CHAPTER 14

General discussion
Maternal mortality is worldwide seen as a valid indicator of the standard of obstetric care in a country. The number of maternal deaths in the Netherlands is low, indicating high standards of obstetric care. Every death is one too many, however, and the goal should be to reduce maternal mortality to an impossible zero. One of the Millennium Development Goals of the United Nations is to lower maternal mortality in all countries with 75% as compared to the levels in 1990. For countries with already low maternal mortality ratios (MMRs), it is a more realistic goal to aim at a reduction of substandard care.

**The cycle of auditing obstetric care**
Knowing the level of maternal mortality is not enough if one aims at a reduction; a thorough understanding of underlying factors and events related to maternal death is necessary.

A model for continuous improvement is the Deming cycle. This is a four-step model for carrying out change: Plan-Do-Check-Act (PDCA). Just as a circle has no end, the PDCA audit cycle should be repeated again and again for continuous improvement. One has to Plan change, Do an assessment, Check and study the results and identify what you have learned, and Act based on what is learned in the Check step. If change did not work, go through the cycle again with a different plan. If the plan does work, incorporate what you have learned from the change with wider changes, or use it to plan new improvements, starting the cycle all over again.

To improve obstetric care, maternal deaths are classified and assessed for substandard care factors, resulting in recommendations to improve care. These recommendations should be communicated to the obstetric community in different ways and implemented into national guidelines. The level of implementation of these guidelines can be monitored in the confidential enquiry of the next period. Periodic confidential enquiries into maternal mortality should take place in every country to assess the level of obstetric care and observe trends in maternal mortality.

In the Netherlands, every 3 years an update of all maternal deaths with trends and recommendations is presented at the national congress of obstetrics and gynaecology. Trend analyses are published internationally. Because the numbers of specific causes of maternal mortality are small, lessons learned from these cases are not always (completely) evidence-based. These lessons should not be ignored, however, even if assessment did not reveal
substandard care. Lectures are therefore given by members of the MMC about specific maternal mortality topics around the country, and sometimes published in anonymized case reports. Furthermore, audits to assess the local level of care were organized for pre-eclampsia and postpartum haemorrhage. The implementation of recommendations and guidelines should lead to a decline in maternal mortality, measured in the next report.

**Numbers and causes of maternal mortality in the Netherlands**

In the Netherlands, the Maternal Mortality Ratio (MMR) over the period 1993-2005 was 12.1 per 100,000 live births.³ The period 1993-2005 showed a statistically significant increase of maternal mortality compared to the period 1983-1992, which had a MMR of 9.7 (OR 1.2, 95% CI 1.0-1.5).⁴ Just as in the previous period 1983-1992, most maternal deaths were caused by pre-eclampsia, followed by thromboembolism, sudden death in pregnancy, sepsis, obstetrical haemorrhage and amniotic fluid embolism. Most indirect deaths were caused by cardiovascular disorders.

As maternal mortality is an indicator of the standard of obstetric care in a country, we could conclude from this rise that there was more suboptimal care in the Netherlands in the studied period. However, substandard care decreased from 78% of all direct cases in the 1983-1992 period to 63% in this study period. In contrast, substandard care in pre-eclampsia did not show such a decline (93 versus 91%), indicating room for improvement.

The level of maternal mortality depends not only on the extent of substandard care. The increasing numbers may be caused by new risk factors and demographic changes in the population of women of childbearing age. Studies have identified socio-demographic variables affecting the risks of pregnancy and childbirth, including age, ethnicity, marital and socio-economic status.⁴-⁶ In our study, several groups at risk were identified.

**High Maternal Age:** In most studies the risk of maternal mortality increases significantly from the age of 35 years.⁵,⁷ The mean age of women becoming pregnant with their first child increased from 26.4 years in 1950 to 29.4 years in 2000 in the Netherlands.⁸ The percentage of women older than 35 years delivering a live born child increased from 11.9% in 1990 to 24.8% in 2005.⁸ The trend of delaying childbirth among many European populations leads to increasing MMR’s, for it causes an increase in older and less healthy mothers. This is also shown in the
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MOMS study, where postpartum haemorrhage, thromboembolism and sepsis were more prevalent in women of 35 years and older. Overall, more older women died due to indirect causes of maternal mortality. Also, more older women are delivered by caesarean section.

