UPDATING AN EVALUATION OF THE QUALITY OF NATIONAL MORTALITY STATISTICS FROM CIVIL REGISTRATION IN SOUTH AFRICA: 1997-2012

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BACKGROUND

For South Africa (SA), two WHO assessments rated the quality of 1996 CRVS mortality data as "low" (Mathers et al, 2005; Mahapatra et al, 2007).

With the transition to democracy, however, CRVS underwent major transformation

Key events included:

- demise of "separate development" policies and the integration of 4 "homelands" and 6 self-governing territories into one consolidated geo-political entity;

- passing of the 1992 Births and Deaths Registration Act, mandating *all* deaths in *all* geographic areas to be registered into a single, centralised CRVS system;

- several strategic efforts to enhance the CRVS system by governmental agencies, incl. Stats SA and the Departments of Health and Home Affairs, in collaboration with local mortality researchers.

RATIONALE AND AIM

Given these initiatives, and the 'low' rating assigned to 1996 data, it was of interest to ascertain whether or not there was improvement in the quality of post-1996 CRVS data.

An output evaluation was hence conducted and published in 2013, with the aim to evaluate the quality of CRVS mortality statistics for 1997 – 2007.

Aim of this presentation: to update the 1997 – 2007 evaluation with more recent data, and

to identify areas of quality improvement or deterioration.

METHODS: WHICH EVALUATION CRITERIA FOR AN OUTPUT EVALUATION OF COUNTRY-LEVEL CRVS DATA?

- To usefully evaluate a country's CRVS mortality data, it is important to know what data attributes and criteria are relevant.

- Much work has been done to develop frameworks and relevant criteria to help assess the performance of **health information systems**, as well as the quality of the data that are captured into these systems.

- In contrast, less work has been done in developing frameworks and criteria for assessing the quality of data from civil registration and vital statistics, in particular.

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CRITERIA USED FOR EVALUATING THE QUALITY OF <u>COUNTRY-LEVEL MORTALITY</u> DATA FROM <u>CIVIL REGISTRATION</u> SYSTEMS

Ruzicka & Lopez, 1990[150] Comparative: 6 criteria	Mahapatra & Rao, 2001[152] Country-level: 9 criteria	Mathers et al, 2005[8] Comparative: 5 criteria	Rao et al, 2005[10] **Country-level:** 9 criteria	Franca et al, 2008[126] **Country-level:** 9 criteria	Mahapatra et al, 2007[9] Comparative: General vital statistics (12)	Cause-of-death statistics (15)	Phillips et al, 2014[17] Comparative: 6 dimensions
Using only rubrics in the ICD relevant to mortality, at the time, ICD-8 or -9		Type of cause-of-death coding used, at the time, ICD-9/10					Level of cause-specific detail, measured by nu. of distinct causes of death in data
No incorrect assignment of causes with a clear age and sex dependency	No incorrect assignment of causes with a clear age and sex- dependency		Incorrect or improbable age or sex dependency	Incorrect or improbable age or sex dependency		Improbable age or sex classifications	Internal consistency: medically impossible cause assignment for any given age or sex
Consistency between proportionate distribution of deaths by cause and estimated mortality level for country	Consistency of cause-specific mortality proportions with general mortality levels		Consistency of cause patterns with general levels of mortality	Consistency of cause patterns with general levels of mortality		Consistency between cause of death and general mortality	
Consistency between age-sex distribution of deaths for major causes, & that expected for each cause	No incidence of improbable age and sex distribution by cause						
Consistency of a current year's data with data from previous years	Consistency of cause-specific mortality proportions over time		Consistency of cause-specific mortality rates over time	Consistency of cause-specific mortality rates over time	Comparable over time	Comparable over time	
Clear indication of number & % of deaths allocated to symptoms, signs & ill-defined conditions	Minimal use of residual categories of causes of death	Use of ill-defined and unspecified categories and codes	Use of ill-defined categories & codes for causes of death	Use of ill-defined categories and codes for causes of death		Use of ill-defined and unspecified categories	Quality of cause-of-death reporting, essentially use of 'garbage' codes[153]

CRITERIA USED FOR EVALUATING THE QUALITY OF COUNTRY-LEVEL MORTALITY DATA FROM CIVIL REGISTRATION SYSTEMS (CONTINUED)

