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ANALYSIS

Reducing maternal deaths from hypertensive disorders: learning from confidential inquiries

Lucy Chappell and colleagues examine the dramatic reduction in maternal deaths from hypertensive disorders of pregnancy in the UK and discuss how systematic confidential inquiries may have contributed

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Key messages

Confidential inquiries into maternal deaths in the UK were established in 1952 and have aimed to report on every pregnancy related death since then

Maternal deaths from hypertensive disorders of pregnancy have reduced dramatically in the UK over the past 60 years

Incremental improvement in clinical management and organisation of care through recommendations made in the confidential inquiry reports and publication of national guidelines are likely to have driven much of this decline in recent decades

To tackle global maternal mortality related to hypertensive disorders, setting up a confidential inquiry is an important first step for many countries

Almost complete eradication of maternal mortality related to hypertensive disorders of pregnancy seems possible

Maternal deaths in the United Kingdom have been the subject of confidential inquiries since 1952. In this time, deaths from hypertensive disorders of pregnancy have substantially reduced in both absolute and relative terms, from 200 women in a three year period in England and Wales (1952-54), to three women across the whole of the UK in the most recent report (2013-15).¹ Deaths from hypertensive disorders are also falling globally, but not as dramatically as in the UK.² Pre-eclampsia and eclampsia are still estimated to cause approximately 30 000 maternal deaths annually worldwide, mostly in low and middle income countries.^{3,4} As with any death, maternal deaths have a huge impact on families, particularly as they are usually unexpected in young adults and involve a child (box 1).

Box 1: Experiencing pre-eclampsia

"Losing anyone is hard at any time but losing your partner when you are on the cusp of becoming a family is the most devastating thing that can happen to a dad. From planning on being a family to being alone tears you up; it happened so suddenly, I went from joy and excitement to devastation just hours later. This changed the path of my life forever and the lack of care for grieving partners is abysmal"—*man who lost his partner and daughter in 2016*

"When you have an arm or leg amputated you can get a prosthetic limb, when your sweetheart is taken from you there is no prosthetic for an amputated soul. I tell my son the brightest twinkling star is his mum opening a curtain in heaven and checking up on us, and his freckles are angel kisses from when his Mum visits him when he's fast asleep. There will never be a Champagne moment in this process, no one can give me back my wife"—*man who lost his wife in 2006*

For women sharing their experiences of pre-eclampsia, see <http://healthtalk.org/pre-eclampsia>

Over the past 65 years, UK confidential inquiries have assessed the causes of maternal deaths, searched for avoidable factors, and aimed to reduce maternal morbidity and mortality by providing recommendations for clinical care, service organisation, and research priorities. Identifying the factors involved in the fall in maternal deaths from hypertensive disorders in the UK may help other health systems to reduce their maternal death rates.

We reviewed and analysed the original confidential inquiry reports, providing aggregated triennial data, from the earliest (England and Wales, 1952-54) to the latest (UK, 2013-15). Definitions of maternal deaths and hypertensive disorders used in these reports are listed in supplementary table 1.

The changing picture of maternal deaths from hypertensive disorders

Since the first confidential inquiry into maternal deaths the number of maternities has fluctuated but, on the whole, remained stable over time (fig 1), allowing for the change in data collection from England and Wales to the whole of the UK. By contrast, the maternal death rate from hypertensive disorders of pregnancy has shown a strong downward trend, from 9.74 maternal deaths per 100 000 maternities in the first confidential enquiry (1952-54), to 0.09 per 100 000 in the 2012-14 report. This trend is most dramatic in recent years and in the first 15 years of the inquiries and has been sustained despite a broadly similar denominator throughout.

Deaths from hypertensive disorders accounted for a fairly stable proportion (11-20.5%) of direct maternal deaths (deaths resulting from obstetric complications of the pregnant state) until 2012-14, when they fell to only 4.5% of direct deaths (fig 2) and 1.5% of all maternal deaths (direct and indirect causes).

These figures can be broken down to examine the cause of death in detail—cerebral, hepatic, miscellaneous, pulmonary, or renal—which were first included in the report from 1958-60 (fig 3) (supplementary table 2A and 2B). Before this, deaths related to hypertensive disorders were ascribed to pre-eclampsia (21.8%) or eclampsia (24.7%) only, reflecting less detailed information available to the inquiry.

Over the 65 years of inquiries, intracranial haemorrhage was the single most common specified cause of death, responsible for 226 of 1063 maternal hypertensive deaths (21.7%). Other common causes of death include renal failure, particularly in earlier reports (6.4%); hepatic causes, including hepatic failure or necrosis (5.6%); and pulmonary complications, including acute respiratory distress syndrome (3.5%) and pulmonary oedema (1.1%), which was last reported in 1994-96. Cardiac failure and anaesthetic complications were responsible for 1.4% and 1.2% of deaths over the 65 year period, but no deaths have been reported since the 1980s.

What has driven the reduction in deaths?

