prone  
2. Supine  
3. Side

SECTION 9

TB MODULE

Cough
9.1 During the illness did......... have a cough?

1. Yes  2. No  3. Don’t know
(If “No” or Don’t know” go to question 9.3)
9.1.1 If “Yes”, for how many days did the cough last? ....... days

9.1.2 If “Yes”, during which part of the day was the cough worse?

1. Day  2. Night  3. Don’t know  4. All times

9.2 Did ............. turn blue while coughing?

1. Yes  2. No  3. Don’t know

9.3 During the illness did.......... have difficulty breathing?

1. Yes  2. No  3. Don’t know

9.4. If “Yes”, for how many days did the difficult breathing last? ....... days

9.5.1 During the illness was s/he breathing faster than normal?

1. Yes  2. No  3. Don’t know

9.5.2 If “Yes”, for how many days did the fast breathing last? ....... days

9.6 During the illness did s/he ever have short periods of stopping and re-starting breathing?

1. Yes  2. No  3. Don’t know
9.7.1 During the illness did s/he have chest in-drawing?

1. Yes  2. No  3. Don't know

9.7.2 If “Yes”, for how many days did the chest in-drawing last? ........days

9.8 During the illness was s/he grunting?

1. Yes  2. No  3. Don't know

9.9.1 During the illness did s/he have a wheeze

1. Yes  2. No  3. Don't know

9.9.2 If “Yes”, for how many days did the wheeze last? ........days

9.9.3 Did s/he wheeze after treatment?

1. Yes  2. No  3. Don't know

9.9.4 Was s/he given specific medication for the wheeze?

1. Yes  2. No  3. Don't know

Respiratory tract infections

9.10 Was s/he ever treated for chest infections?

1. Yes  2. No  3. Don't know

If “No” go to question 9.11.1

9.10.2 “Yes”, give details of treatment

<table>
<thead>
<tr>
<th>Age</th>
<th>Health Facility</th>
<th>Diagnosis e.g. pneumonia</th>
<th>Admitted Yes/No</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Version 2
Weight
If RTHC is available, record the dates of the most recent two weights

9.11.1

<table>
<thead>
<tr>
<th>Date (dd/mm/yy)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9.11.1 Are there other health records available? (apart from the road to health card)

1. Yes  2. No  3. Don’t know

9.11.2 If other medical records are available make copies of these as well as the RTHC.

SECTION 10
Death certificate details

10.1 Are you able to see the death certificate?

1. Yes  2. No

If “Yes”

10.2 Record immediate cause of death (as in the death certificate)

10.3. Record the first underlying cause of death

10.3.2 Record the second underlying cause of death

10.3.3 Record the third underlying cause of death

10.4 Record the contributing cause(s) of death

SECTION 11
Introduce the next section and tell respondent that now you would like to ask questions about the family of the child.

Background information on the family of the deceased
11.1 Date of birth of parents

1. Mother □ □ □ □

2. Father □ □ □ □

11.2.1 Is the father employed? □ Yes □ No

11.2.2 If “Yes” Where is he employed?

11.2.3 What is he employed as?

11.2.4 How long has he worked there? □ months □ years

11.2.5 Does he work there throughout the year or only during certain months of the year?

1. works throughout the year □

2. works only at certain times of the year □

11.3.1 Is the mother employed? □ Yes □ No

11.3.2 If “Yes” Where is she employed?

11.3.3 What is she employed as?

11.3.4 How long has she worked there? □ months □ years

11.3.5 Does she work there throughout the year or only during certain months of the year?

1. works throughout the year □

2. works only at certain times of the year □

11.4 If both parents are employed who took care of the child while parents were at work?

1. Relative within household □

2. Relative outside household □

3. Creche □

4. Other (e.g. friend, neighbour) □

11.5.1 How many individuals in the household receive at least one social grant?

| 0 | 1 | 2 | 3 | 4+ |

11.5.2 (If at least one grant is received) Tick all grants received

1. Old age pension □

2. Care dependency grant □

3. Disability grant □

4. Childcare grant □

5. Other grant (specify) □

Housing

11.6 Type of house

1. Brick house/flat □

2. Shack □

3. Other (specify) □
11.6.1 Number of rooms in the home (excluding bathrooms, sheds stables etc unless persons are living in them)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5+</th>
</tr>
</thead>
</table>