High Parity: Women with high parity are at higher risk. In the last decennia the number of children per woman in the Netherlands did not further decline but remained stable around 1.7. So this factor will not influence the general maternal mortality levels. Hinkula et al. found a slightly lower number of deaths with high parity, but in the group with very high parity more women died, most often due to cardiac and metabolic diseases such as diabetes. Immigrant women are more often of higher parity, which is a contributing factor to their higher risk of maternal death.

Immigrant populations: Another demographic change is the rise of births in non-indigenous women, who are at higher risk. Twenty percent of all births in the Netherlands are in immigrant populations today, whose fertility rate is 40% higher than that of the native Dutch population. MMR of sub-Saharan African and Asian women was more than three times that of the native Dutch group. Migrant women often have more complicated pregnancies, more serious underlying medical conditions or may be in poorer general health. They can also experience difficulties in accessing maternity care. In our study, 29% of the women who died were immigrants, and substandard care was found to be more frequent in this group (for direct deaths 74% versus 58% for indigenous women, and for indirect death 52% versus 32%). In one out of ten cases communication difficulties were mentioned in medical files, and this is probably an underestimation. In contrast with our first enquiry, MMRs of Moroccan and Turkish women were similar compared to the MMR of indigenous women, which could be interpreted as a result from increased health literacy within a multicultural context, as these groups have been in the Netherlands for a relatively long time now.

General health factors: The general health status of women is not improving over years. The exact number of maternal deaths of obese women is not known in the Netherlands, for often the Body Mass Index (BMI) was not mentioned in the pregnancy record. In the United Kingdom more than half of all women who died due to direct or indirect causes were either overweight or obese, with more than
15% of all women being morbidly obese. Weis et al. found that obesity and morbid obesity has a statistically significant association with gestational hypertension (OR 2.5 and 3.2), pre-eclampsia (OR 1.6 and 3.3) and gestational diabetes (OR 2.6 and 4.0). For nulliparous patients the caesarean delivery rate was 20.7% for the control group (BMI less than 30), 33.8% for obese (BMI 30-34.9) and 47.4% for morbidly obese patients (BMI 35 or greater). They concluded that obesity is an independent risk factor for adverse obstetric outcome and is significantly associated with an increased caesarean delivery rate.

Also, due to improved technology and treatment, young women with chronic diseases and congenital birth defects such as cardiac abnormalities have the capability and are taking the risk of getting pregnant nowadays, while they were strongly advised against becoming pregnant in the past. The rise in maternal deaths due to cardiovascular disease is similar to the findings in the UK. The UK report stated that this reflects the increase in acquired heart disease in younger women due to obesity and chronic hypertension, related to unhealthy diets, smoking and alcohol.

Care: The higher maternal age and impaired general health may be associated with an increase in the need for assisted reproductive techniques. IVF is associated with higher maternal mortality in Australia (MMR 25.7 versus 10.9 in the general population) which was confirmed in our study (MMR 40.0 per 100,000 IVF-pregnancies versus 12.1 per 100,000 live born children overall, chapter 13). Also, higher caesarean section rates are reported.

The percentage of caesarean section in the Netherlands increased in the study period from 8.1 to 13.6%, which is reported to have a higher maternal mortality risk for the mother than vaginal delivery.

Trends in maternal mortality 1993-2005
The trend for the most common causes of maternal mortality is shown in figure 1. After the initial increase, with the highest numbers in the period 1999-2002, a decline can be seen in the number of deaths due to (pre-)eclampsia in the last 3 years (2003-2005). This is possibly accomplished by the publications and recommendations made by the maternal mortality committee resulting in a higher common awareness among obstetricians that pre-eclampsia is a life-threatening condition, which should be treated pro-actively. It took some time to implement
the use of magnesium sulphate in the Netherlands, but this probably has had effect on the lowering of deaths due to eclampsia. 