The confidential inquiry reports identify areas for improvement and make recommendations for clinical care of women with hypertensive disorders of pregnancy (supplementary table 3). The rate of decline in mortality from hypertensive disorders was most rapid between the 1950s and 1970s. Although we cannot draw causal inferences from the trends noted in this analysis, it is possible—and has been suggested elsewhere⁵—that this rapid rate of decline was due to wider provision and improved quality of antenatal care with the founding of the NHS in 1948, leading to earlier detection of hypertension and appropriate referral to hospital care. Poor antenatal care was mentioned in early confidential reports as the most frequent avoidable factor in maternal deaths. Other findings were poor education provisions for pregnant women and challenges in organisation of care, particularly difficulties in communication between community and hospital (supplementary table 3) (supplementary table 4).

Nutrition also improved in the post-war period, with introduction of the national milk and vitamin schemes for pregnant women in the 1940s.⁶ Improved consumption of calcium in populations where calcium intake is low has been shown to reduce the incidence of hypertension in pregnancy,⁷ although lack of reliable trend data on the incidence of pregnancy hypertensive disorders in the UK precludes further analysis. Other sociological factors may also have contributed to the trend,

particularly improved access to all kinds of healthcare after the introduction of the NHS and an increase in babies being delivered in hospital (rather than at home), from 63.7% in 1954 to 91.4% in 1972.⁸

The decline in maternal mortality between the 1970s and the millennium is likely to have been achieved by improvements in organisation of care and clinical management of hypertensive disorders of pregnancy. Important inquiry recommendations from this period included senior staff involvement (supplementary table 4), prompt treatment of systolic hypertension, raising awareness of fluid overload and the need for strict fluid balance, and implementation of evidence showing superiority of magnesium sulfate in eclampsia management (supplementary table 5).

Cerebral haemorrhage was reported as the most common cause of death for the first time in the mid-1970s, with recommendations made to control blood pressure soon thereafter (supplementary table 3; supplementary table 5). The 1985-87 inquiry reported a death from acute respiratory distress syndrome for the first time and noted the dangers of fluid overload, with deaths from pulmonary oedema. It also criticised the use of diazepam for prevention of eclamptic seizures and advised the scientific re-evaluation of magnesium sulfate and phenytoin for the management of eclampsia. The recommendation to have clear protocols for hypertensive disorders of pregnancy was first made in the 1988-90 report. After the Eclampsia Collaborative Trial was published,⁹ magnesium sulfate for eclampsia management was recommended in the 1991-93 report (published in 1996), alongside strict fluid balance in women with pre-eclampsia and eclampsia. Notably, the last recorded death from pulmonary oedema associated with hypertensive disorders of pregnancy in the UK was in 1994-96.

In 1985-87 the main factors requiring improvement were human factors, with inappropriate delegation of care to junior staff and communication delays being key concerns. Recommendations for early involvement of senior staff and the development of expert regional teams to provide support to non-specialist units were made (supplementary table 4).

By the millennium, maternal deaths from hypertensive disorders had substantially reduced, having been less than 1 death per 100 000 maternities for almost a decade. Renal, hepatic, and pulmonary causes of death had all decreased, leaving cerebral causes of death, primarily due to intracranial haemorrhage, remaining. This led to a primary focus on the need to treat hypertension effectively, the key message from the 2000-02 report onwards (supplementary table 3 fig 4; supplementary table 5).

The 2003-05 report recommended a treatment threshold of 160 mm Hg systolic blood pressure for starting antihypertensives, which was subsequently reduced to 150 mm Hg (2006-08). The latter report also noted that the incidence of eclampsia had halved, probably due to widespread use of magnesium sulfate.

Recommendations of the confidential inquiries have been incorporated into specific evidence based guidelines, such as the first version of the National Institute for Health and Care Excellence (NICE) Guideline for management of hypertension in pregnancy published in 2010.¹⁰ This guideline advised screening and prevention of pre-eclampsia with aspirin, lowering of blood pressure targets, and planned delivery at 37 weeks' gestation for women with pre-eclampsia. These national guidelines have promoted universal provision of standardised care, rather than management by individual clinician preference, and are likely to have driven the notable recent reduction in deaths. Alongside this, direct involvement of patient support

groups in the production of lay summaries of the confidential inquiry reports has empowered women to seek this standardised high quality care.

Intracranial haemorrhage remains the most common specific cause of death from hypertensive disorders of pregnancy overall. Inadequately treated hypertension is likely to be the most important aetiological factor in intracranial haemorrhage, so the monitoring and control of blood pressure through use of clear blood pressure targets for hypertensive pregnant women is likely to remain of pivotal importance.

Comparison with other countries

The UK confidential inquiries show the powerful process of data collation generating research questions guided by clinical need, these research findings being translated into evidence based national guidelines and reports, and the resultant engagement of healthcare workers and influence on clinical practice leading to improved outcomes. This model is particularly relevant to outcomes such as maternal deaths, which are less common in high income settings and are otherwise difficult to study.