Water and sanitation

11.7 Piped water (inside- inside the house/outside- outside the house)

<table>
<thead>
<tr>
<th></th>
<th>Inside</th>
<th>Outside-communal</th>
<th>Outside-private</th>
</tr>
</thead>
</table>

11.8 Toilet facilities


Smoking habits and alcohol intake of household members

11.9.1 Has the mother ever smoked cigarettes?

1. Yes 2. No

11.9.2 If “Yes”, please give details

<table>
<thead>
<tr>
<th>Time period</th>
<th>Number of cigarettes per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before pregnancy</td>
<td></td>
</tr>
<tr>
<td>During pregnancy</td>
<td></td>
</tr>
<tr>
<td>After delivery</td>
<td></td>
</tr>
</tbody>
</table>

11.9.3 List of people in the house who smoke

<table>
<thead>
<tr>
<th>Number</th>
<th>Relation to child</th>
<th>No. of cigarettes/day</th>
<th>Duration of smoking (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<tr>
<td>2.</td>
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<td>3.</td>
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<td>4.</td>
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<tr>
<td>5.</td>
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</tbody>
</table>

11.10.1 Is the mother currently drinking alcohol?

1. Yes 2. No

11.10.2 If “Yes”

<table>
<thead>
<tr>
<th>Time-period</th>
<th>Type of alcohol(e.g. wine)</th>
<th>Quantity(e.g. 1 litre bottle / day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After delivery</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11.10.3 If “No” did she ever take alcohol?

1. Yes 2. No

11.10.4 If “Yes” When did she stop?

1. Before pregnancy 2. During pregnancy 3. After delivery
11.10.5 List other people in the house who take alcohol

<table>
<thead>
<tr>
<th>Number</th>
<th>Relation to child</th>
<th>Type (e.g. wine)</th>
<th>Quantity (e.g. 1 litre bottle/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<tr>
<td>2.</td>
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<td>5.</td>
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<tr>
<td>6.</td>
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<tr>
<td>7.</td>
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</tbody>
</table>

SECTION 12

SUPPLEMENTARY TB QUESTIONNAIRE

Ask the respondent if any of the relations have been diagnosed with TB, have been coughing a lot, etc.... Record response as shown below
1. Yes  2. No  3. Don't know

<table>
<thead>
<tr>
<th>Relation</th>
<th>Symptom</th>
<th>Diagnosed with TB</th>
<th>Coughing a lot</th>
<th>Coughing up blood</th>
<th>Unexplained weight loss</th>
<th>Unexplained Night sweats</th>
<th>Unexplained fever</th>
<th>Diagnosed HIV/AIDS</th>
<th>Chest pain</th>
<th>Poor appetite</th>
</tr>
</thead>
<tbody>
<tr>
<td>mother</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>father</td>
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<td>Grandmother</td>
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<td>Grandfather</td>
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<tr>
<td>Sibling1</td>
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<td>Sibling2</td>
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<td>Other1</td>
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<td>Other2</td>
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<td>Other3</td>
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</tbody>
</table>

Thank the respondent

Name: ........................................
Signature: .................................. Date: ....... / ....... / 200..
## SECTION 13

### ASSESSMENT BY MEDICAL OFFICER

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Code&lt;sup&gt;6&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main cause of death</td>
<td></td>
</tr>
<tr>
<td>Contributing cause 1</td>
<td></td>
</tr>
<tr>
<td>Contributing cause 2</td>
<td></td>
</tr>
<tr>
<td>Contributing cause 3</td>
<td></td>
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<tr>
<td>Contributing cause 4</td>
<td></td>
</tr>
<tr>
<td>Contributing cause 5</td>
<td></td>
</tr>
</tbody>
</table>

**Death related to BCG**

- [ ] Unrelated to BCG
- [ ] Related to BCG
  - [ ] Definite
  - [ ] Probable
  - [ ] Possible
  - [ ] Inconclusive

<sup>6</sup> Code is based on the Cape Town abridged classification system
VERBAL AUTOPSY QUESTIONNAIRE