Ruzicka & Lopez, 1990[150] 6 criteria	Mahapatra & Rao, 2001[152] 9 criteria	Mathers et al, 2005[8] 5 criteria	Rao et al, 2005[10] 9 criteria	Franca et al, 2008[126] 9 criteria	Mahapatra et al, 2007[9] General vital statistics (12)	Cause-of-death statistics (15)	Phillips et al, 2014[17] 6 dimensions
	Content validity of lay reporting systems		Content validity of cause-of-death data	Content validity of cause-of-death data			
	Adequate coverage and compliance	Coverage of the resident population by death registration	Coverage of the resident population by death registration	Coverage of the resident population by death registration	Coverage of resident population by death registration	Coverage of deaths by medical certification	
	Validity of statistics at sub-national levels of disaggregation		Geographical disaggregation of data	Geographical disaggregation of data	Availability of statistics for small areas	Availability of statistics for small areas	
	Timeliness of compilation and publication of mortality statistics	Timeliness of supplying death registration data to WHO	Timeliness of the release of mortality statistics	Timeliness of the release of mortality statistics	Timeliness in terms of production time	Timeliness in terms of production time	Timeliness and availability of data
		Completeness of death registration	Completeness of death registration	Completeness of death registration	Completeness of death registration	Completeness of deaths with medically-certified cause	Completeness of death reporting
					Missing data: % key variables with no response	Missing data: % cause-of-death reports with no age/sex data	Quality of age and sex reporting
					Routine tabulations by 5-yr age groups and sex	Routine tabulations by 8 age groups and sex	
					Comparable across space	Comparable across space	
					Regularity of dissemination	Regularity of dissemination	
					Accessibility of data in various formats	Accessibility of data in various formats	
					Accessibility of metadata	Accessibility of metadata	
					Accessibility of user service	Accessibility of user service	

Note: The evaluation studies are listed chronologically from left to right in the columns. Shaded columns are for single-country evaluations, compared to the comparative studies of those countries providing mortality data to the WHO, United Nations and/or GBD study, in clear columns.

Data attributes	Criteria: country level CRVS mortality data	CRVS data quality: 1997 - 2007	CRVS data quality: 2008 - 2012	Assessment question	Suggested threshold / desired response
Generaliza-bility	1. Coverage			What % of the population is covered by the (CR) system?	100% of national or sample population
	2. Completeness			Within the covered population, what % of deaths is registered into the CR system?	≥ 90% of deaths
Reliability	3. Epi consistency			To what extent are cause-of-death patterns consistent with the total level of mortality?	< 2 standard deviations from mean model-predicted levels
	4. Temporal consistency			To what extent is cause-specific mortality consistent over time?	< 2% annual death rate fluctuation in leading causes, unless explained by local epi phenomena
Validity	5. Content validity			Against reference diagnosis, to what extent are attribution and coding of the underlying cause accurate?	If no concordance, sensitivity, specificity, or kappa scores from validation studies, consider criteria 6 & 7, plus extent of errors on DNF
	6. Extent of ill-defined & non-specified codes			What proportion of registered deaths is assigned an ill-defined/non-specific cause?	< 10% of deaths
	7. Use of age- & sex-improbable classifications			What proportion of deaths is assigned an improbable age- or sex-cause?	< 1% of deaths
Policy relevance	8. Timeliness			What is the time gap between the end of the reference period (year of death) and time of publication of final tabulations?	≤ 2 years
	9. Availability of sub-national data			Are death and cause-of-death data available at sub-national jurisdictions for analysis?	Yes, at least at provincial/state level, but preferably at health district level

METHODS: PERFORMANCE RATINGS

As used in other country-level evaluations (e.g. China & Brazil), a simple and broadly-defined rating system has been used, distinguishing between:

1. satisfactory,
2. unsatisfactory and
3. unknown/undetermined

To differentiate between 1. and 2., thresholds informed by general premises and principles of demography and epidemiology had been employed.

METHODS: DATA SOURCES

- The evaluation of four criteria
    - epi consistency, temporal consistency, age/sex classification, and ill-defined/non-specific codes

    drew on a dataset produced by Stats SA with 11 years' mortality data from DNFs for 5.38 million deaths that occurred nationally 01/01/97 to 31/12/07.

    - This dataset has been updated annually when cause of death statistics have been released by Stats SA—meaning we could do an update.

- For the remaining five:
    - relevant legislation, web-based data repositories, statistical releases, and published government and research reports had been reviewed to identify developments which shaped the current status of these criteria in terms of data quality.

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RESULTS: 1. COVERAGE OF DEATH REGISTRATION

- During most of the 1900s, coverage was constrained by differential registration practices, based on geographical segmentation and population segregation acts and policies.

- During the 1990s, the 'homeland' ideology was abolished, and the country was geopolitically unified under one government.

- A new *Births and Deaths Registration Act* was passed in1992, whereby death notification became a national, inclusive legal requirement for all people in all geographic areas.

- Hence, we rated *coverage* <u>satisfactory for 1997-2007</u>.

1. COVERAGE OF DEATH REGISTRATION (CONTINUED)

- During the 2nd period, the same inclusive principles applied in legislation and CR practise, and death registration continued as a centralised government service.

  – For these purposes, *coverage* could be rated *satisfactory* for this period too.

- However, it became apparent that a proportion of natural deaths (possibly up to 10%) are certified by traditional leaders or village headmen.