Since their inception in the UK, confidential enquiries into maternal deaths have been set up in numerous other countries. The South African inquiries, running since 1997, show that maternal deaths from hypertensive disorders have decreased overall between 2002-04 and 2011-13, but remain one of the top five causes of maternal deaths, responsible for 14.8% of deaths in 2011-13.¹¹ Similar to the UK, cerebral complications are the most common cause of death (58.2%), related to failure to control severe hypertension. The latest report recommends aggressive control of hypertension, reinforcing the South African Maternity Guidelines, which implies that guideline implementation is an important focus in the South African setting. Teenagers and women under 25 who are pregnant for the first time are also at higher risk of death from pre-eclampsia, so reproductive services are being targeted at this group.¹¹

In a recent review of maternal deaths in Norway from 1996 to 2014, hypertensive disorders were the most frequent cause of maternal deaths, and in 14 of 16 cases assessors concluded that better care may have improved the outcome.¹² Pulmonary oedema was the most common cause of death (43.8%), followed by intracranial haemorrhage (37.5%). The authors point to the lack of recommendations on timing of delivery in women with hypertensive disorders and treatment thresholds for diastolic (rather than systolic) blood pressure in the Norwegian obstetric guidelines at the time of the study. They recommend implementation of evidence based guidelines (similar to those implemented in the UK in 2010) with clear systolic treatment thresholds for hypertension drugs and guidance on fluid management and timing of delivery.¹²

France, which has had confidential inquiries since 1996, has also achieved a substantial reduction in maternal deaths from hypertensive disorders—the rate halved from 1 per 100 000 live births in 2007-09 to 0.5 per 100 000 live births in 2010-12.¹³ The report concludes, however, that scope for improvement remains, estimating that 70% of these deaths could have been avoided with better care.

Implications for clinicians and policy makers

The Global Burden of Disease study of maternal deaths worldwide reported 29 275 maternal deaths from hypertensive disorders (95% uncertainty interval, 25 664 to 33 376) in 2013,

42% (12 232) of which were in sub-Saharan Africa and 36% (10 656) in South Asia.² In these countries with the highest burdens and no confidential inquiry processes, there is a strong case to start inquiries to enable understanding of the specific factors implicated in maternal deaths in each setting and to make targeted recommendations. Importantly, although there may be many similarities and transferable lessons between countries, other factors may differ across healthcare systems, demographics, and income settings, highlighting the context specific nature of each inquiry process. For clinicians and policy makers considering setting up this process, good case ascertainment is a key early priority for meaningful confidential inquiries, and this may have a long latency period as a system becomes accepted and widespread among clinicians, managers, and administrative staff. In the UK it took 30 years for the inquiries to report the same number of maternal deaths as those reported to the registrar general. In this early phase, rapidly improving case ascertainment can initially increase apparent death rates, which may have contributed to the rise in death rates in the first decade of the South African confidential inquiries alongside the HIV epidemic, which contributed to increased maternal deaths at the same time.¹⁴

Where inquiries are already established, an in-depth and integrated review of deaths, healthcare systems, and social context is necessary for pertinent lessons to be learnt and recommendations disseminated. Development and implementation of national, evidence based guidance with specific recommendations pertinent to all settings on aspirin prophylaxis, antihypertensive treatment thresholds, fluid management, and timing of delivery may be a key tool in successfully lowering maternal deaths from hypertensive disorders. But further research into the findings and recommendations of confidential inquiries in other healthcare settings should be undertaken to investigate which recommendations and strategies have been able to reduce deaths most successfully in contexts other than the UK.

In countries where maternal deaths from hypertensive disorders have become a very rare event, confidential inquiries have found that, in the majority of these cases, care could still be improved, and better care may have altered outcome. These findings, together with recent UK mortality statistics, indicate that almost complete eradication of maternal mortality from hypertensive disorders is possible. In countries where maternal mortality is low, inquiries should broaden to include associated maternal morbidity and consideration of the impact of management on perinatal mortality and other adverse fetal outcomes. Reducing the short and long term maternal and fetal complications of hypertensive disorders of pregnancy, as well as aiming for complete eradication of maternal mortality, should be the next goal.

Contributors and sources: FC-R is an NIHR academic clinical fellow in obstetrics and gynaecology. MK is professor of maternal and child population health and leads the MBRRACE-UK national confidential inquiries into maternal morbidity and mortality. MG is CEO of APEC and a member of the confidential inquiry lay summary writing group. AS is professor of obstetrics. LCC is NIHR research professor in obstetrics. The idea was conceived by all authors; FCR reviewed the maternal confidential inquiry reports and produced summary tables and figures with input from all authors. A first draft was written by FCR, and was reviewed and redrafted by LC, MK, AS, MG. LCC is the guarantor of the article.

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pre-eclampsia. Patient group representatives are involved in the Confidential Enquiries into Maternal Death and provide input to design, management, and outputs of the programme.

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Figures

Fig 1 Rates of maternal deaths from hypertensive disorders and maternities over time in the UK

Fig 2 Percentage of direct maternal deaths due to hypertensive disorders over time in the UK

Fig 3 Causes of death from hypertensive disorders in pregnancy by category

Fig 4 Number of deaths from cerebral and pulmonary causes and timing of recommendations for changes in management in the UK