In the period 2000-2004 however, substandard care in cases of mortality due to (pre-)eclampsia was still high in the Netherlands, and was assessed to be present in 96% of all cases which were available for further assessment.\textsuperscript{23} The number of deaths due to pre-eclampsia is still two times higher than in the United Kingdom.\textsuperscript{5} This is also seen in the LEMMoN study, a Dutch nationwide study of serious maternal morbidity, which showed eclampsia to be two times more prevalent in the Netherlands than in the UK.\textsuperscript{24} Another remarkable finding is that maternal mortality due to cardiovascular diseases is as frequent as death from pre-eclampsia in the last 3 years, being the first period with an indirect cause ranking the first place in the Netherlands. Because numbers are small, one cannot yet draw firm conclusions from this trend. However, the sharp decline in mortality due to (pre-)eclampsia stems optimistic for the future.

\textbf{The Maternal Mortality Committee} 

In the Netherlands, the Dutch maternal mortality committee exists of eight obstetricians and one internal medicine specialist working in the field of maternal medicine, appointed by the Dutch Society of Obstetrics and Gynaecology. The members are from both university and non-university hospitals. It might be wise to expand this committee with other specialists working in the field of obstetrics. It is sometimes difficult for obstetricians to draw conclusions about the standard of care provided by other medical specialists, for example the care provided on the intensive care unit where many women died. Because of the small number of deaths one should collect those cases in which more expertise could be needed and ask the medical specialist in question (e.g. anesthetist, intensivist, neurologist, psychiatrist or pathologist) about his/her opinion.

\textbf{Classification difficulties} 

The strict use of uniform definitions is essential to enable comparisons between (international) studies. This was highlighted in Chapter 3. All cases were classified by the definitions of the ICD-10, which stated that the underlying cause is the disease or injury which initiated the chain of events leading directly to death.\textsuperscript{25} Even then, classification might have been arbitrary as maternal death often is the consequence of a cascade of unexpected obstetric
complications. Because differences in classification may influence the MMR, one should interpret the comparison of MMRs in international reports accordingly. Underreporting and classification difficulties are a known factor in (international) reports on maternal mortality, as is illustrated by several studies.\textsuperscript{26-31}

A possible method to lower the effect of misclassification may be the introduction of the term \textit{pregnancy related mortality} (ICD-10), to include all women who died while pregnant or within 1 year after termination of pregnancy, irrespective of the cause of death. If we use this definition, the women who died during pregnancy or within 1 year after termination of pregnancy is 31.5 (623/1,975,336) per 100,000 live born children in the Netherlands during the period 1996-2005 and in the UK in the period 2003-2005 20.4 per 100,000 maternities (432/2,114,004). The higher number in the Netherlands might be due to our accurate collection of maternal deaths after delivery by the linkage of death and birth register. For women dying during pregnancy or within 42 days after termination of pregnancy the number would be 13.6 (269/1,975,336) in the Netherlands vs 16.6 (350/2,114,004) in the UK.

Comparing both the database of Statistics Netherlands and the database of the Dutch MMC identifies most cases of maternal deaths. The linkage of both death and birth register identifies even more cases. Most of these maternal deaths within 6 weeks after termination of pregnancy are also identified by the MMC. The cases not identified by the MMC with death after 42 days but within 1 year after termination of pregnancy often seem to be caused by trauma or cancer (fortuitous deaths). These cases, however, cannot be assessed and classified properly, because only age and cause of death are available from Statistics Netherlands.

\textit{International comparisons}

In only a few countries confidential enquiries are carried out into maternal deaths on a national level.\textsuperscript{5,32,33} The nature of these enquiries are somewhat different in detail. WHO performs systematic reviews to estimate MMRs worldwide.\textsuperscript{34}

Difficulties with international comparisons became clear with two recent international studies of worldwide maternal mortality between countries. In 2007, a report in the Lancet showed MMRs in different countries worldwide, including low income countries.\textsuperscript{35} Also, in 2008, Peristat-II reported maternal mortality in several European countries in the period 2003-2004.\textsuperscript{36} The results of both studies for high income countries are shown in Table I. Also, data from various reports in different countries are listed in this table.
Data were collected, however, by different countries in different ways. For the Lancet report, most countries provided only vital statistics data, which are prone to underreporting. So it is not accurate to compare these numbers with each other and make a statement about differences in quality of care provided in these countries.