- This suggests that the country has two coverage systems, with differing resources and dissimilar performance prospects,

  – For 2008 - 2012: unsatisfactory

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2. COMPLETENESS OF DEATH REGISTRATION

1997 - 2007: satisfactory

2008 - 2012: satisfactory, and improved
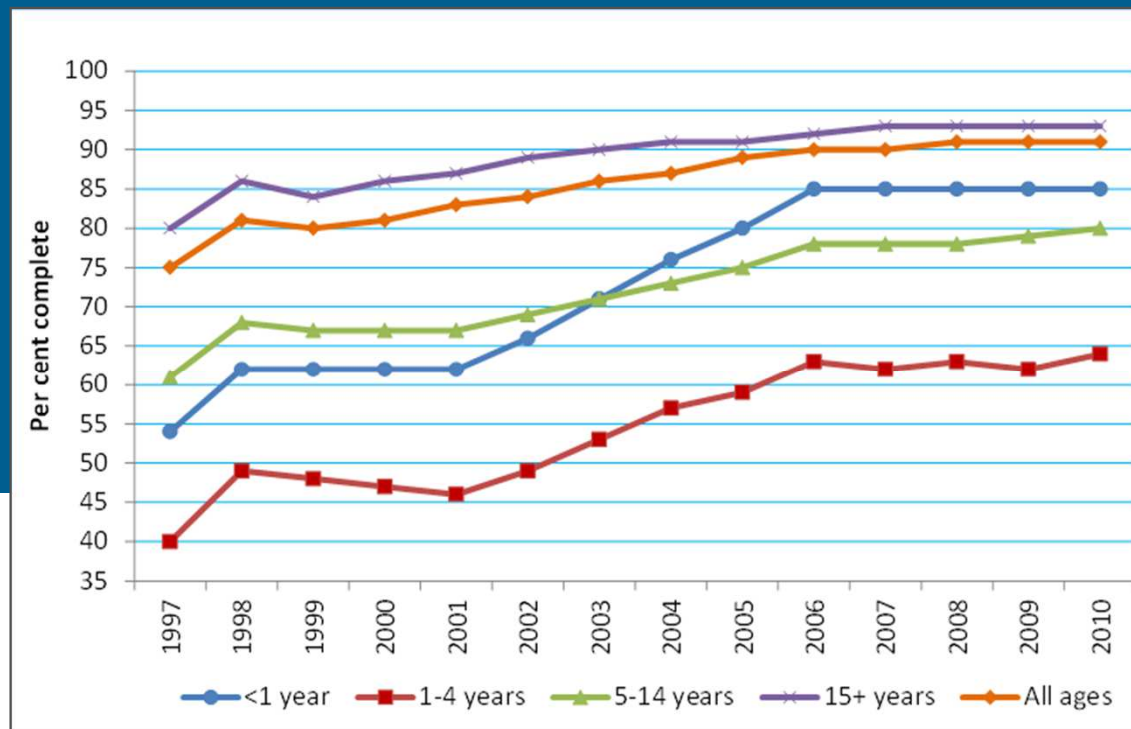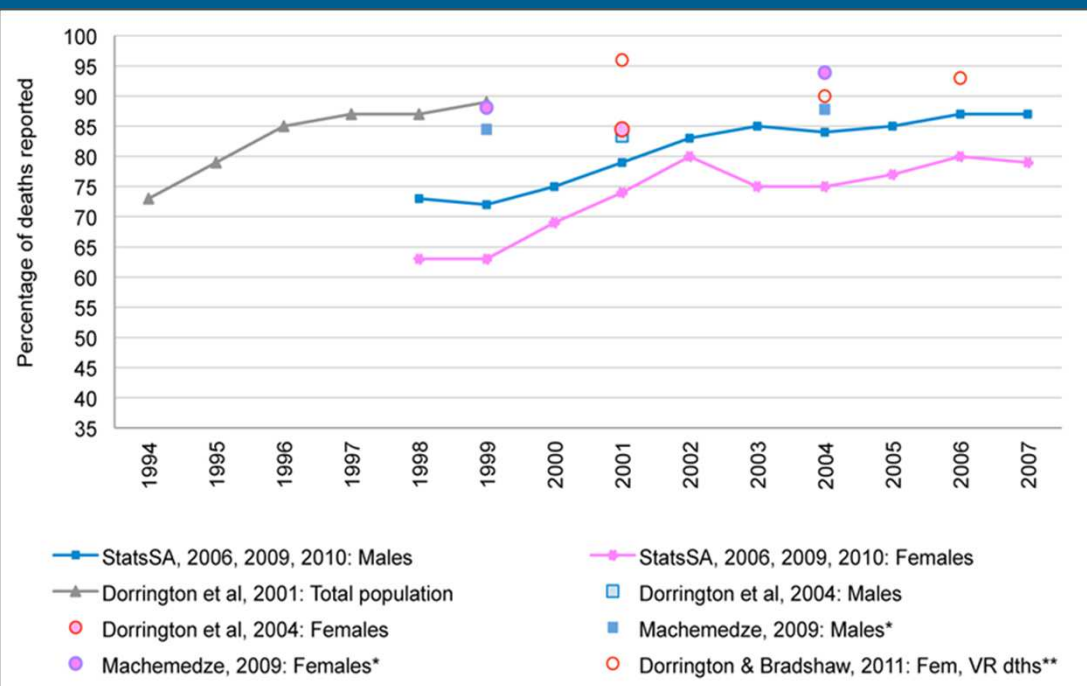
3. EPIDEMIOLOGICAL CONSISTENCY

