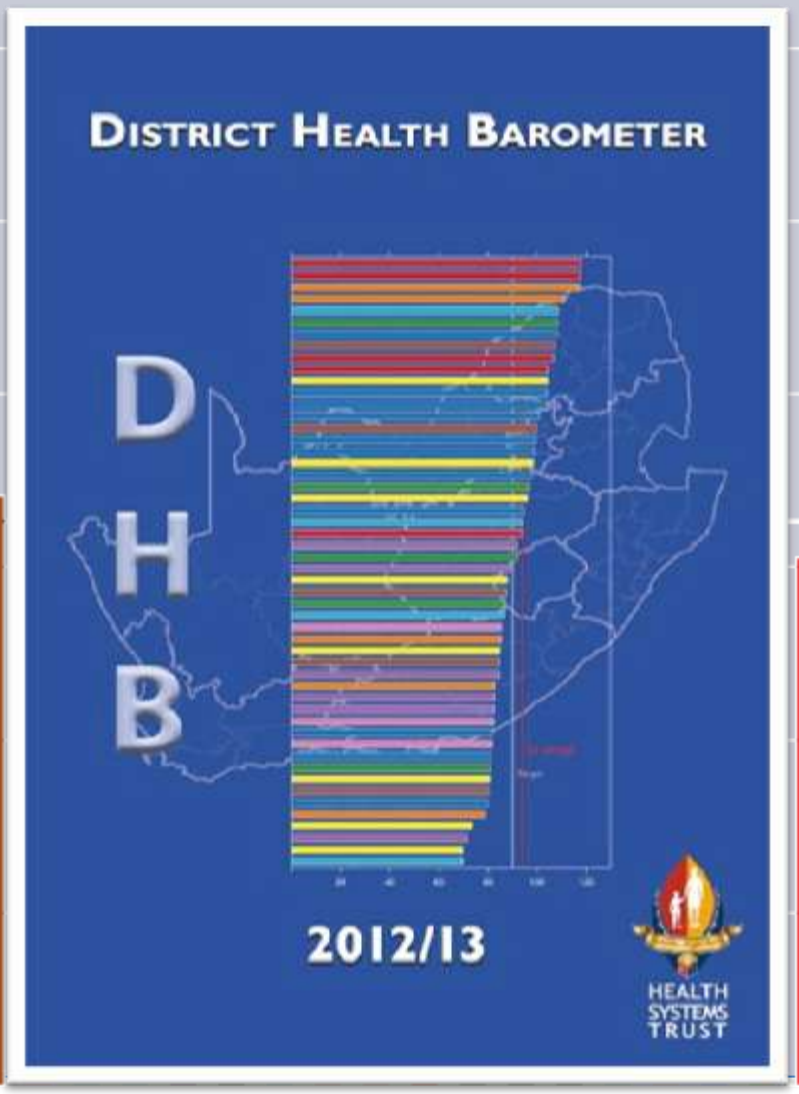
DHB SUPPLEMENT SERIES 1

District Health Barometer 2012/13

FOCUS ON MATERNAL MORTALITY



HEALTH SYSTEMS TRUST

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Focus on Maternal Mortality

DHB Supplement Series 1

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1. Introduction

This document is the first of a series of supplements to the District Health Barometer 2012/13. The purpose of the supplement series is to provide further in-depth information and some explanation of selected indicators presented in the Barometer. This supplement focuses on maternal health and discusses the variations in the maternal mortality ratio when derived from different sources, in this case, the District Health Information System (DHIS) and the National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD). The document provides a district and provincial overview of maternal mortality using the two different sources and concludes by exploring the association of other indicators with maternal mortality at district level.

2. Maternal Mortality in South Africa

The World Health Organization's (WHO) definition of a maternal death is

> the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.

The maternal mortality ratio (MMR) is the number of maternal deaths per 100 000 live births.

The MMR can be calculated in various ways:

- The **population-based MMR** is estimated from the vital registration system and includes all registered maternal deaths regardless of the place of death. The latest best estimate for the South African national population-based MMR is 333 per 100 000 live births for 2009.[1]
- The **facility-based MMR** measures maternal deaths occurring in health facilities, primarily in the public sector, and can be calculated from two sources:
    - The National Committee on Confidential Enquiries into Maternal Deaths (**NCCEMD**) is based on systematic multidisciplinary anonymous investigation of maternal deaths in health facilities by a committee appointed by the Minister of Health.
    - The District Health Information System (**DHIS**) which is routinely collected on a daily basis and reported as aggregated data elements to the National Department of Health on a monthly basis.

NCCEMD	DHIS
The 2010 MMR in facility was 182.8 per 100 000 live births, a decrease from 189.5 in 2009.[2] Interim information released on the 2011 NCCEMD data indicates a further decline in the MMR in facility to 153 per 100 000 live births, largely as a result of averting deaths linked to HIV infection.[3] The average MMR for the 2008-2010 period was 179.2 per 100 000 live births, implying that only 54% of maternal deaths take place in facilities and are recorded in the confidential enquiries system, if the vital registration data are taken as accurate.	In 2012/13, there was a decrease in the MMR in facility (DHIS) from 144.9 to 132.9 per 100 000 live births. The average MMR in facility based on DHIS (all levels of care) for 2011/12 to 2012/13 was 138.9 per 100 000 live births. The NCCEMD MMR values are currently higher than those in the DHIS in most areas.
The NCCEMD is a well-established system with a strong regulatory framework.	DHIS is only approaching completeness in terms of reporting for this indicator, although a few districts have reported data for a number of years and in some cases DHIS reports more maternal deaths than NCCEMD.
Published at district level only every three years with a substantial time-lag.	Data available monthly at facility level which can be aggregated upwards to all levels. The time lag for availability of national dataset is approximately two to three months.
Also provides detailed analysis of the pattern of disease causing maternal deaths, the avoidable factors, missed opportunities and sub-standard care related to these deaths.	Only collects the count of maternal deaths.

There are several challenges in comparing the two data sources for the MMR in facility:

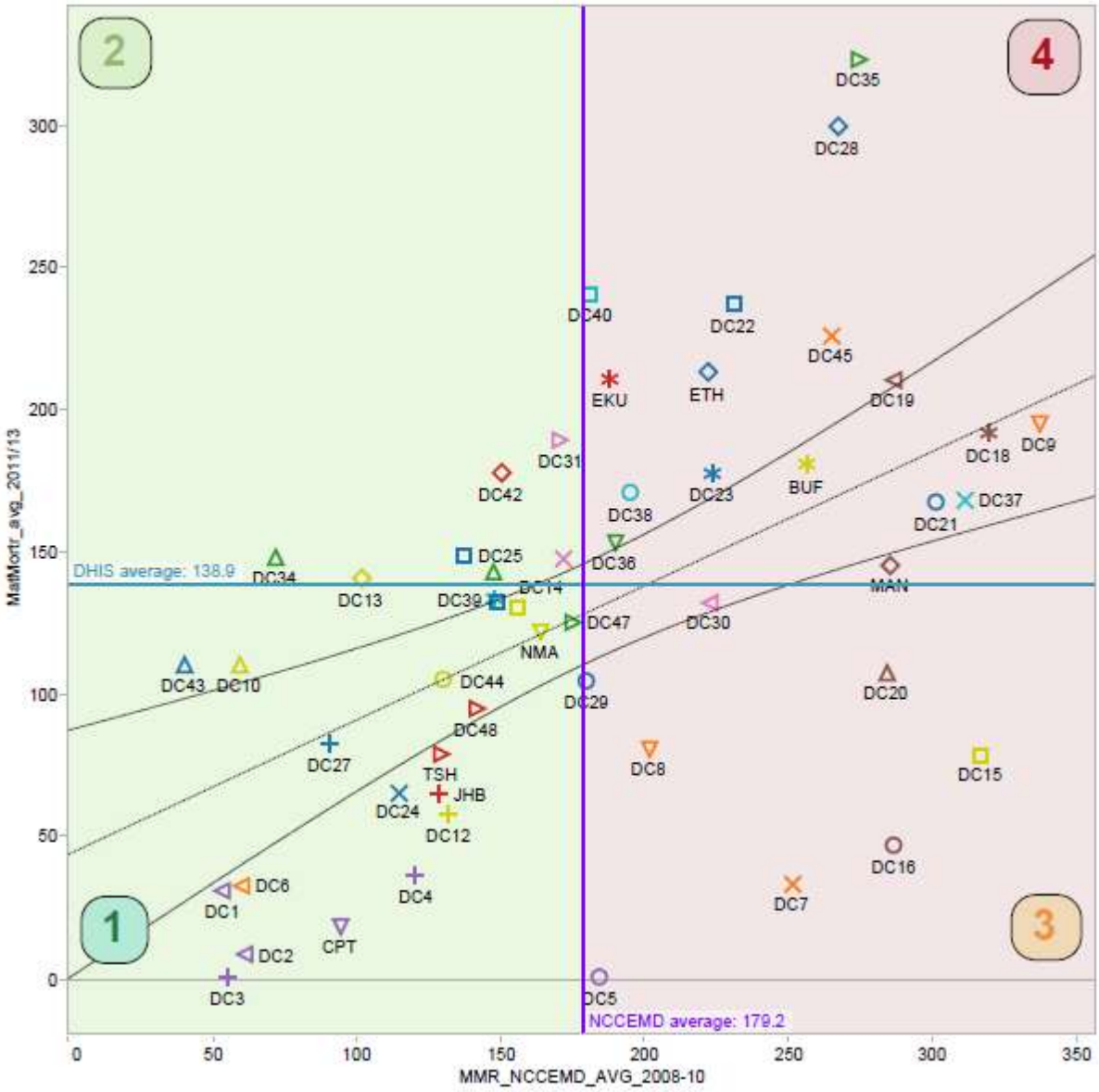
- Although maternal mortality is unacceptably high, at district level the number of maternal deaths per year is fairly small, resulting in ratios which may fluctuate widely year-on-year.
- District-level data have not yet been released by NCCEMD for 2011 and so no data are available to compare with the most recent two financial years of DHIS data.
- The 2008-2010 NCCEMD data were reported according to the geographic boundaries prior to 2011 and maternal deaths in districts affected by boundary changes had to be redistributed, which may have introduced some errors in the distribution of deaths by district.
- The DHIS data are only relatively complete since 2011/12 for most districts and there is thus no overlapping time period where both data sources can be compared for all districts. The WC data have not been automatically imported into DHIS and had to be added manually after extraction from the SINJANI information system.
- It is therefore difficult to be certain about either the LEVEL or the TRENDS for maternal mortality in most districts, although some have steady rates over the whole period and a level of mortality which appears to be consistent with related socio-economic, health service delivery and health outcome indicators.

In order to roughly categorise the level of the MMR in each district, the pooled NCCEMD data from 2008-2010 were compared to the average of the DHIS ratios for 2011/12 and 2012/13 (Figure 1). The geographic distributions of these averaged values are shown in 1 = Low MMR; 2= Medium MMR; 3= Probably high MMR; 4 = High MMR. Map1 (NCCEMD) and Map 2 (DHIS).

The average values and a brief assessment of the level, trends and reliability of the MMR values are given in Table 1 according to their quadrant in the scatterplot:

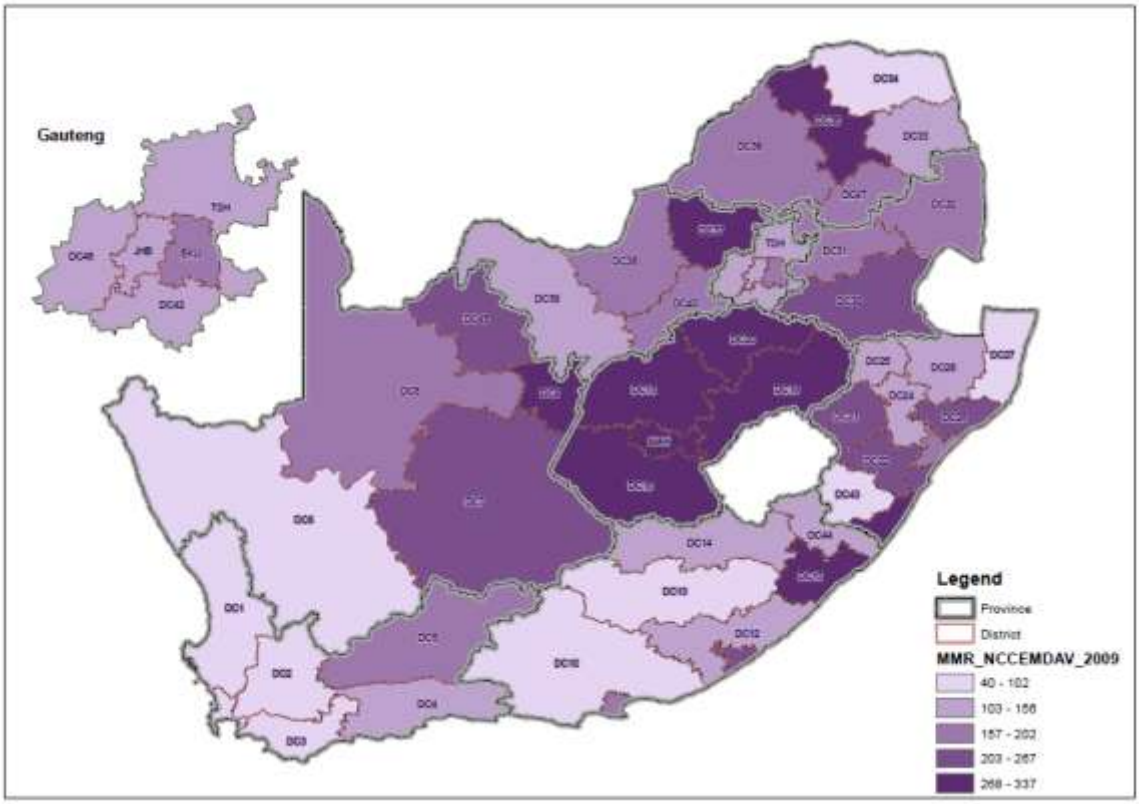
1. **Low MMR** – MMR below the national average for both data sources
2. **Medium MMR** – MMR below the NCCEMD average but higher than the DHIS average
3. **Probably high MMR** – MMR above the NCCEMD average but below the DHIS average, however in most cases the low DHIS values are unexpected or there are possible data completeness problems
4. **High MMR** – MMR above average for both data sources. In most cases these districts also have poor health service delivery indicators and poor outcomes for other mortality indicators. Some of these districts do however contain more regional, tertiary or central hospitals than surrounding districts and therefore it is possible that high ratios are due to referrals of high risk patients or those with complicated deliveries.