PART 2: CHILDHOOD DEATHS

SECTION 1

Background information on the deceased

1.1 Name ...........................................
Family name ...........................................
Mother’s family name ...................................
Mother’s first name ....................................
Study no. of child (if applicable)

T

1.2 Identity number of child

1.3 Address .................................................................

1. Farm □ 2. Formal settlement (urban) □
3. Informal settlement – a) peri-urban □ 4. Other (specify) □
    b) rural □

1.2 Date of birth of child .....................
1.3 Date of death of child ....................

1.4 Sex of child 1. Male □ 2. Female □
1.5 Race of child

SECTION 2

Background information about the interview

2.1 Language of interview: Afrikaans / Xhosa / English
2.2 Date of interview .........................(dd/mm/yy)

SECTION 3

Information about the respondent
3.1 What is the name of the respondent? .................................................................

3.2 What is the relationship of main respondent to the deceased child?

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Grandfather</td>
<td>6. Grandmother</td>
<td>7. Other (specify)</td>
<td></td>
</tr>
</tbody>
</table>

3.3 What is the date of birth of the respondent? (years) □□□□

3.4 First language of main respondent

1. Afrikaans □ 2. Xhosa □ 3. English □
4. Suthu □ 5. Other □

3.5 Highest level of education of respondent

|------------|--------------|-------------|---------|

3.6.1 Are other people present at the interview? 1. Yes 2. No

3.6.2 If mother is not present at the interview, is she alive? 1. Yes 2. No

3.6.3 If yes, why is it not possible to interview her?
........................................................................................................................................
........................................................................................................................................

SECTION 4
ACCIDENTS AND INJURIES

4.1 Did .................. die from an injury or accident? 1. Yes 2. No 3. Don't know

If “No” or “Don’t know”, go to section 5

If “Yes”, what kind of injury or accident? Allow respondent to answer spontaneously

<table>
<thead>
<tr>
<th>1. RTA (pedestrian)</th>
<th>2. RTA (passenger)</th>
<th>3. Fall</th>
<th>4. Drowning</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Sharp object e.g. knife</td>
<td>10. Circumcision</td>
<td>11. Assault/abuse</td>
<td>12. Other specify</td>
</tr>
</tbody>
</table>

Specify below
........................................................................................................................................
........................................................................................................................................
4.2 Did s/he die at the site where the accident or injury occurred?  
1. Yes  2. No  3. Don’t know

4.3 How long after the accident or injury did s/he survive……… (days)

4.4 Did s/he receive medical care before death?  
1. Yes  2. No  3. Don’t know

4.5.1 Did s/he have an ongoing chronic illness or was sick in the month before death?  
1. Yes  2. No  3. Don’t know

4.5.2 If “Yes” give details

..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................

SECTION 5

5.1 Where did (name of child) ………………… die?

<table>
<thead>
<tr>
<th>1. Hospital (Level 1)¹</th>
<th>2. Hospital (Level 2)²</th>
<th>3. Clinic/CHC</th>
<th>4. Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. En route to health facility by ambulance</td>
<td>6. En route to health facility by other transport</td>
<td>7. Other³ (specify)</td>
<td></td>
</tr>
</tbody>
</table>

5.1.2 Name of hospital or health facility (For deaths at hospital or clinic/CHC)

..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................

5.2.1 Open history question
Could you tell me about his/her illness that lead to death⁴? (Try as much as possible to record the respondent’s own words)

..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................

¹ Level 1 Hospitals e.g. Ceres, Robertson, Montague Hospitals
² Level 2 Hospitals e.g. Eben Donges Hospital
³ Other e.g. Brewelskooi Hospital
⁴ From now on this will be referred to as the illness
Record all items mentioned spontaneously in the open history question. Use this to guide you through the rest of the questionnaire.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Duration of symptom (days)</th>
<th>Severity (mild-moderate/severe)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 1</td>
<td>1-7</td>
</tr>
<tr>
<td>5.2.2</td>
<td></td>
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<tr>
<td>5.2.3</td>
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<td>5.2.4</td>
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<tr>
<td>5.2.5</td>
<td></td>
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<tr>
<td>5.2.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.3.1 Is there anything else?  
1. Yes  2. No  3. Don't know

5.3.2 If “Yes” give details

5.4.1 Was care sought outside the home while he/she had this illness?  
(apart from the final admission, if admitted)  
1. Yes  2. No  3. Don’t know