Based on the premise that the composition of mortality by cause changes systematically as all-cause mortality decline,

- *observed* broad patterns of causes of death for SA were compared with *expected* broad-cause values in a model that considers the relationship between the overall level of mortality and the relative contribution of causes to the overall level.
- a difference of more than two standard deviations (>2 SD) between observed and model-predicted proportions suggests unsatisfactory epi consistency of the observed data.

On the basis of the differences between the SA epi profile and that produced in the model predictions, this criterion could not be assessed conclusively as the model does not have the discriminatory power to enable an assessment for South Africa's particular mortality profile.

- Epidemiology consistency: 1997 - 2007: undetermined
  2008 - 2012: undetermined

4. TEMPORAL CONSISTENCY
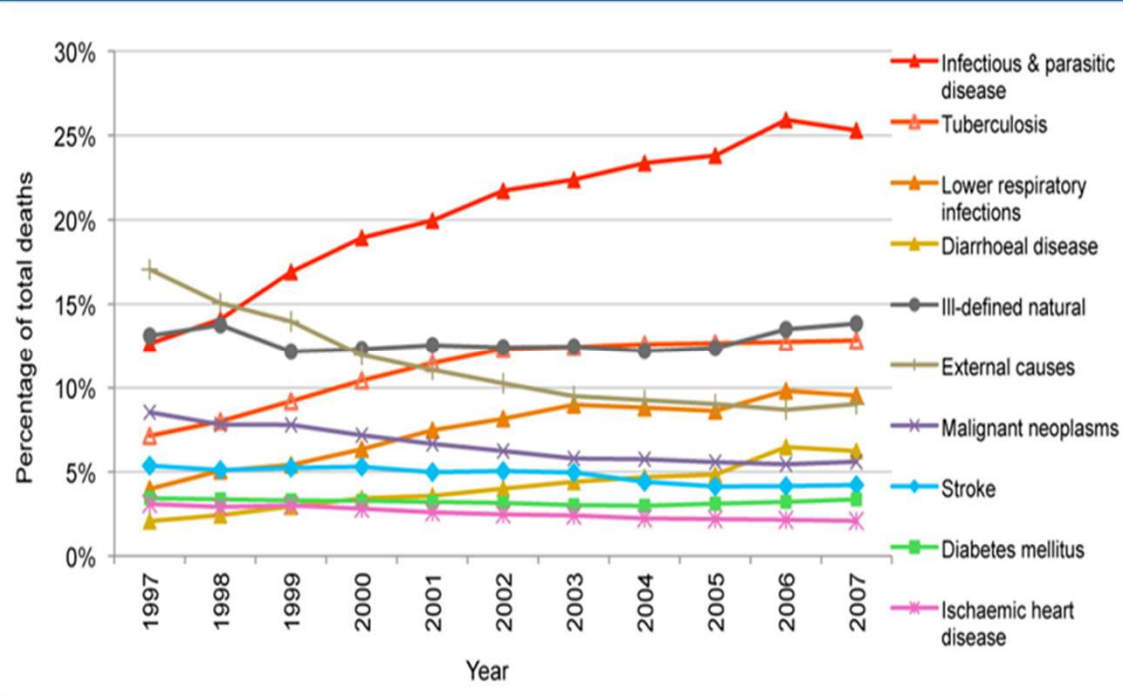
Proportion of total deaths due to leading categories and detailed causes of death, 1997–2007
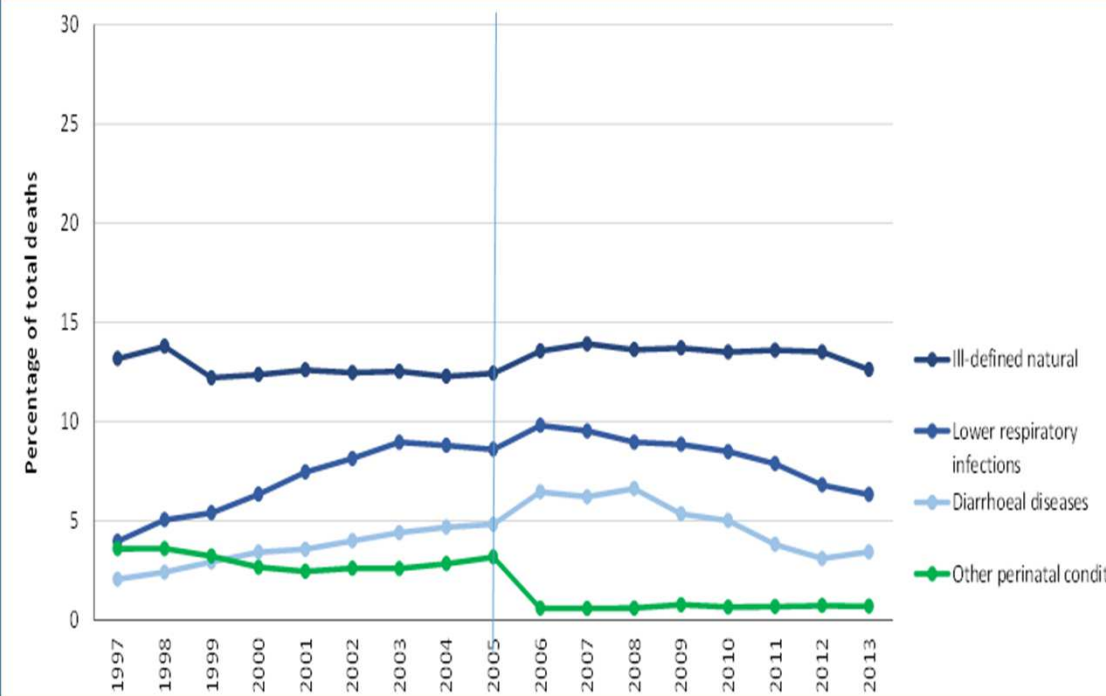
Proportion of total deaths due to selected causes of death, 1997–2013