Figure 1: Scatterplot of MMR as recorded by DHIS (average of 2011/12 and 2012/13) and the NCCEMD (average of 2008-2010)

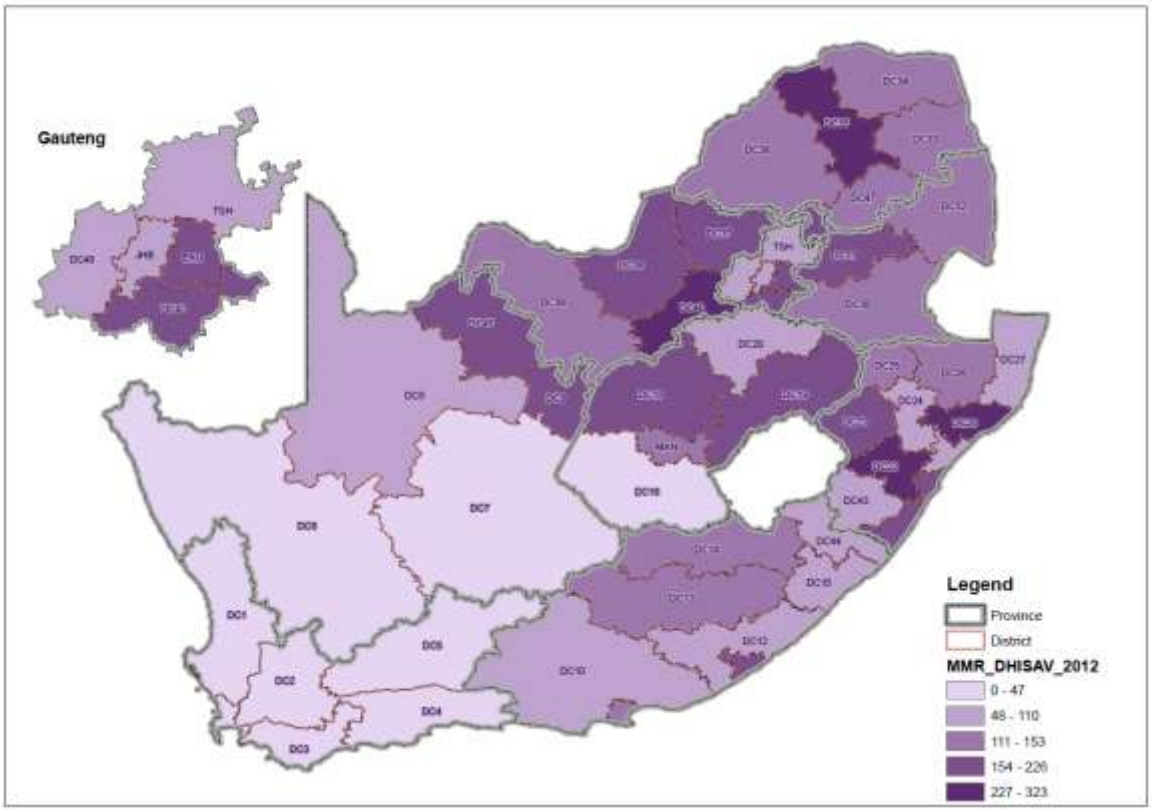


1=Low MMR; 2=Medium MMR, 3=Probably high MMR, 4=High MMR

Map 1: MMR in facility, NCCEMD data, by district, 2008-2010 average



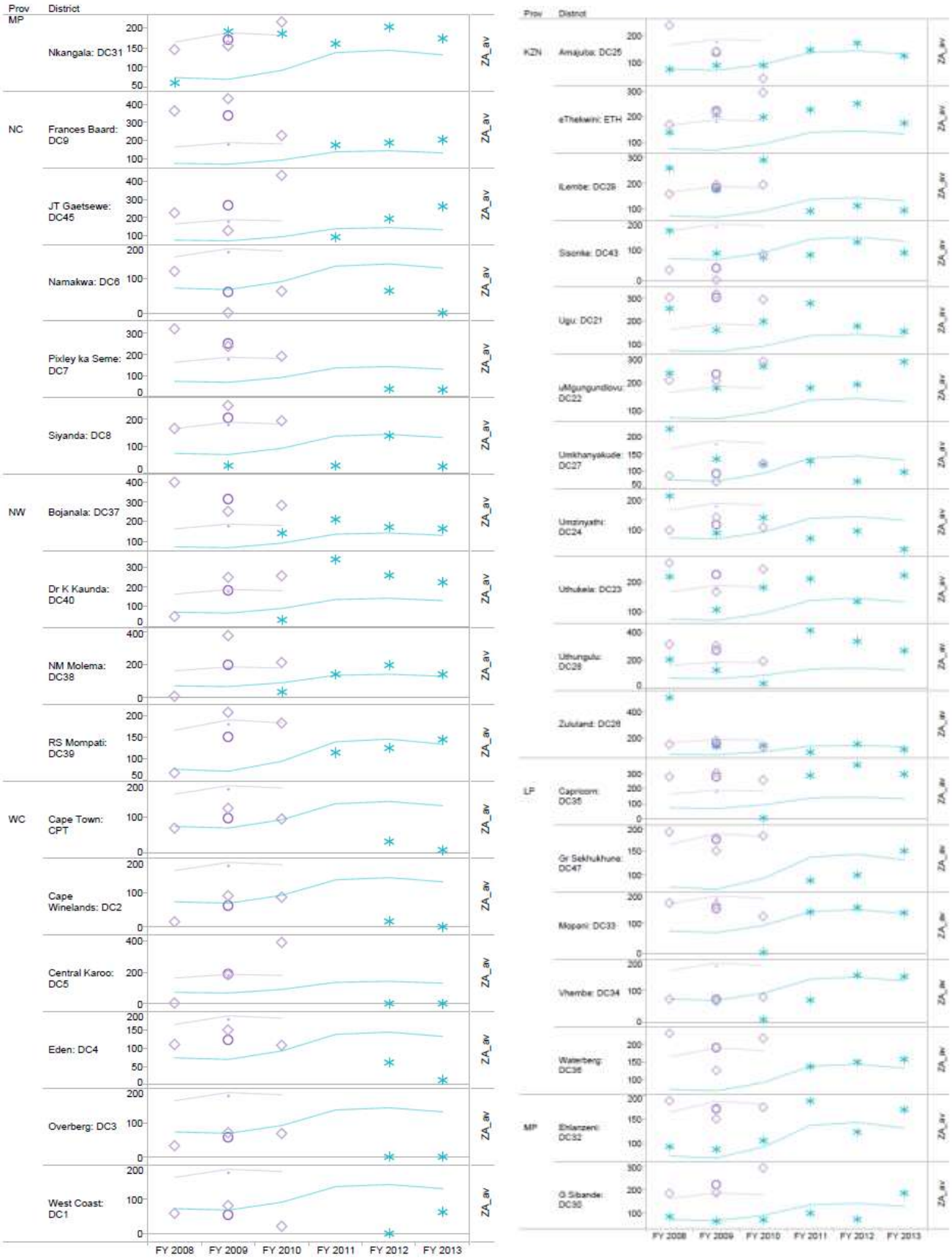
Map 2: MMR in facility, DHIS data, by district, 2011/12-2012/13 average



Basic trend graphs showing all the available data points for each district from NCCEMD (mauve diamond), NCCEMD average over the three years (purple circle) and DHIS (blue star), along with the national averages for these data sources (lines) gives an indication of the stability and comparability of the MMR over time.

Figure 2: Maternal mortality ratio in facility comparing NCCEMD and DHIS estimates, by district

Figure 2 continued



3. District overview of Maternal Mortality

Table 1: Comparison and comment on MMR in facility, based on NCCEMD data (average for 2008-2010) and DHIS (average for 2011/12-2012/13)