If “No” or “Don’t know”, go to section 7

5.4.2 If “Yes”, where did you seek care? (Prompt respondent and record all responses)

1. Traditional healer (herbalist/sangoma)  
2. Hospital  
   a) General consultation
   b) Specialist consultation

Version 2
3. Health centre or clinic ☐ 4. Private doctor ☐

5. Community Health worker or counsellor ☐ 6. Relative or friend ☐

7. Pharmacist ☐ 8. Other ☐

6.4.2 What diagnosis was made at that visit? (Record all the diagnoses if there was more than one) ........................................................................................................................................................................................................................................................................
........................................................................................................................................................................................................................................................................................................................................................................

SECTION 6

Treatment

6.1.1 Did s/he receive any medication\(^5\) during the illness? 1. Yes 2. No 3. Don’t know

If “No”, go to 6.1.3

6.1.2 If “Yes”, what medication did she/he receive?

<table>
<thead>
<tr>
<th>Indication e.g. diarrhoea</th>
<th>Name e.g. gastrolyte</th>
<th>Dose e.g. 1 cup after each loose stool</th>
<th>Duration used e.g. 3 days</th>
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</thead>
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</tbody>
</table>

6.1.3 Did she/he receive any other treatment? 1. Yes 2. No 3. Don’t know

If “Yes”, give details

1. Surgical (specify and give details) ☐

........................................................................................................................................................................................................................................................................
........................................................................................................................................................................................................................................................................................................................................................................

2. Nutritional (specify and give details) ☐

........................................................................................................................................................................................................................................................................................................................................................................
........................................................................................................................................................................................................................................................................................................................................................................

\(^5\) includes prescribed, over the counter, herbal and homeopathic medicines
3. Physiotherapy/occupational therapy/speech therapy □

4. Home-based care □

5. Other (specify) □

SECTION 7
Past medical history

7.1 Had s/he previously been seen at a health facility prior to the illness that lead to death? 1.Yes 2.No 3.Don’t know

If “No” go to question 7.1.3

7.1.2 If “Yes” Details of the consultation(s)

<table>
<thead>
<tr>
<th>Age (M)</th>
<th>Health Facility</th>
<th>Complaint</th>
<th>Diagnosis</th>
<th>Admitted Yes/No</th>
<th>Treatment</th>
<th>Duration of complaint (days)</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

7.1.3 Were his/her vaccinations up to date at the time of death? 1.Yes 2.No 3.Don’t know

(Check on the RTHC if it present)
7.1.3.1 If “No” Which vaccinations were not given (Tick the vaccines not given)

BCG □  OPV 0 □

Hib 1 □  DTP 1 □  OPV 1 □  Hep B1 □

Hib 2 □  DTP 2 □  OPV 2 □  Hep B2 □

Hib 3 □  DTP 3 □  OPV 3 □  Hep B3 □

Measles 1 □  Measles 2 □

DTP 4 □  OPV 4 □

DT □  OPV 5 □
SECTION 8
Pregnancy and delivery

8.1 How long did the pregnancy last? ....... months

8.2.1 Were there problems during pregnancy?

8.2.2 If “Yes”, give details

8.3 Was .............. a singleton or one of a multiple birth multiple birth?
(If two or more babies are born at the same time, it is counted as a multiple birth, even if one or more babies are born dead)

8.4 Were there problems during labour and/ or delivery?

8.5 If “Yes” specify problems

8.6 Who attended the delivery?

8.7.1 Type of delivery

1. Normal delivery 2. Operative delivery

8.7.2 If operative delivery specify type


8.8 After respondent finishes prompt: Was there anything else? (i.e. problems during pregnancy, labour and delivery). ................................................................. .................................................................