1997 - 2007: satisfactory

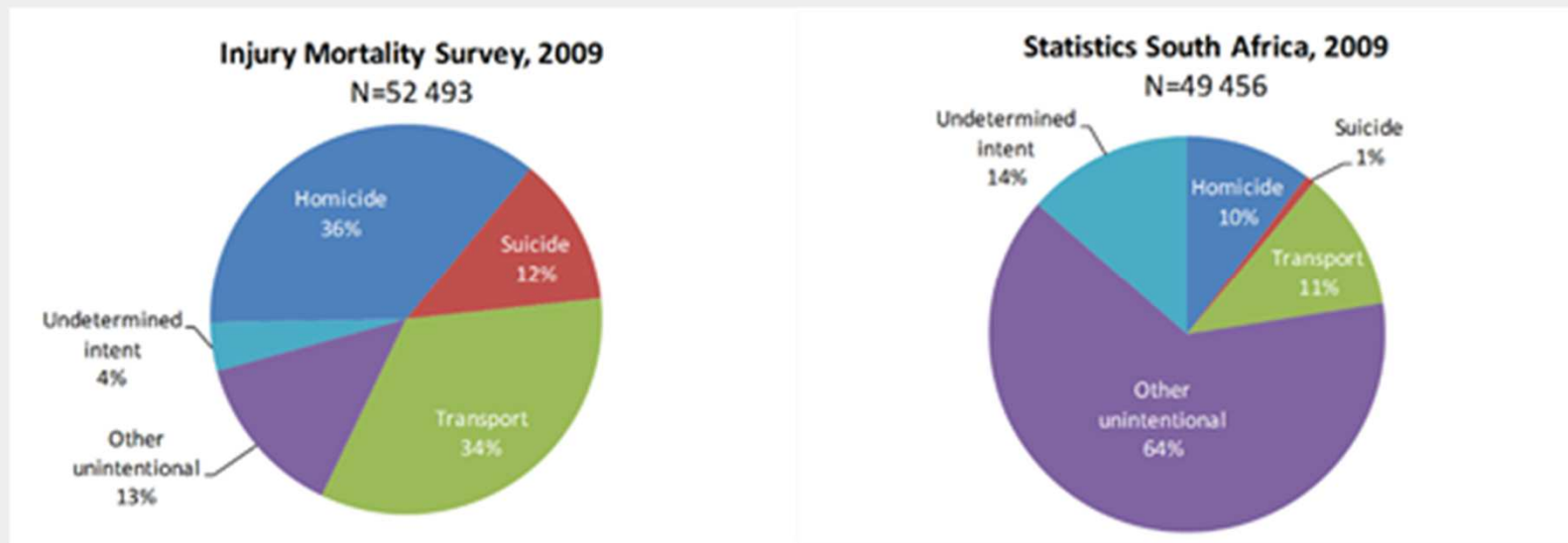2008 - 2012: unsatisfactory

5. CONTENT VALIDITY

- The extent to which attribution and coding of causes of death are accurate is not routinely assessed in SA.