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
1. Low MMR – MMR below the national average for both data sources				
Sisonke: DC43	40.3	110.2	-69.9	According to the DHIS data, the MMR in facility decreased from 127.9 per 100 000 live births in 2011/12 to 92.5 in 2012/13. The value of 86.5 in 2010/11 was the same as the MMR from the 2010 NCCEMD data of 86.5 per 100 000 live births, confirming the relatively low maternal mortality in facilities in this district. The stillbirth in facility rate at 22.1 per 1 000 births was in line with the national rate of 21.8 per 1 000 births. The inpatient early neonatal death rate at 11.1 per 1 000 live births was the second highest provincially and above the national rate of 10.2 per 1 000 live births. It is somewhat surprising that the MMR is relatively low in this district given antenatal HIV prevalence of 39.9% (2011 survey), high TB incidence, relatively poor socio-economic status and below average health service indicators such as couple year protection rate and postnatal visits to mothers.
West Coast: DC1	53.6	31.1	22.4	The MMR in facility was 62.3 per 100 000 live births in 2012/13. The MMR from the 2008-2010 NCCEMD data varied between 20.7 and 81.6 per 100 000 live births. With the relatively small number of births each year, the ratio is likely to fluctuate year-on-year. The stillbirth in facility rate was 15.3 per 1 000 births. This was the lowest in the province and the fourth lowest nationally. Similarly, the inpatient early neonatal death rate was the lowest provincially at 4.6 per 1 000 live births. It was also the third lowest nationally.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
Overberg: DC3	55.9	0.0	55.9	According to the DHIS data, the MMR in facility was 0.0 per 100 000 live births. This can be due to no maternal deaths or that the district did not submit data. According to data from the NCCEMD, the MMR between 2008-2010 ranged from 32.2 to 69.2, among the lowest in the country. The stillbirth in facility rate increased from 12.5 per 1 000 births in 2011/12 to 15.6 per 1 000 births in 2012/13 and was the second lowest in the province. It was well below the national rate of 21.8 per 1 000 births. The inpatient early neonatal death rate increased from 5.6 per 1 000 live births to 8.4 in the same period.
Cacadu: DC10	59.6	110.2	-50.6	According to the DHIS data, the MMR in facility increased drastically from 47.1 per 100 000 live births in 2011/12 to 173.3 in 2012/13. It was the second highest in the province and well above the national ratio of 132.9 per 100 000. The MMR from the NCCEMD data varied from 32.9 to 98.0 between 2008-2010, so more data will be needed to assess the level and trend in maternal mortality for this district. The stillbirth in facility rate was also the second highest in the province at 22.9 per 1 000 births which increased from 20.3% in 2011/12. It was above the national rate of 21.8 per 1 000 births. However, at 5.0 per 1 000 live births, the inpatient early neonatal death rate was the lowest in the province and well below the national rate of 10.2 per 1 000 live births.
Namakwa: DC6	60.4	32.8	27.6	The DHIS MMR in facility reflected zero per 100 000 live births in 2012/13, a drop from 65.5 per 100 000 live births in 2011/12. This could be a reflection of incomplete data recording, however the NCCEMD data has also recorded zero maternal deaths in 2009 and an MMR of 63.4 in 2010. The stillbirth in facility rate decreased annually from 24.1 per 1 000 births in 2010/11 to 17.6 per 1 000 births. The inpatient early neonatal death rate also dropped from 15.2 per 1 000 live births to 7.7 in the same period. This district has a very small and sparse population and fluctuations in mortality rates are not surprising.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
Cape Winelands: DC2	61.1	8.4	52.7	The MMR in facility was zero per 100 000 live births in 2012/13. However, the MMR from the 2008-2010 NCCEMD data averaged 61.1 per 100 000 live births. The stillbirth in facility rate was 16.2 per 1 000 births, the sixth lowest in the country. The inpatient early neonatal death rate was 5.7 per 1 000 live births, the sixth lowest nationally and below the provincial average of 6.2 per 1 000 live births.
Umkhanyakude: DC27	91.0	82.4	8.6	According to the DHIS data, the MMR in facility increased from 68.1 per 100 000 live births in 2011/12 to 96.7 in 2012/13. The MMR from the 2010 NCCEMD data of 121.2 per 100 000 live births was of similar magnitude to the DHIS ratio of 128.3 in 2010/11. The stillbirth in facility rate at 18.2 per 1 000 births increased from 16.6 in 2011/12 but was below the national rate of 21.8 per 1 000 births. The inpatient early neonatal death rate at 5.7 per 1 000 live births was the second lowest provincially and well below the national rate of 10.2 per 1 000 live births. These mortality rates are surprisingly low for a district with one of the highest HIV prevalences and greater than average TB incidence.
Cape Town: CPT	94.5	18.5	76.0	The MMR in facility was 30.7 in 2011/12 dropping to 6.4 per 100 000 live births in 2012/13. However, the MMR from the 2010 NCCEMD data was 92.8 per 100 000 live births, indicating that SINJANI data (that was imported into the DHIS) may be under-reporting maternal deaths in Cape Town. The stillbirth in facility rate was 17.5 per 1 000 births and the inpatient early neonatal death rate 5.9 per 1 000 live births.
Umzinyathi: DC24	115.0	65.5	49.5	According to the DHIS data, the DHIS MMR in facility decreased from 141.2 in 2009/10 to only 34.7 in 2012/13, the lowest in the province. The MMR from the 2008-2010 NCCEMD data was relatively similar to the DHIS data for the corresponding period, and it will be interesting to see if the continued decline is corroborated when more recent data are released. The stillbirth in facility rate at 18.0 per 1 000 births was the lowest provincially. The inpatient early neonatal death rate was 7.5 per 1 000 live births, below the provincial and national averages.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
Eden: DC4	120.9	36.1	84.7	The DHIS MMR in facility was 11.9 per 100 000 live births in 2012/13, a decrease from 60.4 per 100 000 live births in 2011/12, and about 10 times lower than the MMR estimated from the NCCEMD data. The data need verification, although some fluctuation is expected since the number of births is fairly small in this district. The stillbirth in facility rate decreased from 21.5 per 1 000 births in 2011/12 to 19.5 per 1 000 births. The inpatient early neonatal death rate increased from 7.0 per 1 000 live births to 8.1 in the same period.
Johannesburg: JHB	128.9	64.9	64.0	The MMR recorded by the DHIS dropped by 6.2 percentage points in 2012/13 to 61.8 per 100 000 live births, the second lowest in the province. This rate may reflect incomplete recording of maternal deaths, since the MMR estimated from NCCEMD data was double this value at 126.9 per 100 000 in 2010. The stillbirth in facility rate increased from 18.5 per 1 000 live births in 2011/12 to 19.0 per 1 000. The inpatient early neonatal death rate remained stable in 2012/13 at 10 per 1 000 live births.
Tshwane: TSH	129.4	78.8	50.6	The MMR in facility recorded by the DHIS was 62 per 100 000 live births in 2012/13, a decrease from 95.5 per 100 000 live births in 2011/12 and lower than the provincial ratio of 116.5 per 100 000 live births. The value was lower than the MMR from the 2010 NCCEMD data of 148.0 per 100 000 live births. The stillbirth rate of 21.1 per 1 000 births was slightly higher than the provincial rate of 19.9 per 1 000 births. The inpatient early neonatal death rate dropped from 9.6 to 6.5 per 1 000 live births in 2012/13 which was the second lowest in the province and below the provincial rate of 8.8 per 1 000 live births.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
A Nzo: DC44	131.1	104.6	26.4	The MMR in facility recorded in the DHIS decreased from 153.7 per 100 000 live births in 2011/12 to 55.5 in 2012/13. The ratio varied between 103.5 and 153.7 per 100 000 live births over the previous four years and the decrease to 55.5 should be verified. It seems unlikely that the level of mortality would be so consistently low in such a deprived district with many poor health service indicators. The stillbirth in facility rate increased slightly from 17.3 per 1 000 births in 2011/12 to 18.1 in 2012/13 – below the national average of 21.8 per 1 000 births. The inpatient early neonatal death rate of 10.9 per 1 000 live births was just above the national average of 10.2 per 1 000 live births.
Amathole: DC12	132.4	58.1	74.4	According to the DHIS data, the MMR in facility decreased from 97.5 per 100 000 live births in 2011/12 to 18.6 and it was the lowest in the province and 8th lowest nationally. This rate seems implausible, since the MMR based on NCCEMD data ranged from 98.2-160.2 from 2008-2010. However this difference may be due to incorrect redistribution of maternal deaths from the old Amathole district which incorporated Buffalo City to the new district boundaries. It is also possible that complicated deliveries from Amathole are referred to the provincial hospital in Buffalo City. The stillbirth in facility rate was 18.2 per 1 000 births. It was below the national rate of 21.8 per 1 000 births. At 10.7 per 1 000 live births, the inpatient early neonatal death rate was above the national rate of 10.2 but below the provincial rate of 16.4 per 1 000 live births.
West Rand: DC48	141.8	94.9	46.9	The MMR in facility was also the lowest provincially at 60.1 per 100 000 live births in 2012/13, a decrease from 95.5 in 2011/12. It was also much lower than the 2010 MMR from the NCCEMD data of 184.3 per 100 000 live births. The stillbirth in facility rate decreased from 17.5 per 1 000 births in 2011/12 to 14.2 in 2012/13, lower than both the provincial average of 19.9 per 1 000 births and the national average of 21.8. At 5.1 per 1 000 live births, the inpatient early neonatal death rate was the lowest in the province and much lower than the national rate of 10.2 per 1 000 live births.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
RS Mompati: DC39	148.1	133.1	15.0	The MMR in facility recorded in the DHIS reflected an increase from 123.3 per 100 000 live births in 2011/12 to 142.9 per 100 000 live births in 2012/13. It was above the national ratio of 132.9 per 100 000, although the average both years was slightly below the national ratio. These rates are slightly lower than those recorded by NCCEMD (180.3 for 2010). The stillbirth rate was 23.3 per 1 000 births and the inpatient early neonatal death rate 8.0 per 1 000 live births.
Zululand: DC26	149.5	131.9	17.6	The MMR in facility recorded by DHIS dropped substantially from 152.2 per 100 000 births in 2011/12 to 111.6 in 2012/13, lower than the provincial average of 165.5 but higher than the national average of 132.9. It was within the same range as the MMR from the 2010 NCCEMD data of 126.3 per 100 000 live births. The stillbirth rate rose from 18.8 per 1 000 births in 2011/12 to 21.4. The inpatient early neonatal death rate of 7.9 per 1 000 live births was higher than the provincial average of 8.7 per 1 000 live births, although the rate has fluctuated so widely it is difficult to interpret.
Joe Gqabi: DC14	156.3	130.6	25.7	According to the DHIS data, the MMR in facility increased from 121.0 per 100 000 live births in 2011/12 to 140.3. It was above the national ratio of 132.9 although the 2-year average was slightly below the national ratio. The MMR calculated from the NCCEMD was exactly the same as the DHIS ratio for 2009/10 and 2010/11. The stillbirth in facility rate was the second lowest in the province at 17.6 per 1 000 births and the long term trends suggests that it is declining. The inpatient early neonatal death rate was 10.0 per 1 000 live births.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
N Mandela Bay: NMA	164.2	121.7	42.4	According to the DHIS data, the MMR in facility increased from 117.5 per 100 000 live births in 2011/12 to 126.0. However, it was below the national ratio of 132.9 per 100 000. The MMR from the NCCEMD data was 180.5 in 2010 indicating that DHIS may be underreporting maternal deaths in this district to some extent The stillbirth in facility rate was the lowest in the province at 16.8 per 1 000 births. It was below the national rate of 21.8 per 1 000 births. At 27.7 per 1 000 live births, the inpatient early neonatal death rate was the highest provincially and well above the national rate of 10.2 per 1 000 live births. This high ENDR is an outlier, since usually the MMR, stillbirth rate and ENDR are positively correlated.
Gr Sekhukhune: DC47	175.6	125.1	50.4	The MMR in facility recorded by DHIS was 151.5 per 100 000 births, having increased substantially since 2011/12. The 2010 NCCEMD data reflected a somewhat higher MMR of 183.4 per 100 000 live births. The stillbirth in facility rate was 23.6 per 1 000 births and the inpatient early neonatal death rate 9.8 per 1 000 live births.
2. Medium MMR – MMR below the NCCEMD average but higher than the DHIS average				
Vhembe: DC34	71.9	148.0	-76.1	The MMR in facility recorded by DHIS was 146.3 per 100 000 births in 2012/13. This district is unusual in that the MMR estimated from the NCCEMD data is lower than the DHIS ratio at between 65.3-78.7 over the period 2008-2010. The stillbirth in facility rate at 16.7 per 1 000 births was the lowest in the province and the inpatient early neonatal death rate was also the lowest at 8.8 per 1 000 live births.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
C Hani: DC13	101.7	140.6	-38.9	According to the DHIS data, the MMR in facility increased from 118.8 per 100 000 live births to 162.3 in 2012/13. These ratios are somewhat higher than the MMR calculated from the NCCEMD data. The stillbirth in facility rate was 20.5 per 1 000 births. It was slightly below the national rate of 21.8 per 1 000 births. At 10.2 per 1 000 live births, the inpatient early neonatal death rate was on par with the national rate of 10.2 per 1 000 live births.
Amajuba: DC25	137.6	149.0	-11.4	According to the DHIS data, the DHIS MMR in facility decreased from 173.4 per 100 000 live births in 2011/12 to 124.6. It was, however, much higher than the MMR from the 2010 NCCEMD data of 36.7 per 100 000 live births, although the 2010 value appears to be an outlier if compared to the previous years. The stillbirth in facility rate was 25.9 per 1 000 births, the third highest provincially. At 2.9 per 1 000 live births, the inpatient early neonatal death rate was the lowest in the country. This seems implausible given the relatively high stillbirth rate, and should be investigated.
Mopani: DC33	147.5	142.9	4.6	The MMR in facility recorded by DHIS was 134.8 per 100 000 births, the lowest in the province and in line with the national average of 132.9 per 100 000 live births. The 2010 NCCEMD data reflected an MMR of 121.1 per 100 000 live births. The stillbirth in facility rate at 21.1 per 1000 births was the second highest in the province and the inpatient early neonatal death rate was 11.1 per 1 000 live births.
Sedibeng: DC42	150.6	177.6	-27.0	Sedibeng has the second highest MMR in facility in the province at 195.0 per 100 000 live births in 2012/13, an increase from 160.3 in 2011/12 and higher than the national rate of 132.9 per 100 000 live births (as per DHIS data). The 2010 MMR from the NCCEMD data was 196.1 per 100 000 live births, roughly comparable with the DHIS estimates. The stillbirth in facility rate decreased from 25.7 per 1 000 births in 2011/12 to 20.2 in 2012/13, similar to the provincial average of 19.9 per 1 000 births and lower than the national average of 21.8. The inpatient early neonatal death rate was 9.5 per 1 000 live births, but appears to be increasing when considering long term trends.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
Nkangala: DC31	170.8	189.1	-18.2	The MMR in facility (DHIS data) was 174.5 per 100 000 births in 2012/13, down from a high of 203.6 per 100 000 live births the year before, but above the national average of 132.9 per 100 000 births. The MMR from the 2010 NCCEMD data was 215.7 per 100 000 live births, indicating reasonable correlation between the two data sources. The stillbirth in facility rate was 28.1 per 1 000 births, the fifth highest in the country. The inpatient early neonatal death rate at 9.5 deaths per 1 000 live births was below the national average of 10.2.
Ehlanzeni: DC32	171.9	147.9	24.0	The MMR in facility increased from 124.8 per 100 000 live births to 170.9 in 2012/13. The MMR from the 2010 NCCEMD data was 174.7 per 100 000 live births, thus it would appear that the rates are comparable between the two sources for this district. The stillbirth in facility rate increased from 20.8 per 1 000 births in 2011/12 to 21.8 per 1 000 births in 2012/13; similar to the national average and it was the lowest rate in the province. Inpatient early neonatal death rate, however, decreased from 10.0 per 1 000 live births to 9.2 in the same period and was below the national average of 10.2 per 1 000 live births.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
3. Probably high MMR – MMR above the NCCEMD average but below the DHIS average, however in most cases the low values unexpected or there are possible data completeness problems				
iLembe: DC29	180.4	104.0	76.4	According to the DHIS data, the MMR in facility decreased from 112.5 per 100 000 live births in 2011/12 to 95.5. It was the third lowest provincially and well below the national ratio of 132.9 per 100 000. The MMR calculated from NCCEMD data ranged from 156.4 to 193.5 between 2008-2010, indicating that maternal deaths may be under-reported in DHIS. The stillbirth in facility rate was 21.8 per 1 000 births and the inpatient early neonatal death rate 9.3 per 1 000 live births.
Central Karoo: DC5	185.2	0.0	185.2	According to the DHIS data, the MMR in facility was 0.0 per 100 000 live births in 2012/13. This can be due to no maternal deaths or that the district did not submit data. The MMR calculated from the NCCEMD data for 2009 and 2010 appears disproportionally large at 182.3 and 389.5, however due to the small number of births in the district, these represent 2 and 4 maternal deaths respectively. The stillbirth in facility rate increased from 16.3 per 1 000 births in 2011/12 to 33.5 per 1 000 births and was the highest in the province. It was also well above the national rate of 21.8%. The inpatient early neonatal death rate increased from 11.1 per 1 000 live births to 13.1 in the same period. Mortality rates tend to fluctuate widely in this district due to small numbers, making trends difficult to discern.
Siyanda: DC8	201.8	80.9	120.9	The MMR in facility was 24.3 per 100 000 live births in 2012/13 and much lower than the national ratio of 132.9. It was, however, much lower than the MMR from the 2010 NCCEMD data of 192.1 per 100 000 live births. The stillbirth in facility rate increased over two years from 21.0 per 1 000 births in 2010/11 to 27.9 in 2011/12. The inpatient early neonatal death rate decreased from 13.2 per 1 000 live births in 2011/12 to 8.0 per 1 000 in 2012/13, and there has been a downward trend over 10 years, despite some year-on-year fluctuations.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
G Sibande: DC30	222.9	132.0	90.9	The MMR in facility (based on DHIS data) increased from 76.4 per 100 000 live births in 2011/12 to 187.6 in 2012/13, well above the national average of 132.9. The MMR from the 2010 NCCEMD data was 295.8 per 100 000 live births, suggesting some under-reporting in DHIS. The stillbirth in facility rate increased slightly from 23.1 per 1 000 births in 2011/12 to 25.2 per 1 000 births in 2012/13 and was above the national average of 21.8. The inpatient early neonatal death rate was 10.3 per 1 000 live births in 2012/13. It was on par with the national average of 10.2 per 1 000 live births. A high MMR is consistent with the very high HIV prevalence in G Sibande.
Pixley ka Seme: DC7	251.4	33.3	218.1	The MMR in facility was 31.9 per 100 000 live births and much lower than the national ratio of 132.9. It was, however, much lower than the MMR from the 2010 NCCEMD data of 189.7 per 100 000 live births suggesting incomplete recording of maternal deaths in DHIS. The stillbirth in facility rate decreased from 21.4 per 1 000 births in 2011/12 to 13.2 in 2012/13. The inpatient early neonatal death rate has shown a drastic decrease from 19.4 per 1 000 live births in 2011/12 to 10.9 per 1 000 in 2012/13, although with relatively small numbers, it has fluctuated in a similar way over the past 10 years, making it difficult to discern any real trend.
Fezile Dabi: DC20	284.6	107.6	177.0	The MMR in facility recorded in the DHIS appears to be quite variable and has ranged from 256.7 in 2010/11 to 90.0 per 100 000 live births in 2011/12 and was 125.2 per 100 000 live births in 2012/13. The MMR in facility based on the NCCEMD data has been above 260 from 2008-2010, indicating a substantial challenge still remains in maternal health. It will be important to validate data quality and monitor trends as more recent data become available. The stillbirth in facility rate reduced slightly from 28.5 per 1 000 births in 2011/12 to 26.3 per 1 000 births, but has remained substantially above the national average, in common with most Free State districts. Also of concern, the inpatient early neonatal death rate was 13.5 per 1 000 live births, which is higher than both the provincial and national averages of 10.8 and 10.2 per 1 000 live births respectively, although there are signs of a recent decline.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
Xhariep: DC16	287.4	46.6	240.8	The MMR in facility reflected in DHIS was 0.0 per 100 000 live births in 2012/13, although DHIS and NCCEMD ratios for previous years have given rates above 200 and up to 581, indicating that maternal and newborn safety is poor, but not reliably measured using only routine indicators that only record events in facilities. The stillbirth in facility rate was 14.6 per 1 000 births, the lowest in the province and has been for the past 10 years. The inpatient early neonatal death rate follows the same pattern as the stillbirth in facility rate; having dropped gradually from 10.4 per 1 000 live births in 2002/03 to 3.7 in 2012/13. Very few deliveries and births take place in facilities in this district, making facility-based mortality rates extremely difficult to interpret. Given the large size of the district, it does suggest inadequate service provision for the population.
OR Tambo: DC15	317.2	78.6	238.6	The MMR in facility recorded in the DHIS decreased from 88.8 per 100 000 live births in 2011/12 to 68.5 in 2012/13. However, the DHIS values are so much lower than the MMR based on NCCEMD data, which ranged from 283.1-352.1 between 2008-2010 that they are almost certainly under-reported in the DHIS. Several other health service indicators are poor and other health outcomes are amongst the worst in the country, making it highly unlikely that maternal mortality is low in this district. The stillbirth in facility rate was 28.4 per 1 000 births, the second highest nationally. It has been the highest in the province for the past six years. The inpatient early neonatal death rate of 20.3 per 1 000 live births is the second highest in the country and the highest amongst the NHI districts. Socio-economic conditions are poor, OR Tambo has one of the highest proportion of deliveries to women under 18 years, with low couple year protection rates and postnatal visits to mothers. One reason OR Tambo may have higher ratios than surrounding districts is that is has a regional and provincial tertiary hospital, which may be receiving high risk cases from neighbouring areas.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
4. High MMR – MMR above average for both data sources.				
Dr K Kaunda: DC40	181.4	240.2	-58.8	The MMR in facility recorded in the DHIS was 222.3 per 100 000 live births in 2012/13, the highest in the province. The MMR in DHIS appears to be comparable to the estimates based on NCCEMD data. The stillbirth in facility rate decreased over the past four years from 26.8 per 1 000 births to 21.9 per 1 000 births and was the lowest in the North West Province. The inpatient early neonatal death rate was 14.0 per 1 000 live births. It was above the national average of 10.2 per 1 000 live births and also the highest in the province as well as the second highest amongst the NHI districts.
Ekurhuleni: EKU	188.3	210.3	-22.0	The MMR in facility was 218.7 per 100 000 live births in 2012/13, an increase from 202.0 in 2011/12 and higher than the national rate of 132.9 per 100 000 live births (as per DHIS data). The 2010 MMR from the NCCEMD data of 151.1 per 100 000 live births was much lower than the 2012/13 MMR in facility (DHIS data). This is one of few districts where the DHIS MMR seems to be slightly higher than NCCEMD estimates. The possible increase in rate should be monitored carefully. Ekurhuleni had the highest stillbirth in facility rate, inpatient early neonatal death rate, and MMR in facility in the province. The stillbirth in facility rate at was 21.4 per 1 000 births. The inpatient early neonatal death rate was 10.1 per 1 000 live births.
Waterberg: DC36	190.0	153.3	36.7	The MMR in facility recorded by DHIS was 156.6 per 100 000 births in 2012/13 which was much higher than the national average of 132.9 per 100 000 live births. The 2010 NCCEMD reflected an MMR of 216.0 per 100 000 live births, suggesting some under-reporting of maternal deaths by DHIS in this district. The stillbirth in facility rate was 22.5 per 1 000 births and the inpatient early neonatal death rate 10.1 per 1 000 live births.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
NM Molema: DC38	195.6	170.6	25.0	According to the DHIS data, the MMR in facility was 141.4 per 100 000 live births in 2012/13 and it was the lowest in the province. The MMR calculated from NCCEMD data was somewhat higher in 2010 and 375.2 in 2009, thus indicating some uncertainty around the level and trend of maternal mortality in this district. The stillbirth in facility rate remained stable at 24.3 per 1 000 births and was the highest in the province. It was also above the national rate of 21.8 per 1 000 births. The inpatient early neonatal death rate decreased from 12.0 per 1 000 live births in 2011/12 to 10.5.
eThekwini: ETH	222.2	213.2	9.0	According to the DHIS data, the DHIS MMR in facility decreased from 251.6 per 100 000 live births in 2011/12 to 174.8 in 2012/13. However, it was still above the national ratio of 132.9 per 100 000. The MMR based on data from the NCCEMD was somewhat higher at 293.4 in 2010. On average the MMR from the two sources is very similar. eThekwini is the district with the largest number of maternal deaths (over 100 each year on average). The stillbirth in facility rate was 22.9 per 1 000 births. At 9.6 per 1 000 live births, the inpatient early neonatal death rate increased from 8.8 per 1 000 live births and it was above the national rate of 10.2.
Uthukela: DC23	223.7	177.4	46.3	The MMR in facility (DHIS data) has fluctuated between 105.4 per 100 000 live births in 2008/09 and 221.9 in 2012/13. It was the third highest in the province. The value was comparable with the MMR from the 2008-2010 NCCEMD data of 164.6-241.9 per 100 000 live births. The stillbirth rate was 24.4 per 1 000 births and slightly above the national rate of 21.8 per 1 000 births. The inpatient early neonatal death rate is at 6.6 per 1 000 live births was the third lowest provincially and below the national rate of 10.2 per 1 000 live births.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
uMgungundlovu: DC22	231.4	236.5	-5.0	According to the DHIS data, the MMR in facility increased from 193.5 per 100 000 live births in 2011/12 to 279.4 in 2012/13 and was the second highest nationally. It was comparable to the MMR from the 2010 NCCEMD data of 278.6 per 100 000 live births. The stillbirth in facility rate at 27.6 per 1 000 births was the second highest provincially. The inpatient early neonatal death rate was 9.1 per 1 000 live births.
Buffalo City: BUF	256.6	180.5	76.1	According to the DHIS data, the MMR in facility increased from 164.2 per 100 000 live births in 2011/12 to 196.9 and was the highest in the province. However, the DHIS value for 2010/11 of 204.5 was markedly less than the 2010 MMR from the NCCEMD data of 326.1 per 100 000 live births, indicating that reporting of maternal deaths in DHIS may be incomplete for this district. The stillbirth in facility rate was 22.1 per 1 000 births. It was just above the national rate of 21.8 per 1 000 births. At 14.0 per 1 000 live births, the inpatient early neonatal death rate was below the national rate of 10.2.per 1 000 live births.
JT Gaetsewe: DC45	265.1	225.9	39.2	The MMR in facility was the highest provincially at 260.5 per 100 000 live births and much higher than the national ratio of 132.9. It was, however, much lower than the MMR from the 2010 NCCEMD data of 435.3 per 100 000 live births, although the NCCEMD estimates for 2008-2010 have varied widely, indicating uncertainty about the true level of maternal risk in this district. On average the MMR is over 200 from both sources. The stillbirth in facility rate was the highest in the province at 28.4 per 1 000 births. The inpatient early neonatal death rate increased from 5.0 per 1 000 live births in 2011/12 to 8.2 per 1 000 in 2012/13, but variations over the past 10 years make trends difficult to discern, and data quality may be a problem given how low the rate is in comparison to the stillbirth rate.