(Keep using this prompt until respondent replies that there were no other complications)

8.9 Mother’s obstetric history (Take a brief obstetric history of the mother)

<table>
<thead>
<tr>
<th>No. of pregnancies</th>
<th>No. of miscarriages</th>
<th>No. of deliveries</th>
<th>Children alive</th>
<th>Children died</th>
<th>Age at death</th>
<th>Cause of death</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

Version 2
8.16 During the illness did s/he have pale palms or white nails?
1. Yes  2. No  3. Don’t know

8.17.1 During the illness did............. have a skin rash?
1. Yes  2. No  3. Don’t know

8.17.2 If “Yes”, was the rash all over the body?
1. Yes  2. No  3. Don’t know

8.17.3 Was the rash also on the face?
1. Yes  2. No  3. Don’t know

8.17.4 How many days did the rash last? ........ days

8.17.5 Did the rash have blisters containing clear fluid?
1. Yes  2. No  3. Don’t know

8.17.6 Did the skin crack/split or peel after the rash started?
1. Yes  2. No  3. Don’t know

8.17.7 Was this rash measles?
1. Yes  2. No  3. Don’t know

8.18.1 Was s/he growing normally for her/his age?
1. Yes  2. No  3. Don’t know

8.18.2 If the road to health card is available, describe the growth curve pattern in the last 6 months.
1. Normal  2. Flat  3. Faltering

8.19.1 Dietary history
4. Milk (breast or formula) with other food
5. Other (specify)

8.19.2 Has there been a change in the child’s diet in the last month?
1. Yes  2. No  3. Don’t know

8.19.3 If “Yes”, what are the changes?
1. Changed from breast milk to formula  2. Changed from formula to breast milk

Version 2
3. Introduced other foods □

4. Other (specify) □

8.20 During illness did s/he become thin?
1. Yes 2. No 3. Don’t know

8.21 During the illness did his/her skin flake off in patches?
1. Yes 2. No 3. Don’t know

8.22 Did his/her hair change in colour to a reddish (or yellowish) colour?
1. Yes 2. No 3. Don’t know

8.23 Did s/he have body swelling and become miserable? (kwashiorkor)
1. Yes 2. No 3. Don’t know

8.24 Did s/he have wasting and look “old” (marasmus)?
1. Yes 2. No 3. Don’t know

8.25 During the illness did ………….. experience any generalized convulsions/fits?
1. Yes 2. No 3. Don’t know

8.26 During the illness did ………….. become unresponsive or unconscious?
1. Yes 2. No 3. Don’t know

8.27 During the illness did ………….. have a bulging fontanel?
1. Yes 2. No 3. Don’t know

8.28 During the illness did ………….. have a stiff neck?
1. Yes 2. No 3. Don’t know

8.29 During the illness did …………..’s body feel cold when touched?
1. Yes 2. No 3. Don’t know

8.30 During the illness did………..have any vomiting?
1. Yes 2. No 3. Don’t know

8.31 If “Yes”, for how many days did the vomiting last? ……..days
8.32.1 During the illness did..........have diarrhoea? (more frequent and/or more liquid stools than usual)  
1. Yes 2. No 3. Don’t know

8.32.2 How frequently were stools passed? ..........times per day

8.32.3 For how many days did the diarrhoea last? ........ (days)

8.32.4 Did s/he have signs of dehydration (prompt respondent) 
1. Dry mouth/mucosa  2. Sunken eyes  3. Sunken fontanel

Tell respondent that you would like to ask some questions pertaining to sleeping arrangements for the child

8.33.1 Sleeping arrangements for the child
1. Parents’ room on parental bed  2. Parents room on own cot/bed/mattress  
3. Alone in separate room  4. Other (specify) ..............................................................

8.33.2 Type of bed/cot/mattress
1. Foam rubber  2. Feather  3. Other  4. Don’t know

8.33.3 Covering on mattress
1. Plastic  2. Other material

8.33.4 Sleeping position of child

SECTION 9
TB MODULE
COUGH

9.1 During the illness did..........have a cough?  
1. Yes 2. No 3. Don’t know

If “No”, go to question 9.3

9.1.1 If “Yes”, for how many days did the cough last? ...... days

9.1.2 If “Yes”, during which part of the day was the cough worse?  
1. Day 2. Night 3. Don’t know 4. All times

Version 2
9.2 Did ............. turn blue while coughing?