- However, a number of studies have shed light on the accuracy of cause attribution, mostly focussing on the misclassification of HIV/AIDS deaths, and mostly limited in size and geographical coverage, e.g.

  - Studying death certificates and medical records at a teaching hospital in Cape Town in 500 paediatric deaths, Westwood (2000) found that HIV-deaths was 11% under-certified; a further 30% of HIV-related deaths were classified using non-specific terms.

  - Comparing DNFs with medical records for 683 deaths in Cape Town, Yudkin *et al.* (2009) estimated that 36% of HIV-attributable deaths were classified to other conditions; A further 37% were indicated in euphemisms such as *immune suppression* or *retroviral disease*.

  - In a more recent validation study of 703 deaths in Cape Town, substantial misclassification was found for HIV/AIDS; also for IHD, hypertensive disease, diabetes (Burger, 2012).

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5. CONTENT VALIDITY (CONTINUED)

Modelling studies with national CRVS data showed a similar quality problem:

- Analysing CRVS data for 2000-2001, Groenewald *et al.* (2005) found 61% of HIV/AIDS deaths classified to other conditions.
- Birnbaum *et al.* (2006) confirmed substantial misclassification of HIV/AIDS for 1996 - 2006, suggesting that over 90% of HIV/AIDS deaths were misattributed to other causes.

Injuries in SA represent another substantial quality problem:

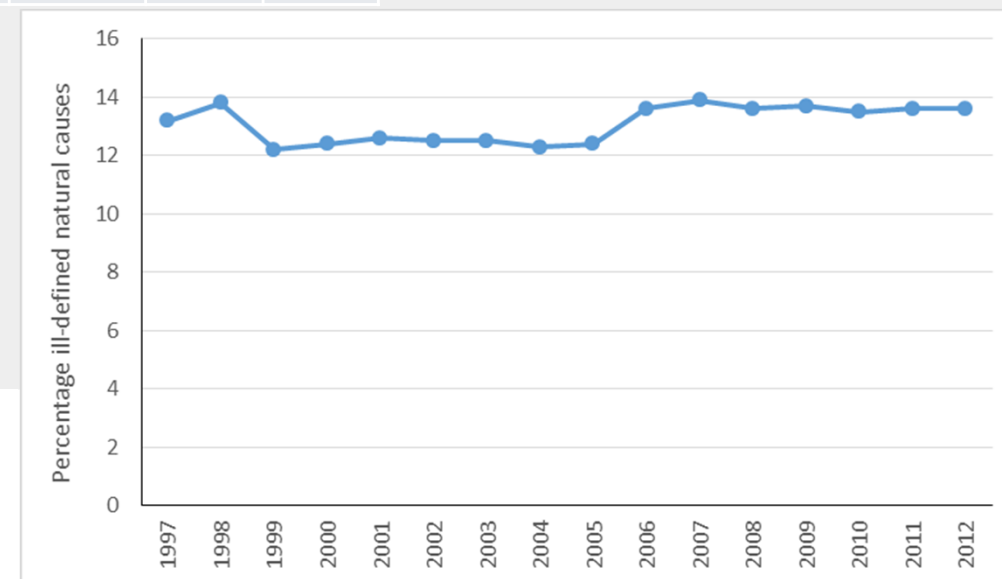1997 - 2007: unsatisfactory; 2008 - 2012: unsatisfactory

# 6. % ILL-DEFINED AND NON SPECIFIC CAUSE-OF-DEATH CODES

Ill-defined/non-specific codes: 1997 - 2007: unsatisfactory

2008 - 2012: unsatisfactory

Table 2. Percentage of total deaths assigned selected ill-defined and non-specific codes by province of death occurrence, South Africa, 1997-2007

	Western Cape	Eastern Cape	Northern Cape	Free State	KwaZulu-Natal	North West	Gau-teng	Mpuma-langa	Lim-popo	South Africa
Chapter R codes	6.0	17.5	7.5	9.6	15.0	9.9	12.4	8.5	17.9	12.8
Non-spec. cancer	1.5	0.6	0.7	0.5	0.5	0.4	0.8	0.4	0.4	0.6
Ill-def. CVD	3.0	3.0	4.0	4.5	3.5	5.1	3.8	3.4	3.8	3.7
Ill-def. injury	12.3	6.6	6.3	5.4	6.9	5.7	10.4	7.0	4.4	7.6
All four categories	22.8	27.7	18.5	20.0	25.9	21.1	27.4	19.3	26.5	24.7