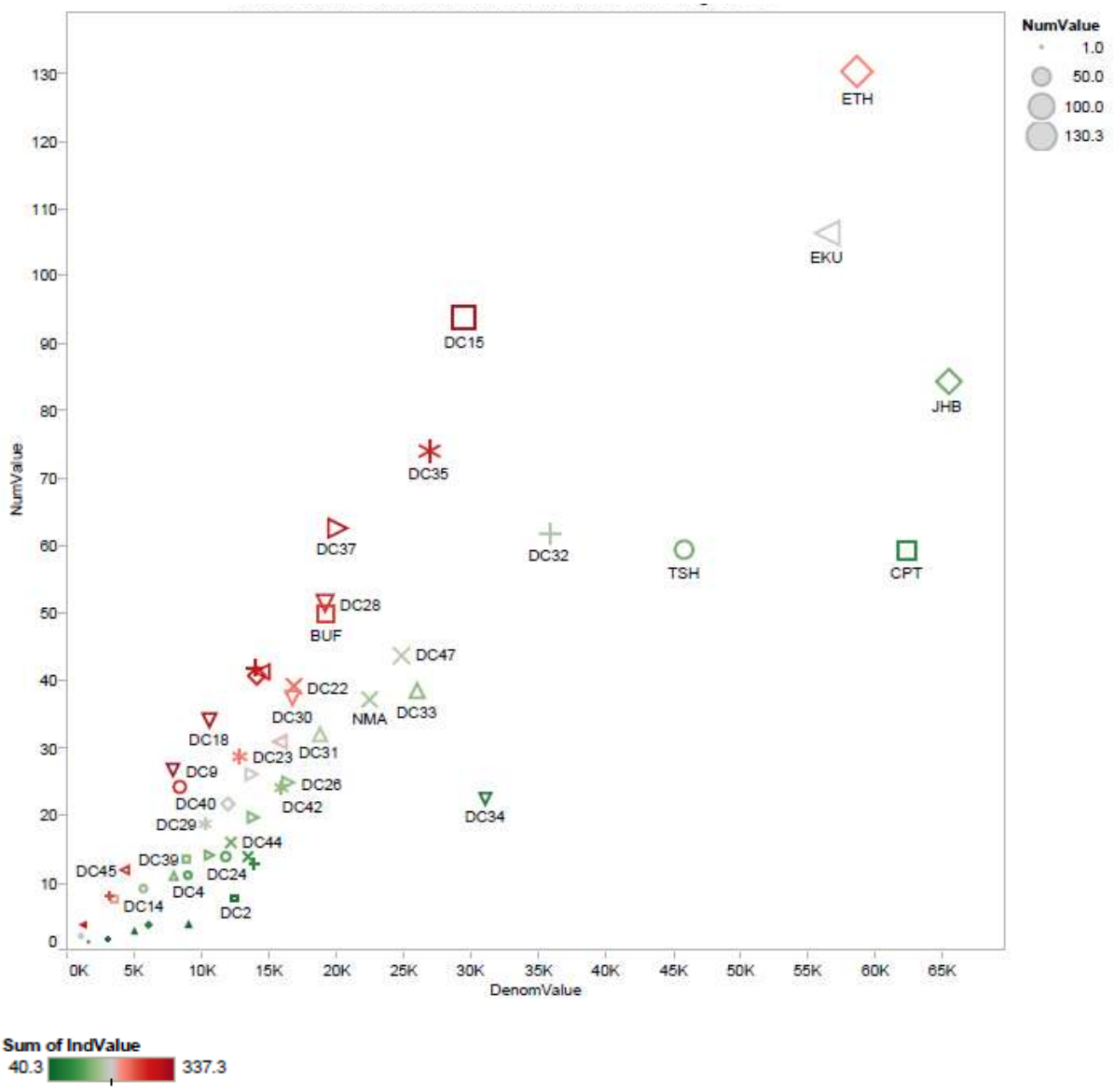
District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
Uthungulu: DC28	267.3	299.5	-32.1	The MMR in facility (DHIS data) decreased from 332.5 per 100 000 live births in 2011/12 to 266.5 but was the third highest ratio in the country in 2012/13. The MMR calculated from the 2008-2010 NCCEMD data ranged from 189.8 to 309.6 per 100 000 live births. The stillbirth in facility rate increased from 26.4 per 1 000 births in 2011/12 to 28.4 in 2012/13. It was the highest in KZN and higher than the national rate of 21.8 per 1 000 births. The inpatient early neonatal death rate at 12.1 per 1 000 live births was highest rate in the province and above the national rate of 10.2 per 1 000 live births.
Capricorn: DC35	274.8	323.2	-48.4	The MMR in facility recorded by DHIS was 292.2 per 100 000 births which was much higher than the national average of 132.9 per 100 000 live births and the highest in the country. The MMR in district hospitals is similar across the province, but the MMR in the Pietersburg tertiary hospital is the main driver of the very high rate in Capricorn. The 2010 NCCEMD reflected an MMR of 251.3 per 100 000 live births. The stillbirth in facility rate at 26.3 per 1 000 births was the highest in the province and the inpatient early neonatal death rate was also the highest at 17.5 per 1 000 live births.
Mangaung: MAN	285.6	145.4	140.2	The MMR in facility recorded in the DHIS was 103.3 per 100 000 live births and well below the national average of 132.9. It is the lowest rate since 2007/08. The NCCEMD estimates for MMR in facilities are somewhat higher than DHIS for comparable time periods, but indicate reasonable data completeness and also suggest a promising downward trend. Thus the difference between the sources may be due to improvement in maternal care over the intervening time period, which appears to be supported by specific interventions undertaken in the Free State.[4] The stillbirth in facility rate increased over two consecutive years from 24.9 per 1 000 births in 2009/10 to 30.5 in 2011/12 and dropped to 24.4 per 1 000 births in 2012/13. The inpatient early neonatal death rate also increased annually from 2009/10 when it was 8.5 per 1 000 live births to 10.8 per 1 000 live births in 2011/12 and then decreased to 7.5 per 1 000 live births in 2012/13.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
T Mofutsanyane: DC19	286.9	210.5	76.4	The MMR in facility recorded in the DHIS decreased annually from 352.9 per 100 000 live births in 2009/10 to 157.5 per 100 000 live births in 2012/13. However, it was still the second highest among the districts in the province and well above the national ratio of 132.9. The MMR based on NCCEMD data was very similar, suggesting that maternal deaths are accurately recorded in DHIS for this indicator. Stillbirth in facility rate decreased annually from 33.9 per 1 000 births in 2009/10 to 24.7 in 2012/13. The inpatient early neonatal death rate increased from 8.4 per 1 000 live births in 2011/12 to 12.3 which was slightly higher than the provincial and national rates of 10.8 and 10.2 per 1 000 live births respectively.
Ugu: DC21	301.7	166.9	134.8	According to the DHIS data, the MMR in facility decreased from 276.4 per 100 000 live births in 2010/11 to 155.9 in 2012/13. The value in 2010/11 was slightly lower than the MMR from the 2010 NCCEMD data of 290.9 per 100 000 live births. There are no obvious data errors, so hopefully this decline will be verified when new NCCEMD data are released. The stillbirth in facility rate remained stable at 23.5 per 1 000 births and was above the national rate of 21.8 per 1 000 births. The inpatient early neonatal death rate was 8.3 per 1 000 live births and below the national rate of 10.2 per 1 000 live births.
Bojanala: DC37	311.5	168.3	143.2	The MMR in facility recorded in the DHIS reflected a slight decrease from 172.4 per 100 000 live births in 2011/12 to 164.1 per 100 000 live births in 2012/13 but was still well above the national average of 132.9. The NCCEMD estimate of 280.6 for 2010 suggests that maternal deaths for the district are under-recorded in DHIS. The stillbirth rate was 24.0 per 1 000 births and the inpatient early neonatal death rate 9.4 per 1 000 live births.