1. Yes  
2. No  
3. Don't know

9.3 During the illness did ........... have difficulty breathing?

1. Yes  
2. No  
3. Don't know

9.4 If "Yes", for how many days did the difficult breathing last? ........ days

9.5.1 During the illness was s/he breathing faster than normal?

1. Yes  
2. No  
3. Don't know

9.5.2 If "Yes", for how many days did the fast breathing last? ...... days

9.6.1 During the illness did s/he have in drawing of the chest?

1. Yes  
2. No  
3. Don't know

9.6.2 If "Yes", for how many days did chest in drawing last? ........ days

9.7 During the illness was s/he grunting?

1. Yes  
2. No  
3. Don't know

9.8.1 During the illness did s/he have a wheeze

1. Yes  
2. No  
3. Don't know

9.8.2 If "Yes", for how many days did the wheeze last? ......days

9.8.3 Did s/he wheeze after treatment?

1. Yes  
2. No  
3. Don't know

9.8.4 Was s/he given specific medication for the wheeze?

1. Yes  
2. No  
3. Don't know

Version 2
Respiratory tract infections
9.9.1. Was s/he ever treated for respiratory tract infections?  
1. Yes  2. No  3. Don’t know

9.9.2 “Yes”, give details of treatment

<table>
<thead>
<tr>
<th>Age (M)</th>
<th>Health Facility</th>
<th>Diagnosis e.g. pneumonia</th>
<th>Admitted Yes/No</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

Weight
If RTHC is available, record the dates of the most recent two weights
9.10.1

<table>
<thead>
<tr>
<th>Date (dd/mm/yy)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9.10.2 Are there other health records available? (Apart from the road to health card)  
1. Yes  2. No  3. Don’t know

9.10.3 If other medical records are available make copies of these as well as the road to health card.

SECTION 10
Death certificate details

10.1 Are you able to see the death certificate?  
1. Yes  2. No

If “Yes”

10.2 Record immediate cause of death (as in the death certificate)

10.3 Record the first underlying cause of death

10.4 Record the second underlying cause of death

10.5 Record the third underlying cause of death
14.6 Record the contributing cause(s) of death

SECTION 11
Introduce the next section and tell respondent that now you would like to ask questions about the family of the child.

Background information on the family of the deceased

11.1 Date of birth of the parents
1. Mother □ □ □ □

2. Father ... □ □ □ □

11.2.1 Is the father employed? 1. Yes 2. No

11.2.2 If “Yes” Where is he employed?

11.2.3 What is he employed as?

11.2.4 How long has he worked there? ........ months ........ years

11.2.5 Does he work there throughout the year or only during certain months of the year?
1. works throughout the year □ 2. works only at certain times of the year □

11.3.1 Is the mother employed? 1. Yes 2. No

11.3.2 If “Yes” Where is she employed?

11.3.3 What is she employed as?

11.3.4 How long has she worked there? ........ months ........ years

11.3.5 Does she work there throughout the year or only during certain months of the year?
1. works throughout the year □ 2. works only at certain times of the year □
11.4 If both parents are employed who took care of the child while parents were at work?

<table>
<thead>
<tr>
<th>Relative within household</th>
<th>2. Relative outside household</th>
<th>3. Creche</th>
<th>4. Other (e.g. friend, neighbour)</th>
</tr>
</thead>
</table>

11.5.1 How many individuals in the household receive at least one social grant?

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4+</th>
</tr>
</thead>
</table>

11.5.2 (If at least one grant is received) Tick all grants received

- [ ] Old age pension
- [ ] Care dependency
- [ ] Disability grant
- [ ] Childcare grant
- [ ] Other grant (specify)

Housing

11.6.1 Type of house

- [ ] Brick house/flat
- [ ] Shack
- [ ] Other (specify)

11.6.2 Number of rooms in the home (excluding bathrooms, sheds stables etc unless persons are living in them)

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5+</th>
</tr>
</thead>
</table>

11.6.3 Number of people living in the home at the time of the child’s death

Water and sanitation

11.7 Piped water (inside- inside the house/ outside- outside the house)

<table>
<thead>
<tr>
<th>None</th>
<th>Inside</th>
<th>Outside-communal</th>
<th>Outside-private</th>
</tr>
</thead>
</table>

11.8 Toilet facilities

<table>
<thead>
<tr>
<th>None</th>
<th>Pit</th>
<th>Flush</th>
<th>Bucket</th>
<th>Other</th>
</tr>
</thead>
</table>