Peristat-II only reports over 2 years. Due to the statistical effect of rare events, small changes in absolute numbers cause large fluctuations in ratios. For example, Malta has a MMR of 0, because in official statistics no maternal death had been reported in the period 2003-2004. In the other study its MMR was 8.0.
Discussion

Because of the different methods of collecting data, in different time periods, even while in most cases the same source of vital statistics was used, differences in MMRs occur even in a single country, as presented in Table I.

Large discrepancies are seen between MMRs of causes of death between different countries. These differences might be due to underreporting, classification bias, differences in the prevalence of specific underlying causes of death in these countries, or due to higher case fatality rates with differences in quality of obstetric care. Peristat-II showed large variations of the use of different classification groups between different countries. This is unlikely to be caused by differences in prevalence or case fatality rates. One should thus be careful to draw firm conclusions from comparing MMRs of causes of death between different countries.

Maternal mortality in the Netherlands and the UK

As explained above, it is not accurate to compare MMRs for causes of maternal death between every country, since MMRs are subject to classification bias. The number of maternal deaths also depends on the methods used to collect data. The United Kingdom and the Netherlands use comparable methods to collect data, and appear to have only small differences in classification. The MMR between the Netherlands and the UK is comparable, with a MMR of 12.1 in the Netherlands and 14.0 in the UK.

In the Netherlands, direct maternal mortality (MMR 8.8) is more frequent than indirect mortality (MMR 3.3). In the UK indirect mortality (MMR 7.7) occurs more frequently than direct mortality (MMR 6.2) since 1994-1996. The gap between both groups became smaller in the last report.

The numbers for the five main causes of maternal mortality are listed in Figure 1 for the Netherlands and in Figure 2 for the UK. The main difference is the prevalence of maternal mortality due to (pre-)eclampsia in the Netherlands. In the first 10 years in the studied period a rising line can be seen, from MMR 3.1 to 4.6 per 100,000 live births. In the last 3 years the MMR showed a remarkable improvement with a steep decline to 1.7.

In the Netherlands in the period 1993-2005, the second place is shared by thromboembolism and cardiovascular diseases (MMR 1.6). The third place is for sudden death in pregnancy (MMR 0.8), followed by obstetric haemorrhage and obstetric sepsis (MMR 0.7).
The five main causes of maternal mortality in the UK switched places in the last triennial reports due to small non-significant fluctuations. The leading cause of maternal mortality in the UK in the last two reports (2000-2005) is cardiac disease, trading places with thromboembolism which became the next commonest cause. Thromboembolism has been the most common cause of direct maternal mortality in the last reports. In the period 2003-2005, maternal mortality due to (pre-)eclampsia comes at a shared third place with genital tract sepsis.
Discussion

In the UK in the period 2000-2002 the leading cause of death when late maternal mortality was included, was suicide. In the last report this rate showed a decrease. This might indicate that the recommendations to identify women at potential risk in the antenatal period and to develop management plans for them, are having a beneficial effect. In the Netherlands, death due to psychiatric disorders has never had such a high ranking (Chapter 12). There may be underreporting, however.

The differences between the UK and the Netherlands are remarkable, and are probably not completely due to classification or registration bias, for the methods used for both enquiries are comparable. The main differences are seen on the classification of early pregnancies, cardiac death and sudden death in pregnancy. In the UK, early pregnancies are all categorized in the group ‘early pregnancy’. But in the Netherlands, death due to septic abortion is classified in the obstetric sepsis group. A woman dying suddenly, without a specific cause, is classified in the Netherlands as direct maternal mortality from sudden death of unknown origin, with a MMR of 0.8. In the UK no such deaths were mentioned in the last report. In the UK such cases are more likely classified as indirect deaths from cardiac disease. The other possible explanations are demographic differences or differences in care. The demographic explanations mentioned in the last report of the CEMACH are older or obese mothers, more women with medically complex pregnancies and more women putting their health at risk with their lifestyle. Also the increasing number of migrant women played a role. In the Netherlands, however, the same trends can be seen.