District	NCCEMD 2008-10 (SA: 179.2)	DHIS 2011_13 (SA: 138.9)	Diff (NCCEMD-DHIS)	Comment
Lejweleputswa: DC18	320.0	191.3	128.7	The MMR in facility recorded in the DHIS at 159.2 per 100 000 live births decreased from 223.5 per 100 000 in 2011/12. It was, however, still higher than the provincial ratio of 132.7 and the national ratio of 132.9 per 100 000 live births. The MMR in DHIS is around one third lower than reflected in the NCCMED data (ranging from 202.4-452.4 in 2008-2010), so is probably under-reported unless there has been a dramatic improvement in maternal care. The stillbirth in facility rate decreased from 33.3% in 2011/12 to 26.7% in 2012/13; however, it was the highest in the province and above the national average of 21.8%. Although the inpatient early neonatal death rate has decreased from 15.3 per 1 000 live births, it is above both the provincial and national averages that are at 10.8 and 10.2 per 1 000 live births respectively and it is the eleventh highest in the country.
Frances Baard: DC9	337.3	194.8	142.5	The MMR in facility was 204.1 per 100 000 live births and much higher than the national ratio of 132.9. It was in line with the MMR from the 2010 NCCEMD data of 225.9 per 100 000 live births. There might be a possible link between the relatively low delivery by caesarean section rate and the relatively high MMR and needs investigation. The stillbirth in facility rate was 28.1 per 1 000 births and the inpatient early neonatal death rate 16.1 per 1 000 live births. The latter was the highest provincially and has climbed steadily from 6.1 in 2007/08.

While the focus of this document is on the MMR by district, it is worth considering the actual number of maternal deaths and live births as well as the ratio itself in focussing efforts to reduce the overall MMR for the country, since the districts have vastly different population sizes and numbers of births each year. This scatterplot illustrates that the metro areas tend to have the highest number of live births and among the highest number of maternal deaths. eThekwini had on average 130 maternal deaths each year based on the NCCEMD data between 2008-2010. In contrast, the number of maternal deaths in the sparsely populated Northern Cape and the Western Cape districts (except for Frances Baard and the Cape Town metro) was under 15 per year.

Figure 3: Scatterplot of number of maternal deaths (numerator) versus live births (denominator), NCCEMD 2008-2010 average



Note: The size of the shape is proportional to the average number of maternal deaths per year.
The shapes are coloured from lowest (green) to highest (red) MMR in facility.

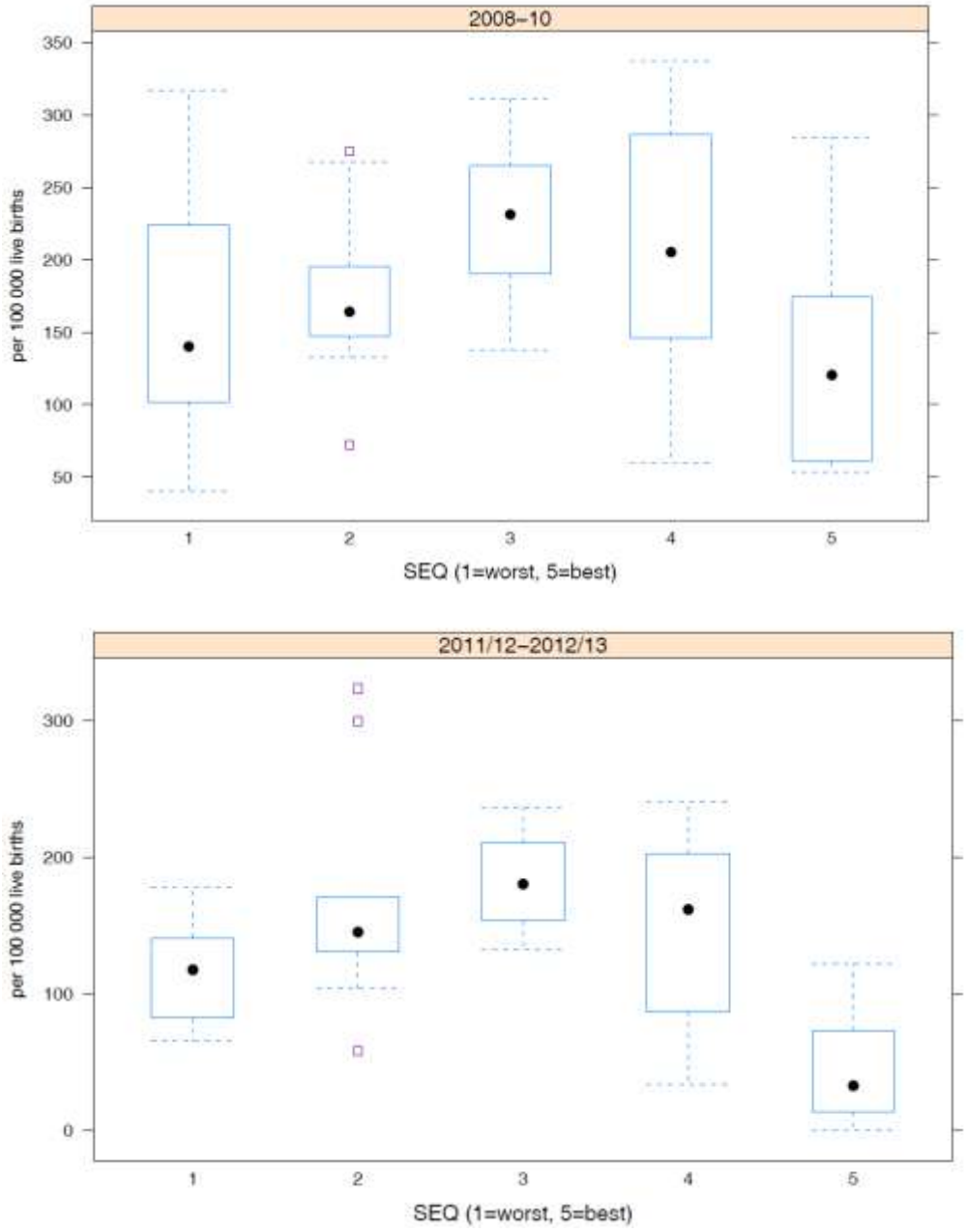
4. Maternal Mortality by socio-economic status

Although it might be expected that the MMR would be lowest in the least deprived areas and worst in most deprived areas, in fact the distribution of MMRs by district according to district-level socio-economic quintile (SEQ) indicates that the highest median MMR is in districts in SEQ 3, decreasing in both SEQ 1 (poorest quintile) and SEQ 5 (wealthiest quintile). Wabiri et al. analysed the third South African HIV Prevalence, Incidence, Behaviour and Communication Survey to examine inequalities in maternal health care service access and outcomes.[5] They found that

> aside from early antenatal attendance at antenatal clinic and deficiencies in overall access in some provinces and rural formal areas, inequalities in the utilisation of maternal health services were mostly small. Several measures were even higher amongst the poorest quintile.

The following graphs plot the values of the indicator for each district according to socio-economic quintiles. The black dot represents the median of the values for districts in the quintile. The box is drawn between the first and third quartiles of the values. The horizontal lines (the 'whiskers') extend to at most 1.5 times the box width (the interquartile range) from either or both ends of the box. They must end at an observed value. Any value more than 1.5 times the interquartile range is considered an outlier and is shown by a small rectangle.

Figure 4: Box-and-whisker plots of MMR in facility by SEQ, 2008-10 (NCCEMD) and 2011/12-2012/13 (DHIS)



5. Provincial overview of Maternal Mortality

This document has focussed on the use of routine data for assessment of MMR at the district level. However, it is useful to show an example of how specific provincial interventions have produced measurable results that have been published, and that correspond with changes observed in routine data. The Free State, a province that has had one of the highest MMRs, identified inter-facility transport as a problem in maternity services and implemented staffed maternity inter-facility transport in December 2011.[4] Maternal mortality, stillbirths and neonatal mortality declined following implementation.

Figure 5: Relationship between inter-facility vehicles dispatched within 1 hour and maternal mortality (arrow indicates when vehicles were issued)[4]

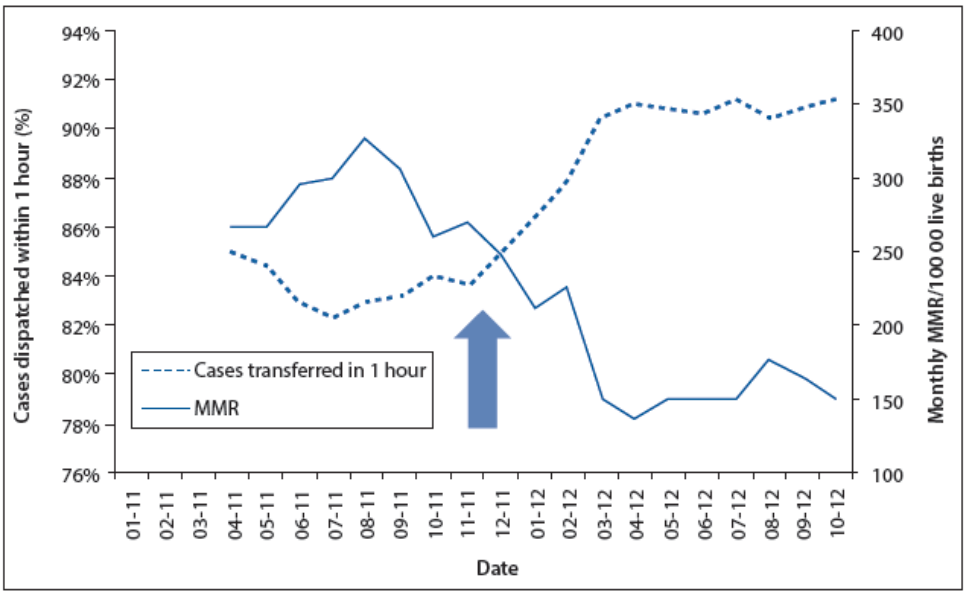


Figure 6: Box-and-whisker plot of maternal mortality in facility ratio (DHIS), district values by province