Smoking habits and alcohol intake of household members

11.9.1 Has the mother ever smoked cigarettes?

- [ ] Yes
- [ ] No

11.9.2 If “Yes”, please give details

<table>
<thead>
<tr>
<th>Time period</th>
<th>Number of cigarettes per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before pregnancy</td>
<td></td>
</tr>
<tr>
<td>During pregnancy</td>
<td></td>
</tr>
<tr>
<td>After delivery</td>
<td></td>
</tr>
</tbody>
</table>
11.10.1 List of people in the house who smoke

<table>
<thead>
<tr>
<th>Number</th>
<th>Relation to child</th>
<th>No. of cigarettes/day</th>
<th>Duration of smoking (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11.10.2 Is the mother currently drinking alcohol?

1. Yes 2. No

11.10.3 If “Yes”, give details

<table>
<thead>
<tr>
<th>Time-period</th>
<th>Type e.g. wine</th>
<th>Quantity e.g. 1 litre bottle / day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After delivery</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11.10.4 If “No” did she ever take alcohol?

1. Yes 2. No

11.10.5 If “Yes” When did she stop?

1. Before pregnancy ☐ 2. During pregnancy ☐ 3. After delivery ☐

11.10.6 List of other people in the house who take alcohol

<table>
<thead>
<tr>
<th>Number</th>
<th>Relation to child</th>
<th>Type (e.g. wine)</th>
<th>Quantity (e.g. 1 litre bottle/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SECTION 12

SUPPLEMENTARY TB QUESTIONNAIRE

Ask the respondent if any of the relations have been diagnosed with TB, have been coughing a lot, etc...... Record each response as shown below
1. Yes  2. No  3. Don’t know

<table>
<thead>
<tr>
<th>Relation</th>
<th>Diagnosed with TB</th>
<th>Coughing a lot</th>
<th>Coughing up blood</th>
<th>Unexplained weight loss</th>
<th>Unexplained Night sweats</th>
<th>Unexplained fever</th>
<th>Diagnosed HIV+/AIDS</th>
<th>Chest pain</th>
<th>Poor appetite</th>
</tr>
</thead>
<tbody>
<tr>
<td>mother</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>father</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grandmother</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grandfather</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>uncle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>aunt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sibling1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sibling2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thank the respondent

Name: ....................................................
Signature: ............................................ Date: ...... / ...... / 200..
OTHER CHILDHOOD CONDITIONS
(Reference period is within 1 month of the event of death)

8.10 Describe the BCG vaccination site just before death

1. Nothing to see or feel □
2. Scar □
3. Ulcerating □
4. Swollen □
5. Discharging □

8.11.1 During the illness did s/he have swelling in the armpit(s)?

If “No”, go to question 8.13.1

1. Yes 2. No 3. Don’t know

8.11.2 If “Yes”, which armpit was the swelling in?


8.11.3 What was the size of the swelling? (in finger-breadths)

1. one 2. two 3. ≥ three

8.11.4 Characteristics of the swelling

1. Red 2. Hot 3. Tender

8.12.1 During the illness did s/he have a fever?

1. Yes 2. No 3. Don’t know

8.12.2 If “Yes”, how many days did the fever last? ........ days

8.13 During the illness did s/he have oral thrush?

1. Yes 2. No 3. Don’t know

8.14.1 If “Yes”, was it

1. Severe (covering most of the mouth)
2. Persistent (never got better or kept re-appearing, despite treatment)

8.15 During the illness did s/he suffer from lack of blood or pallor?

1. Yes 2. No 3. Don’t know
SECTION 13

ASSESSMENT BY MEDICAL OFFICER

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main cause of death</td>
<td></td>
</tr>
<tr>
<td>Contributing cause 1</td>
<td></td>
</tr>
<tr>
<td>Contributing cause 2</td>
<td></td>
</tr>
<tr>
<td>Contributing cause 3</td>
<td></td>
</tr>
<tr>
<td>Contributing cause 4</td>
<td></td>
</tr>
<tr>
<td>Contributing cause 5</td>
<td></td>
</tr>
</tbody>
</table>

Death related to BCG

- [ ] Unrelated to BCG
- [ ] Related to BCG
  - [ ] Definite
  - [ ] Probable
  - [ ] Possible
  - [ ] Inconclusive

*ICD code based on the Cape Town abridged classification system*