Perhaps the most interesting cause can be the differences in care. Mortality due to (pre-)eclampsia in the period 1993-2005 (MMR 3.5) was four times higher than the MMR in the period 2003-2005 in the UK (MMR 0.85). In the period 2000-2002 this difference was even 6.6 times higher with a MMR of 4.6 in the Netherlands and 0.7 in the UK. The percentage of substandard care for (pre-)eclampsia in the Netherlands is 91% (and in the analysis in the period 2000-2004 even 96%), compared with a percentage of 72% in the UK, with 44% major substandard care. The other causes of maternal mortality do not show such remarkable differences in numbers and care, so it is likely that the care given in the Netherlands is a major factor for the higher maternal mortality due to (pre-)eclampsia.
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The Confidential Enquiry in the UK has a somewhat different system of collecting cases for thorough assessment. All health professionals in the UK have the duty, by government requirements, to provide sufficient information. They have to report all circumstances leading to the woman’s death, with all available records. Also, very important, they have to reflect on any clinical or other lessons that have been learned. Regional managers collect data and because these managers operate at a local level, much more information can be gathered for a root-cause analysis. The assessment is processed at two levels, the first being the regional and the second being the central level. It was stated in their report that in the United Kingdom virtually all direct and indirect maternal deaths were identified and assessed.

In the Netherlands, voluntarily reporting and assessment is based on all clinical information, concerning general and obstetric histories, as well as information regarding the index pregnancy. Other sources of information such as antenatal charts, laboratory and bacteriological results, pathology and autopsy reports and professional correspondence were also analysed. More specific information, such as short communications by phone, the exact working of a team or interpersonal skills, are often not available for analysis. No specific recommendations can be made on these latter important aspects of obstetric care.

Substandard care

The level of substandard care in the Netherlands indicates room for improvement of obstetric care. However, it is not correct to say that if there would be no substandard care, there would be no maternal mortality anymore. In several cases, the identified substandard care factor did not directly lead to the death of the woman.

In the United Kingdom, the term suboptimal care is introduced instead of substandard, for this has less negative implications. Also, suboptimal care is divided in minor and major suboptimal care. This gives more insight in the impact of the different types of suboptimal care. Major suboptimal care contributed significantly to the death of the mother, and in many (not all) cases different treatment may have altered the outcome. Minor suboptimal care is a relevant contributory factor. Different management might have made a difference but the mother’s survival was unlikely in any case.

In the Netherlands, the most common cause of death has also the highest percentage of substandard care: in 91% of pre-eclamptic deaths substandard care was assessed to be present. This is unlike the situation in the United Kingdom,
where the most common cause of direct death is thromboembolism with 56% substandard care. In the UK, the highest percentage of substandard care was also found in pre-eclamptic cases (72%).

However, a comparison of the percentages of substandard care mentioned in different studies cannot be taken too absolute, because the assessment of care will always be prone to some subjectivity. At best care can be judged more objectively in the presence of guidelines, indicating the level of care that the profession agreed on to be standard. But the guidelines do not usually apply to all clinical situations.

It might seem that due to the low maternal mortality in high income countries, analysis of these cases focussus only on a small problem, highlighting problems that only happen to some women. However, assessment of these cases showes that most deaths do not occur due to very rare diseases. Analysis of severe maternal morbidity focusses on other causes and should take place next to analysis of maternal mortality, as also shown by Mantel et al., to have an accurate insight in the level of obstetric health care in a country. The fact that the maternal mortality ratio in the Netherlands is not decreasing means that there are no grounds for complacency and highlights the necessity for further vigilance and the need for these reports to continue.
REFERENCES


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Discussion