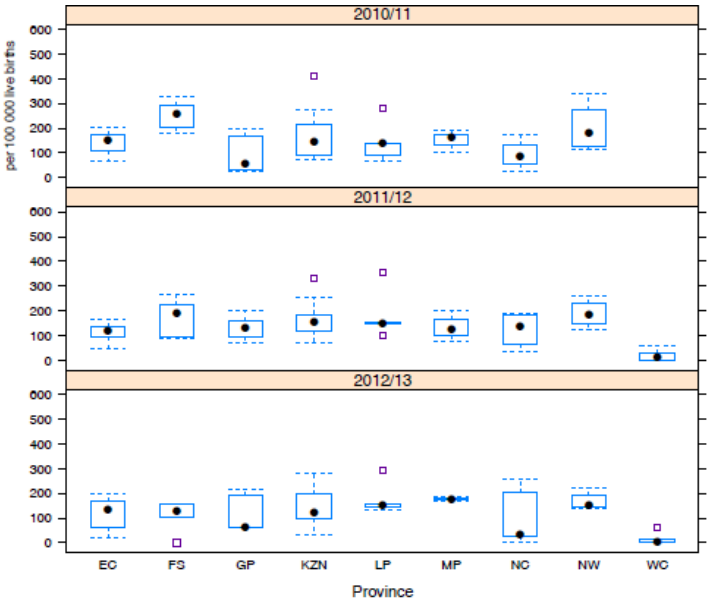
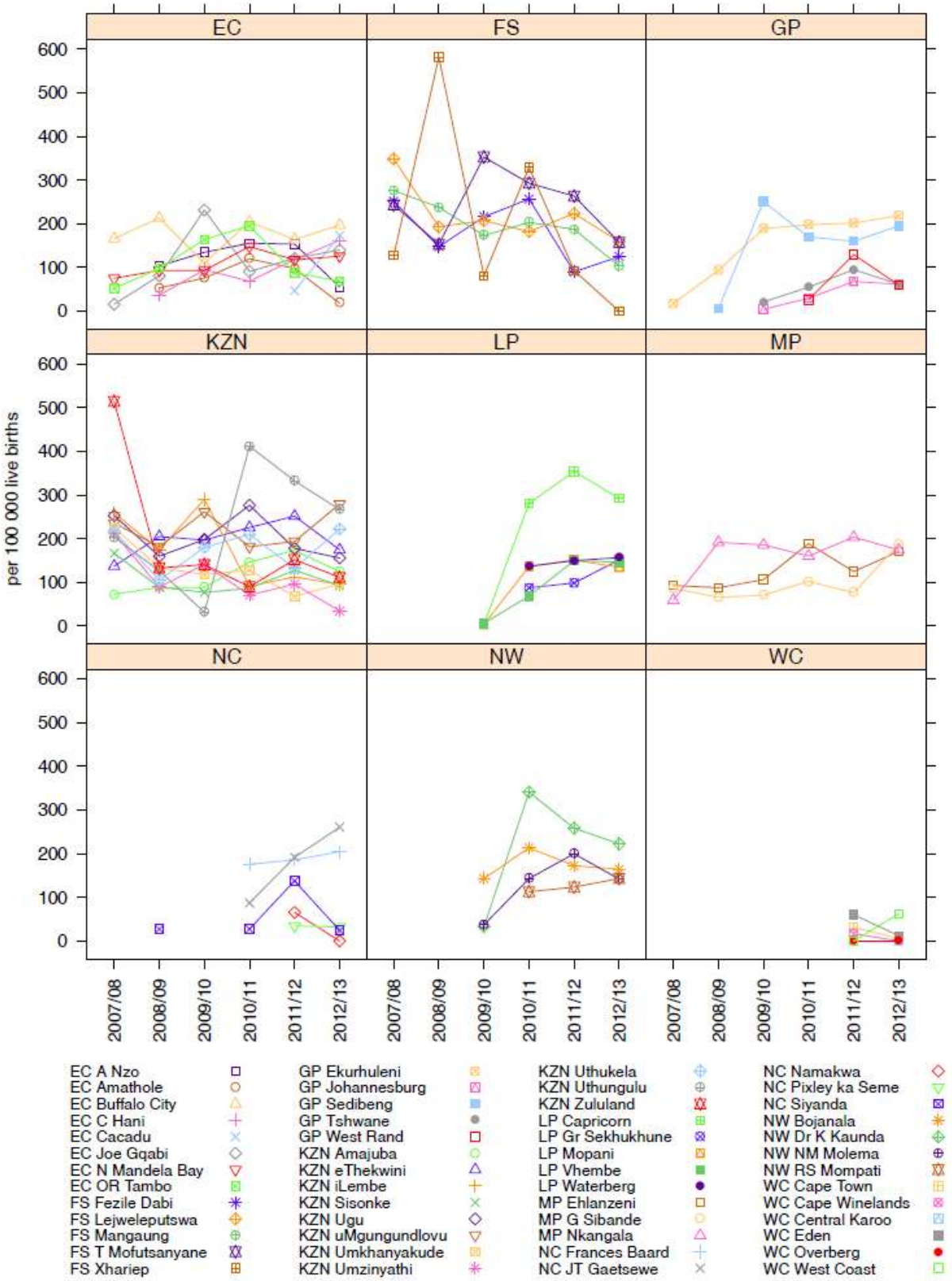


Figure 7: Annual trends: Maternal mortality in facility ratio (DHIS)

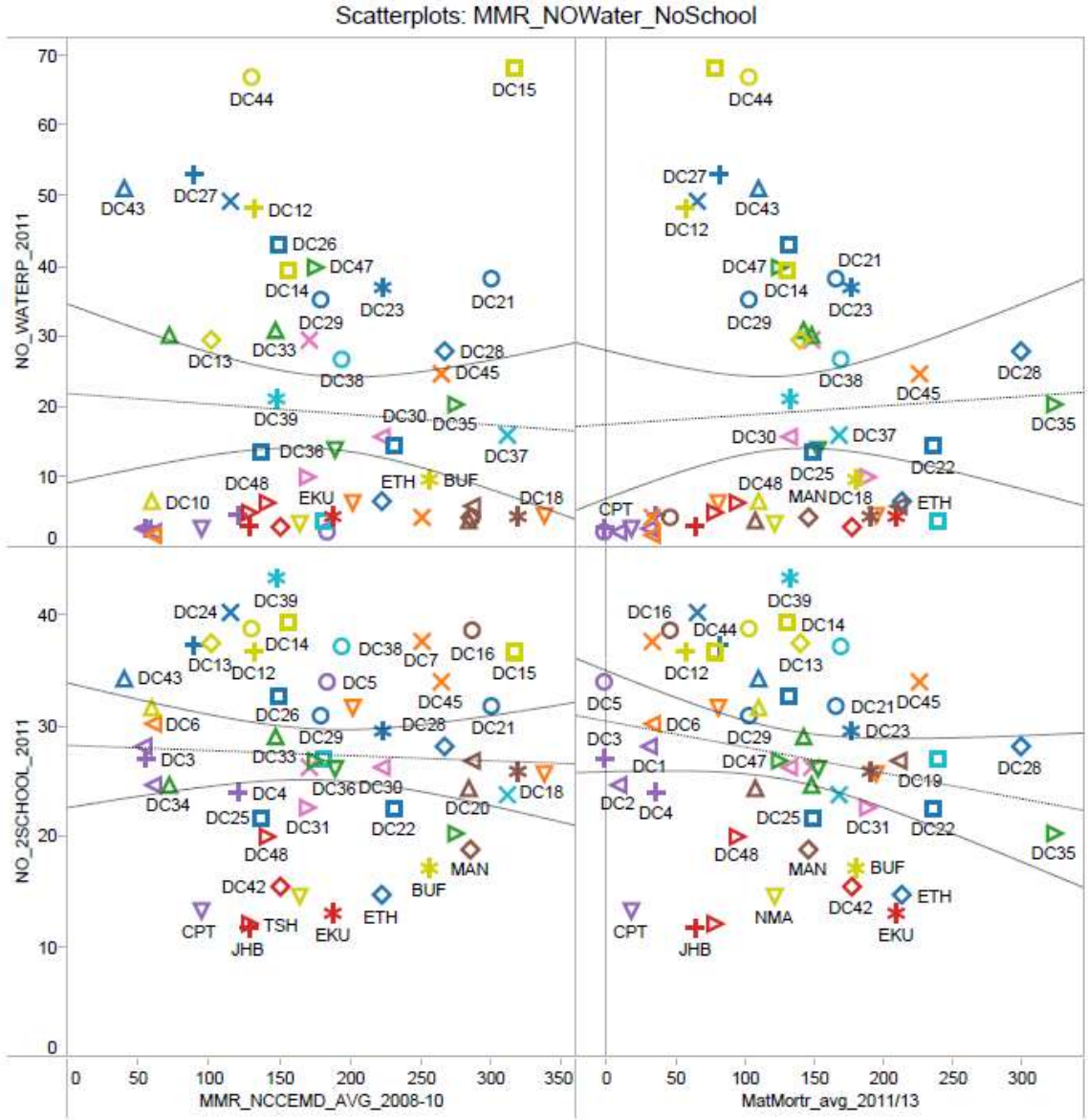


6. Association of maternal mortality with other indicators at district level

The following scatterplots show how the MMR in facility is related to a selection of other socio-demographic, health service and outcome indicators.

There is a weak inverse relationship between MMR and the percentage of adults (18-65 years) with no secondary schooling. District-level aggregation probably obscures the importance of education, since analysis of survey data has revealed sizable associations between level of education and maternal indicators.[5]

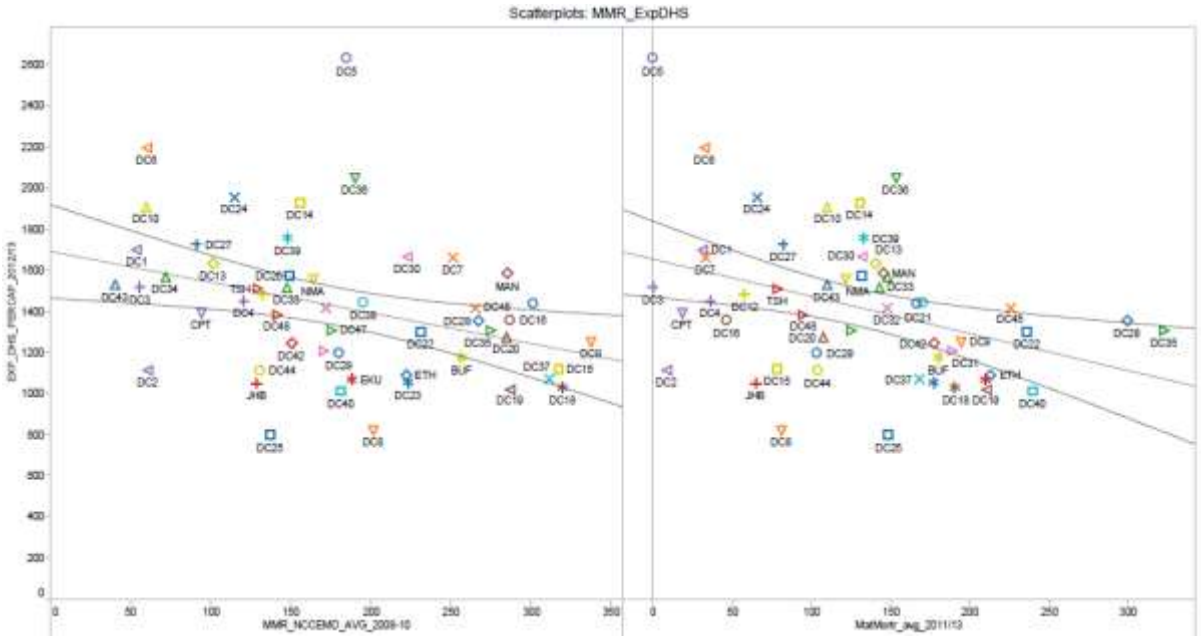
Figure 8: Scatterplot of percentage of people without piped water and percentage of adults with no secondary schooling versus MMR



No water = percentage of people living in a household without piped water inside their dwelling/yard or within 200m (Source: Census 2011).
No school = percentage of adults (18-65 years) with no secondary schooling (Source: Census 2011).

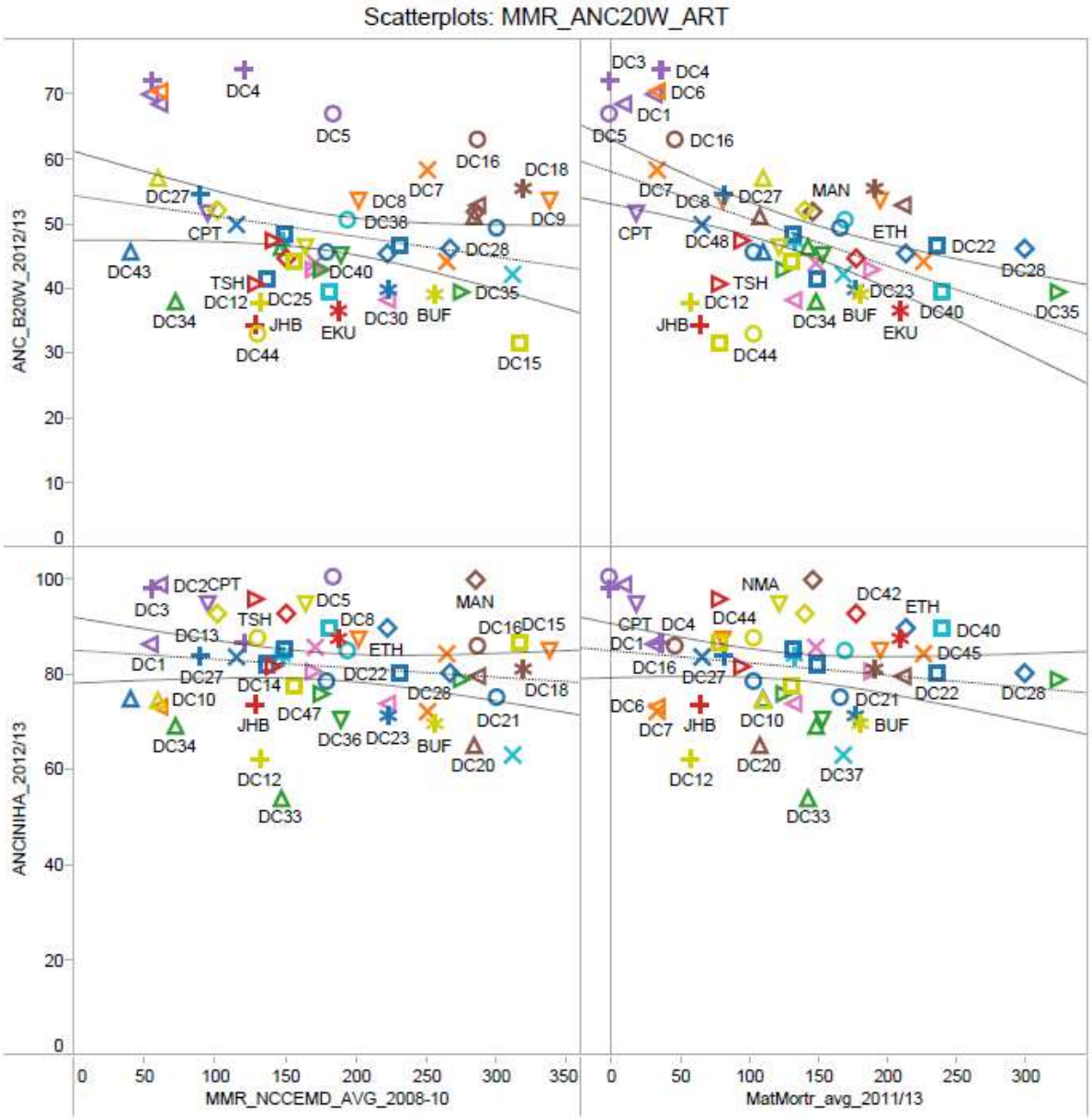
Lower MMRs are associated with higher expenditure on district health services per capita (uninsured).