7. USE OF AGE- AND SEX-IMPROBABLE CLASSIFICATIONS
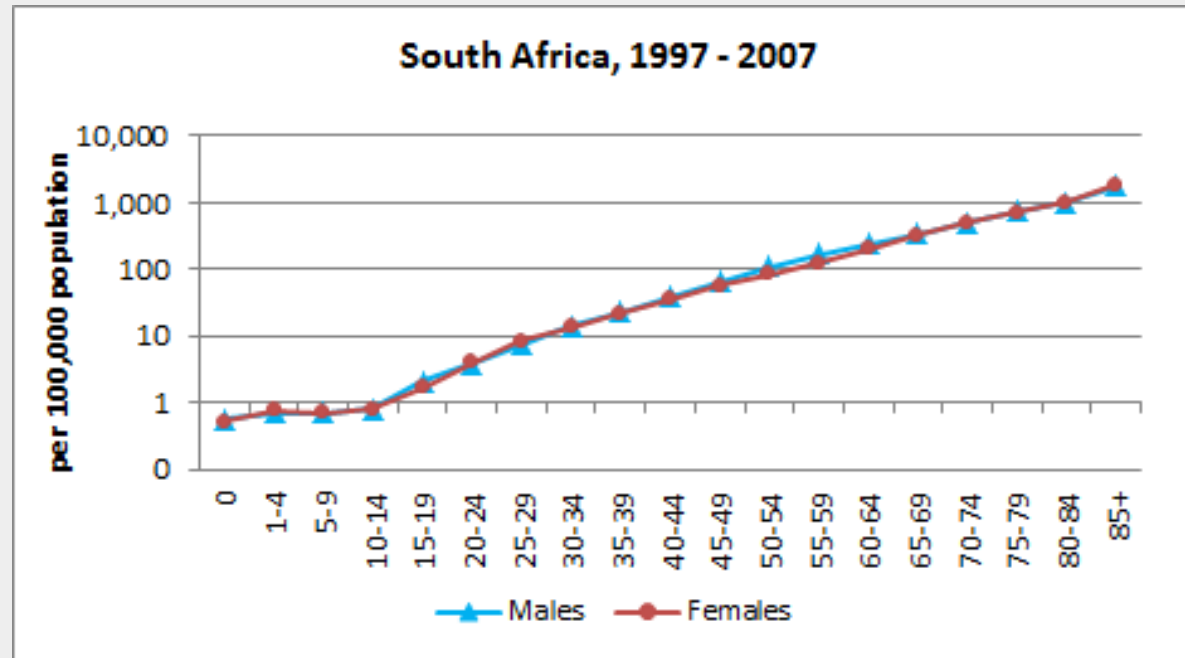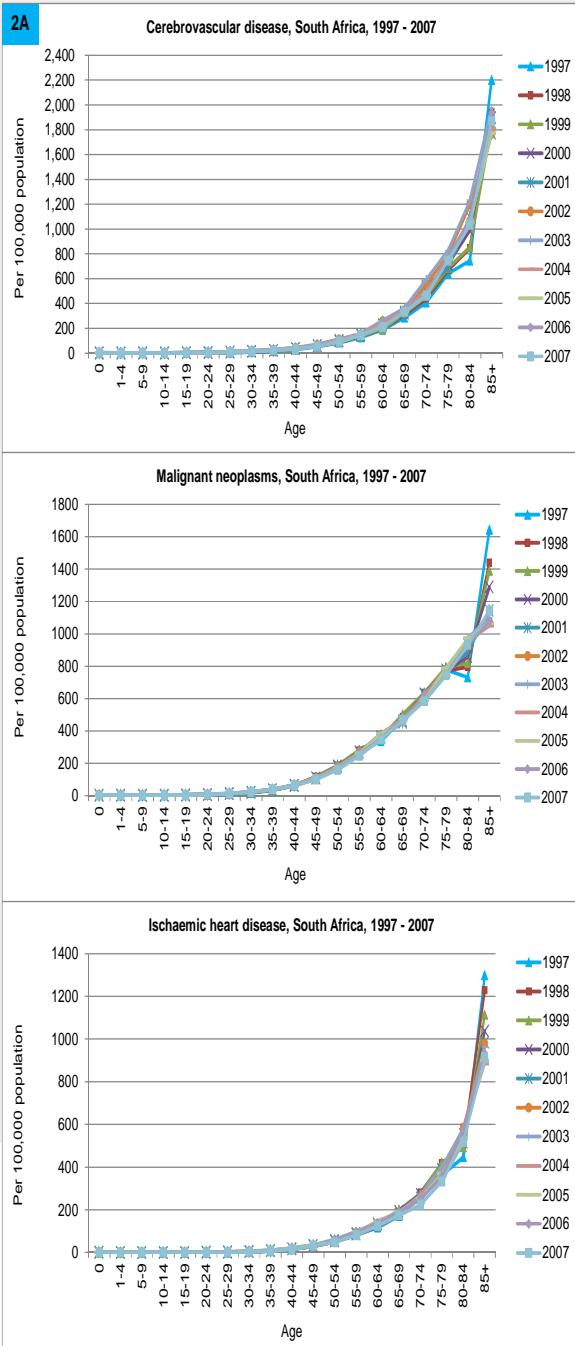
1997 - 2007: satisfactory