Figure 9: Scatterplot of provincial and local government expenditure on district health services per capita (uninsured) versus MMR



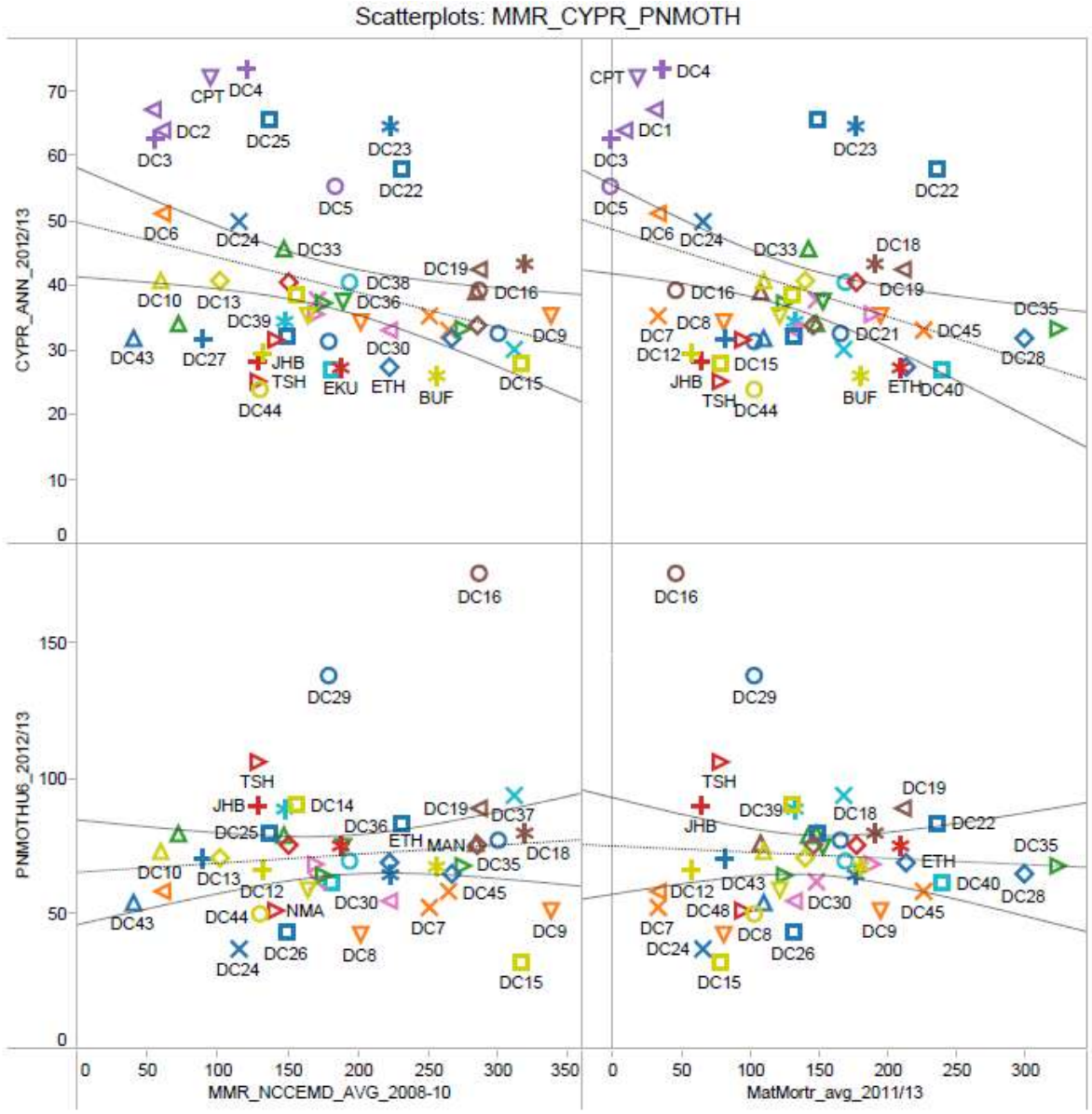
High MMRs are associated with a lower proportion of antenatal clients booking for antenatal care before 20 weeks gestation. There is no clear relationship with the percentage of HIV-positive antenatal clients who are initiated onto ART and MMR, which may be due to the relatively poor quality of the ART indicator and the limitations of using aggregated data. Other research, such as that reported from longitudinal data collected at demographic surveillance sites shows definite benefits to maternal and child survival with maternal HIV treatment.[6]

Figure 10: Scatterplot of antenatal visits before 20 weeks rate and antenatal client initiated on ART rate versus MMR



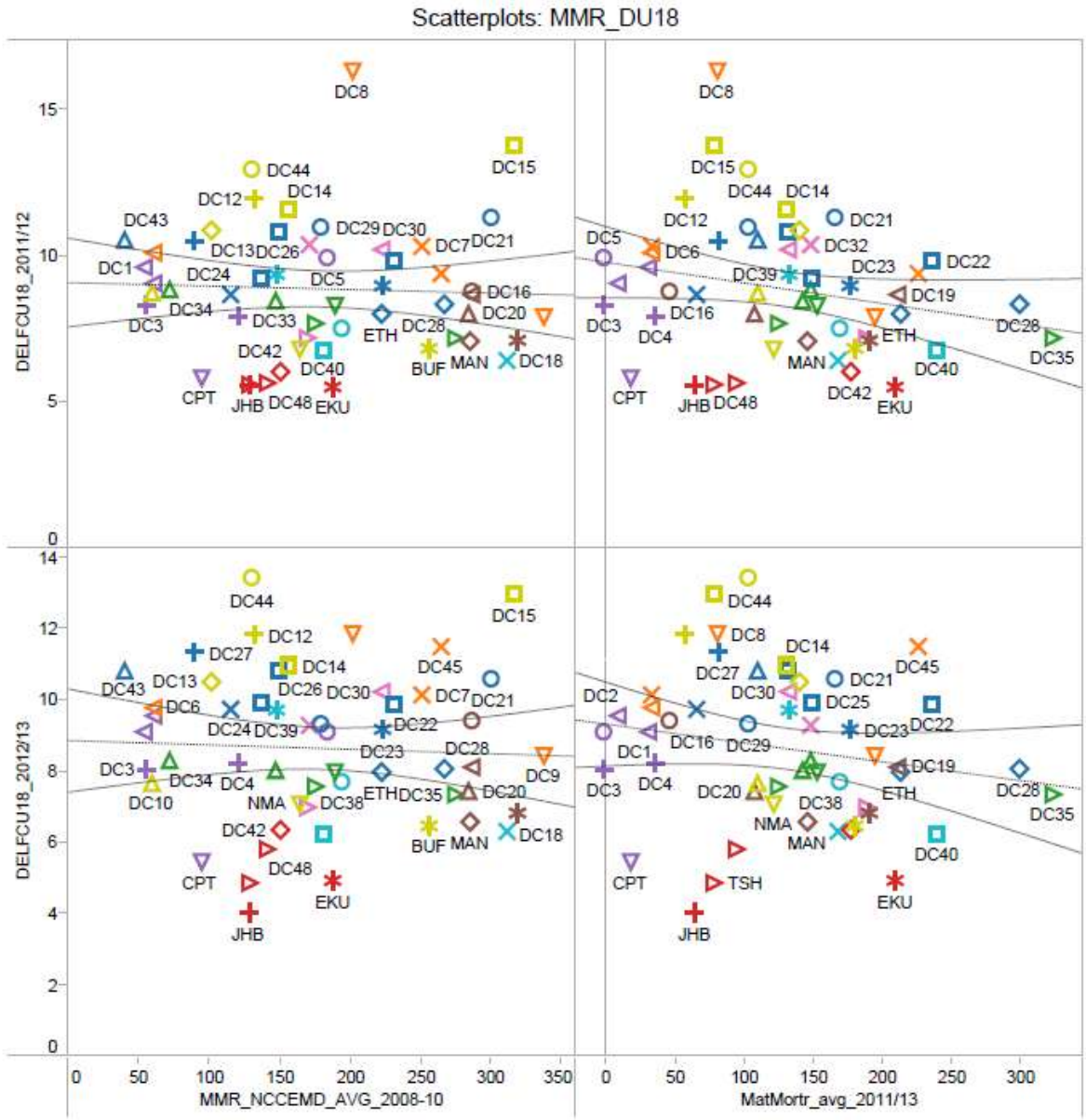
Good access to contraception as indicated by higher couple year protection rates is associated with lower MMR. Burton and Benn comment that ensuring reliable contraception may be the most important contribution to saving the lives of women of reproductive age.[7] There is no obvious correlation with the percentage of mothers who receive a follow up visit within 6 days. This may be since these MMRs are based on maternal deaths in facility whereas deaths occurring later in the period covered by the definition of MMR may not occur in facilities. The vast majority of maternal deaths occur within a week of childbirth.[8]

Figure 11: Scatterplot of couple year protection rate and postnatal care mother visits within 6 days rate versus MMR



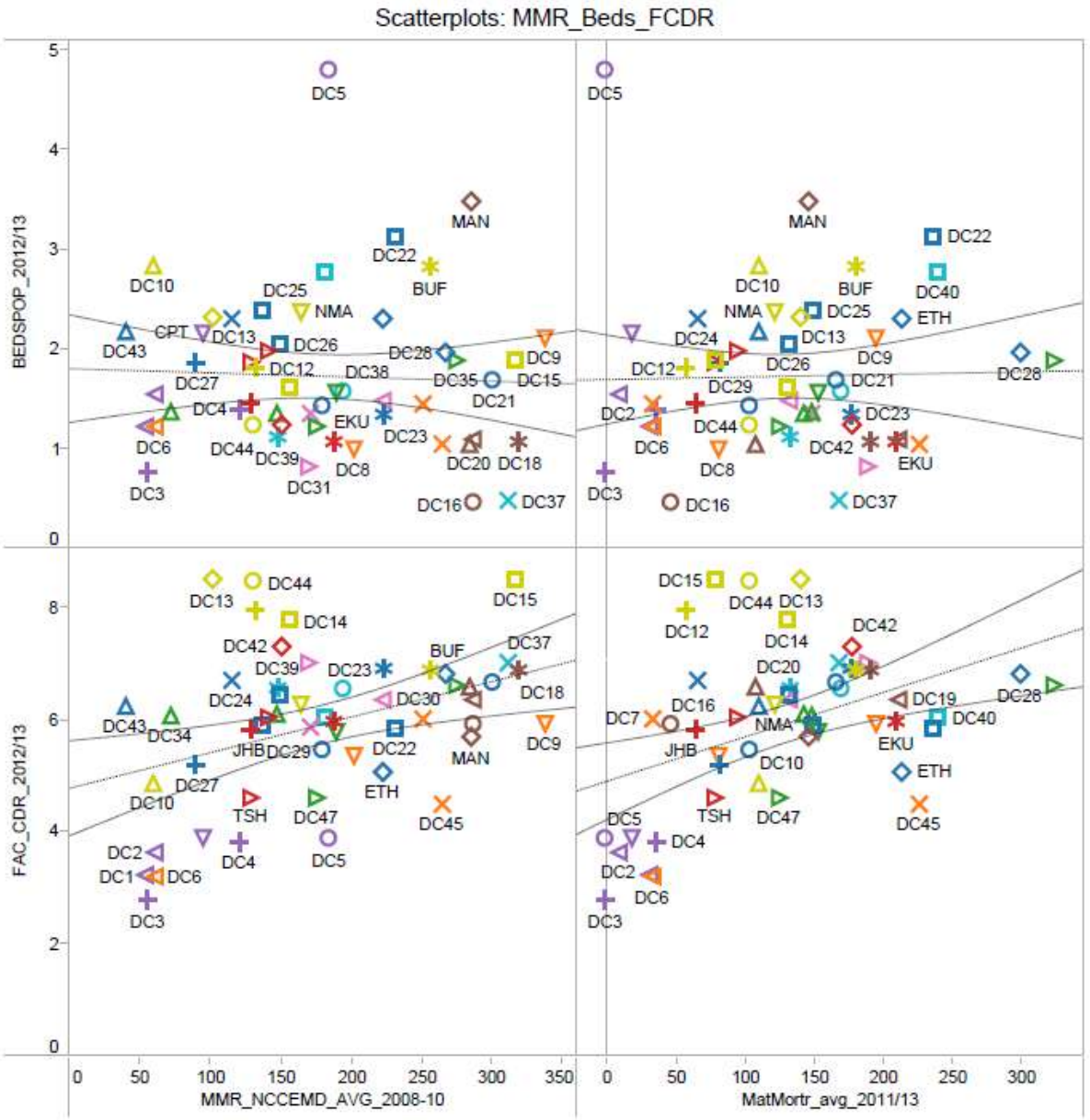
There is no apparent association between a higher proportion of deliveries in women under 18 years and MMR.

Figure 12: Scatterplot of delivery in facility under 18 years rate versus MMR



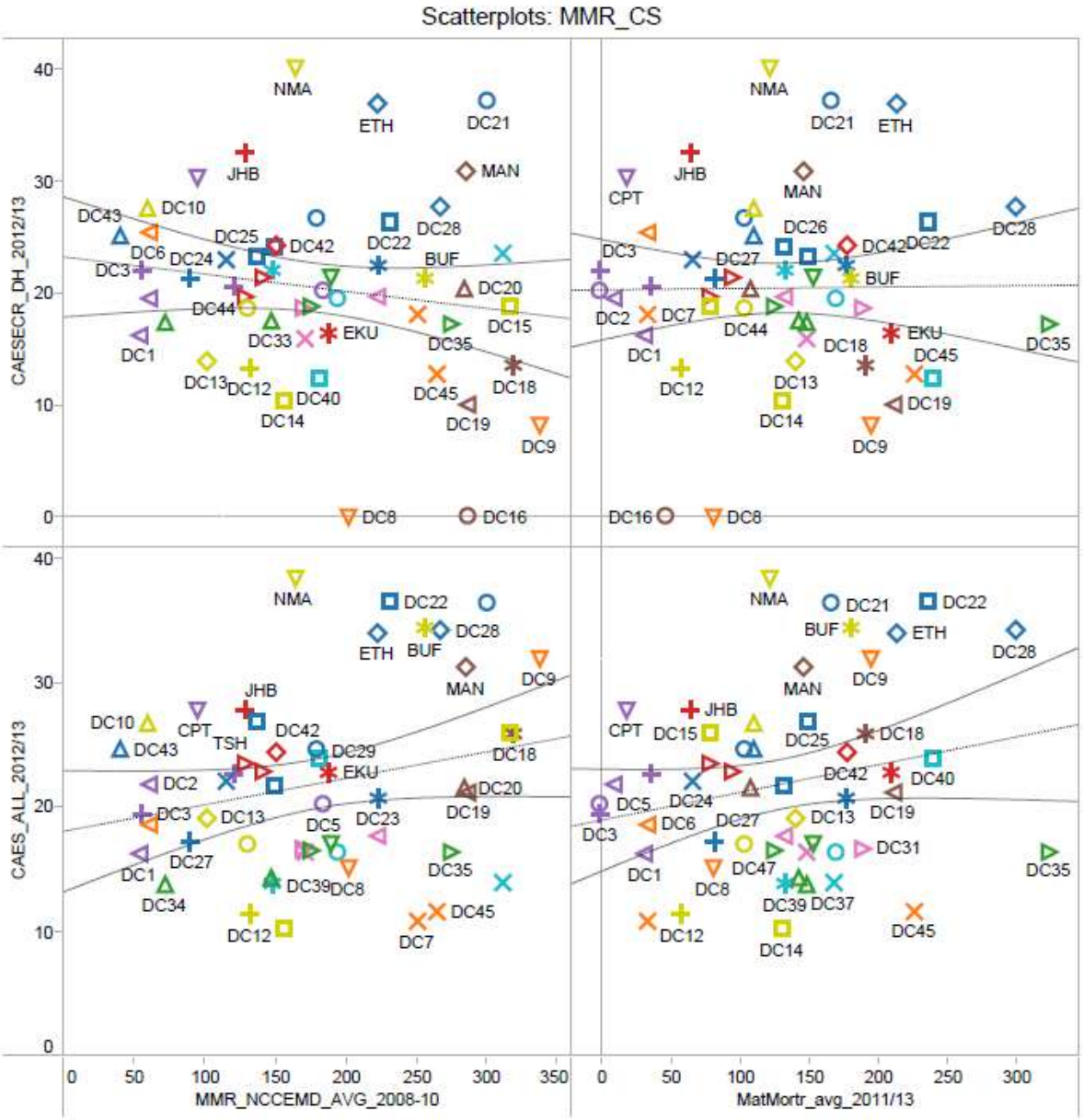
There is no clear association between the overall number of hospital beds per population per district and the MMR. This is probably too crude a measure of the availability of maternity services. There is, however, a correlation between overall mortality in hospitals (facility crude death rate) and MMR, apart from the Eastern Cape where the MMR is surprisingly low compared to overall mortality rates.

Figure 13: Scatterplot of usable beds per 1 000 population and facility crude death rate versus MMR



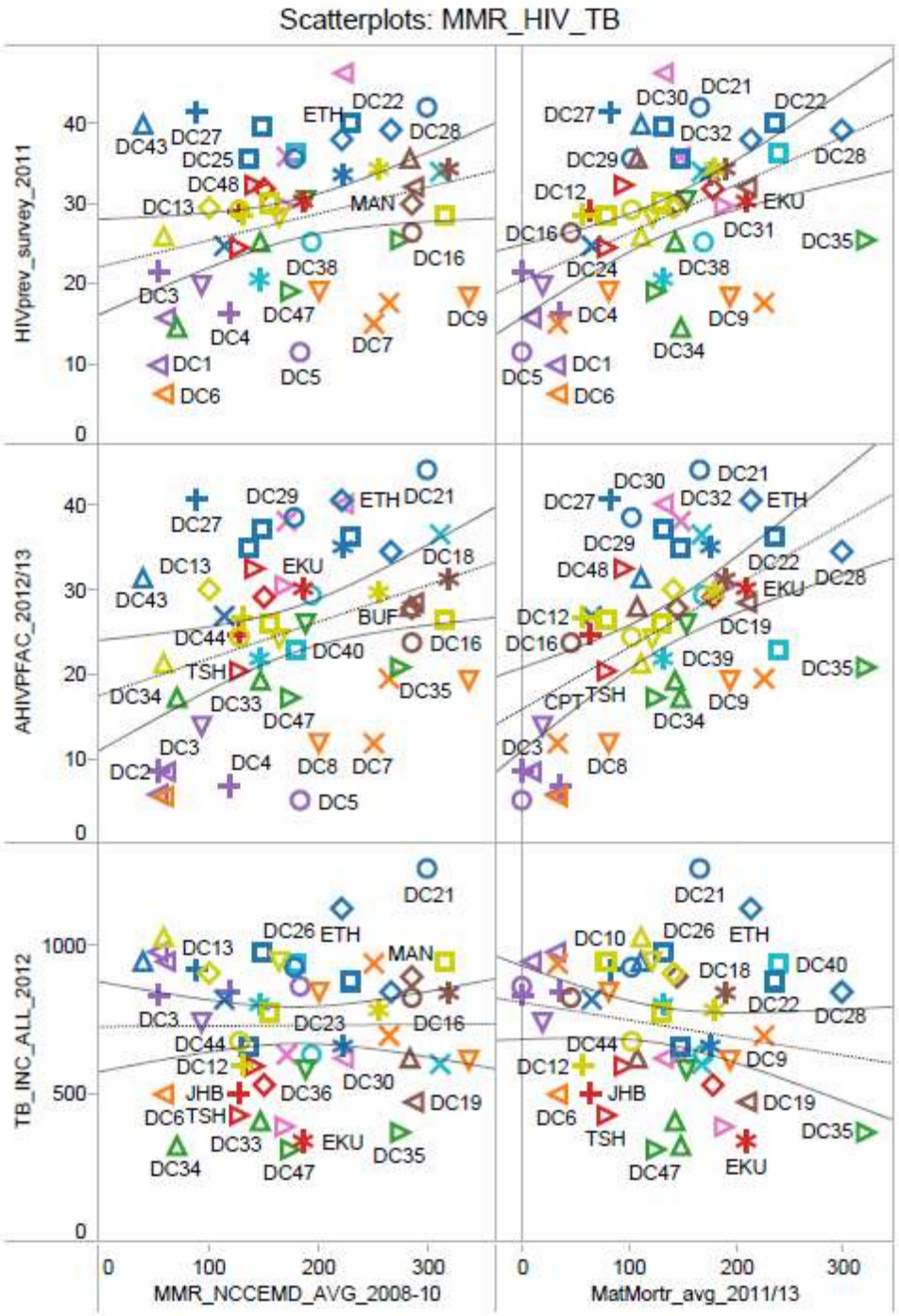
The MMR tends to be higher in districts with higher Caesarean section rates (including all levels of facilities). However whether mortality is higher as a direct result of too many Caesarean sections, or whether the Caesarean section rate is high due to a higher proportion of pregnancies or deliveries with complications is not possible to determine from these data.

Figure 14: Scatterplot of Caesarean section rate (District Hospitals) and Caesarean section rate (all levels) versus MMR



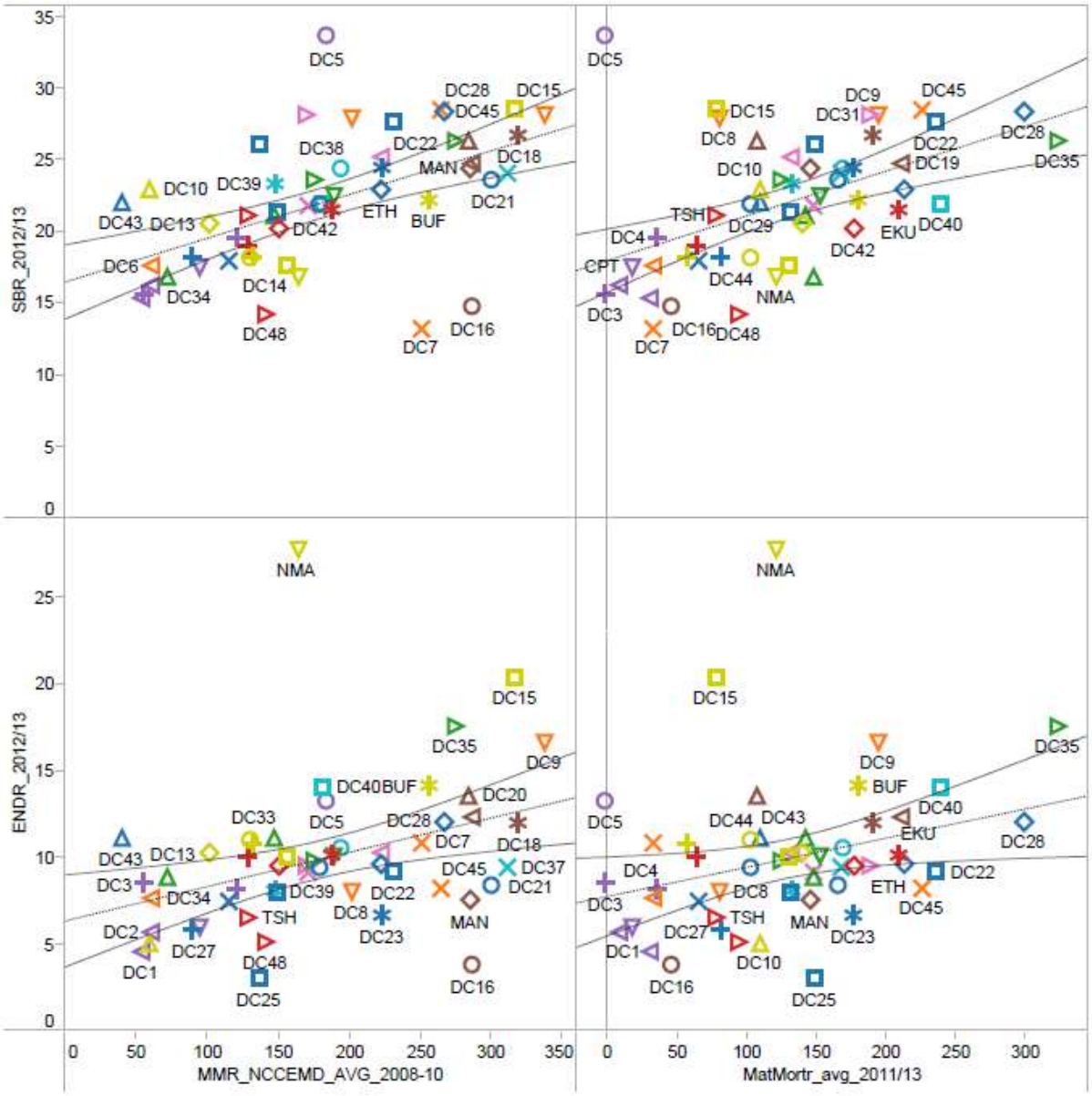
The MMR tends to be higher in districts with high antenatal HIV prevalence as expected. Analysis of maternal deaths from the NCCEMD 2005-7 suggests that the MMR in HIV-infected women was about 10 times higher than in uninfected women in a context of limited antiretroviral therapy.[9] Similarly, a smaller study at Charlotte Maxeke Hospital indicated a 6.2-fold higher MMR during 2003 to 2007,[8] and Ngene et al found worst outcomes in an ICU context.[10] Although TB is also expected to affect maternal mortality, the association with TB incidence (all types) in the total population aggregated to district level is less clear.

Figure 15: Scatterplot of HIV prevalence among antenatal clients (survey), antenatal client HIV prevalence in facility (DHIS) and incidence (diagnosed cases) of TB (all types) versus MMR



MMR is closely related to both stillbirth rates and the early neonatal death rates. Districts with a high MMR should thus have comprehensive interventions including both maternal and child health.

Figure 16: Scatterplot of stillbirth rate in facility and inpatient early neonatal death rate versus MMR



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