Assumed later period is satisfactory, because

StatsSA uses ANACoD as part of the date-editing

- 2008 - 2012: satisfactory

8. Timeliness

- 1997 - 2007:   became satisfactory

  For 1997 – 2001:   10% sample
  By 2002:   full data set for 1997 up to 2002 became available

- 2008 - 2012:   timeliness satisfactory

- Currently: lag of one year

9. Sub-national availability of mortality data

- 1997 - 2006:   satisfactory—available at provincial level

- 2007 - 2012:   satisfactory—further disaggregated to the health district level

Data attributes	Criteria: country-level CRVS mortality	CRVS data quality: 1997 - 2007	CRVS data quality: 2008 - 2012	Assessment question	Suggested threshold / desired response
Generaliza-bility	1. Coverage	Satisfactory	Unsatisfactory	What % of the population is covered by the (CR) system?	100% of national or sample population
	2. Completeness	Satisfactory	Satisfactory ⬆	Within the covered population, what % of deaths is registered into the CR system?	≥ 90% of deaths
Reliability	3. Epi consistency	Undetermined	Undetermined	To what extent are cause-of-death patterns consistent with the total level of mortality?	< 2 standard deviations from the mean of model-predicted levels
	4. Temporal consistency	Satisfactory	Deteriorated	To what extent is cause-specific mortality consistent over time?	< 2% annual death rate fluctuation in leading causes, unless explained by local epi phenomena
Validity	5. Content validity	Unsatisfactory	Unsatisfactory	Against reference diagnosis, to what extent are attribution and coding of the underlying cause accurate?	If no concordance, sensitivity, specificity, or kappa scores from validation studies, consider criteria 6 & 7, plus extent of errors on DNF
	6. Extent of ill-defined & non-specified codes	Unsatisfactory	Unsatisfactory	What proportion of registered deaths is assigned an ill-defined/non-specific cause?	< 10% of deaths
	7. Use of age- & sex-improbable classifications	Satisfactory	Satisfactory	What proportion of deaths is assigned an improbable age- or sex-cause?	< 1% of deaths
Policy relevance	8. Timeliness	Satisfactory	Satisfactory ⬆	What is the time gap between end of the reference period (yr of death) and the time of publication of final tabulations?	≤ 2 years
	9. Availability of sub-national data	Satisfactory	Satisfactory ⬆	Are death and cause-of-death data available at sub-national jurisdictions for analysis?	Yes, at least at provincial/state level, but preferably at health district level

LESSONS LEARNT/CONCLUDING REMARKS

First period: 6 / 8 criteria rated satisfactory

Second period: 4 / 8 satisfactory

Lesson 1: However, this does not reflect a deterioration in data quality, but rather more analysis, scratching deeper, and more insight into data

Lesson 2: Updating made us realize there is a subjectiveness in thresholds (e.g. headman's tasks increases the count and contribute to higher completeness (good!), but decreases reliability of cause-of-death

Lesson 3: Some training efforts to assist physicians in accurately attributing the underlying cause has been conducted. However, the need for training remains massive.

LESSONS LEARNT/CONCLUDING REMARKS

VSPI—being applied to 148 countries' CRVS data, using 6 dimensions, shows 'rapid and extensive improvement in the performance of the CRVS system, improving from "very low" (VSPI = 7.8) for 1990-94 to "high" quality (70.5 for 2005-2009).

Our evaluation of the CRVS mortality data, using nine criteria, confirms the overall observation by Mikkelsen et al, but ours also highlights the problem areas.

Lesson 4: a single composite metric, that is good for international comparison, may not be able to pick up or show quality problems with individual criteria

LESSONS LEARNT/CONCLUDING REMARKS

Lesson 5: Compared to the assessments of Mathers (2005) and Mahapatra et al (2007), SA's mortality data have improved considerably since their analyses of 1996 data.

Lesson 6: Great strides in improvements, but there is still much to be done to improve the quality of mort data—in particular with regard to cause-of-death data.

Lesson 7: Collaboration among stakeholders is essential, when a country desires improved CRVS data quality, and academics and scientists have an important independent role to play.

FINAL REMARK

African vital statistics — a black hole?

J. L. BOTHA, D. BRADSHAW

Summary

An attempt was made to describe the disease patterns among blacks on the basis of registered deaths, which have been collected for the whole of the RSA since 1978. The pattern of cause-specific proportional mortality resembled that of an under-developed population. It was noticed that the data were not suitable for detailed descriptions because there was evidence of under-registration and mis-

population. We decided to use this available information to describe the disease pattern among blacks.

Material and methods

Information on deaths among blacks in South Africa from 1979 to 1980 and on the sample tabulation of the 1980 census was supplied to us by the Central Statistical Services on computer tapes. Some studies of the sample tabulation of the 1980 census were used for checking the accuracy of our

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