

# The Comparative Study of Maternal Mortality over Time: The Role of the Professionalisation of Childbirth

Vincent De Brouwere\*

**Summary.** Midwifery in western countries emerged during the seventeenth century in France with the training of midwives under supervision of male obstetricians. A wave of new schools of midwifery reached all European countries in the eighteenth century to reduce maternal and infant mortality. During the nineteenth century most European countries adopted a strategy for the promotion of skilled attendance at delivery based on professional midwives who progressively replaced traditional midwives. However, the effectiveness of the strategy reflected by the coverage of deliveries by these midwives varied widely among European countries. This was partly due to a conflict of interest with medical doctors. The reduction in maternal mortality was parallel to the intensity of the coverage by professional midwives with a clear contrast between the USA—with a staggering maternal mortality around 600–800 per 100,000 live births—and Sweden, Denmark, Norway or the Netherlands with a ratio around 250–300 per 100,000 live births. The more recent history of maternal mortality reduction in Sri Lanka and Malaysia showed that technical and political conditions similar to what will be shown to have prevailed in Sweden also permitted the dramatic fall.

**Keywords:** maternal mortality; safe motherhood policy; midwives; USA; Britain; Scandinavian countries; eighteenth century; nineteenth century; twentieth century

The Millennium Development Goal declaration has set out the ambitious objective of a 75 per cent reduction in maternal deaths between 1990 and 2015.<sup>1</sup> During an earlier historical epoch, western countries achieved a remarkably similar feat, reducing maternal mortality from 300–600 maternal deaths per 100,000 live births in 1935 to around 20–30 in 1960. Part of this reduction can be attributed to improvement in the general socio-economic conditions of the population, but the main factor was the universal access of pregnant women to modern obstetric care. However, European and American maternal mortality ratios showed great variations before the advent of modern obstetrics.

Understanding the possible causes of these variations in relation to the safe motherhood policies decided upon and implemented in western countries in past centuries can contribute to a clarification of the context in which such policies may be effective. This is relevant today for developing countries which are sometimes pulled between a policy of institutional delivery and community-based strategies using so-called trained traditional birth attendants in addition to health centre-based intrapartum care.<sup>2</sup>

\*Department of Public Health, Institute of Tropical Medicine, Nationalestraat, 155, 2000 Antwerpen, Belgium. E-mail: vdbrouw@itg.be

<sup>1</sup>United Nations 2000.

<sup>2</sup>WHO 2005; Costello *et al.* 2006.

The aim of this article is to understand better the impact of maternity care-providers on maternal mortality. It is divided into three main sections. The first describes the context in which maternity care was provided in the past. It first sets the scene of childbirth before any documented attempt to structure attendance at birth into something more 'scientific'. A second sub-section discusses the emergence of scientific midwifery with reference to authors of textbooks on obstetrics and the activities of surgeons. A third sub-section shows how training in obstetrics became attractive in eighteenth-century Europe and how the proliferation of midwifery schools reflected a common continent-wide policy to reduce maternal and infant mortality.

The second section analyses and contrasts technical and political factors that shaped safe motherhood policies in the nineteenth and twentieth centuries, and the success of their implementation in Europe, mainly in Sweden and Britain as well as Australia and the USA. The third section discusses evidence regarding the impact of skilled attendance that can be drawn from an analysis of historical maternal mortality trends. The factors that contributed to the reduction of maternal mortality in western countries are summarised in a frame coupling technical and political factors. This frame provides a key to why some developing countries were able to reduce maternal mortality in the twentieth century while others were not. This also relates to Loudon's work on maternal mortality in western countries during the nineteenth to the twentieth century.<sup>3</sup> It uses lessons learned from history to understand the obstacles that may need to be overcome to implement safe motherhood policies.

### Methodology and Limitations

This article is based on three main sources of epidemiological data and analysis. The first is Loudon's seminal work on death in childbirth.<sup>4</sup> The second is the work of Högberg *et al.* on Sweden.<sup>5</sup> The third main source is a book edited by Hilary Marland and Anne Marie Rafferty regarding relevant debates and controversies from the seventeenth to the twentieth centuries.<sup>6</sup> Other works were used to describe the historical context, to clarify specific problems, or bring qualitative elements to the analysis.<sup>7</sup>

One of the first limitations to identifying historical levels of maternal mortality concerns definitions and hence the recording of a death as 'maternal'. Before the second half of the nineteenth century, almost all maternal deaths were direct, occurring during or just less than one week after childbirth. Indirect and late maternal deaths between delivery and 42 days were not systematically recorded as 'maternal', making a significant difference to recorded levels. For instance, Andersson *et al.* showed that in Sweden between 1800 and 1899, maternal mortality ratios per 100,000 live births were 256.4 for direct obstetric deaths, 320.7 for direct and indirect obstetric deaths, 489.2 for pregnancy-related deaths (deaths of women while pregnant or within 42 days of

<sup>3</sup>Loudon 1988, 1992a, 1992b.

<sup>4</sup>Loudon 1986, 1988, 1992a, 1992b; Loudon in Marland and Rafferty (eds) 1997.

<sup>5</sup>Andersson *et al.* 2000; Högberg and Wall 1986a; Högberg and Wall 1986b; Högberg *et al.* 1986; Högberg 2004.

<sup>6</sup>Marland and Rafferty (eds) 1997.

<sup>7</sup>Shorter 1982.

termination of pregnancy, irrespective of the cause of death) and 837 for pregnancy-related and late maternal deaths (direct and indirect maternal deaths from 42 days to one year).<sup>8</sup> In the first half of the twentieth century, the published US maternal mortality ratio comprised direct and indirect maternal causes of death, while in Britain only direct maternal causes of deaths were considered. This means that during this period, between 10 and 20 per cent 'non puerperal causes' of the high maternal mortality rate in the USA compared with Britain was due to the difference in the way maternal mortality was recorded in the two countries.<sup>9</sup> However, this does not change the rank of the USA nor explain its high maternal mortality compared to other western countries.

Before 1930, direct obstetric deaths in childbirth were nowhere systematically recorded. Shorter found that in Denmark from 1882 to 1889, 16 per cent of maternal deaths were not considered maternal; in Aberdeen between 1918 and 1927, 13 per cent of deaths due to puerperal sepsis were not recorded as maternal.<sup>10</sup> Therefore, figures reported in vital statistics certainly underestimated maternal mortality. This is still the case, even in the USA and Europe.<sup>11</sup>

A second limitation is linked to the difficulty of controlling biases in interpretation of the reduction of western maternal mortality as only due to modern obstetrics or the excellence of nineteenth-century midwifery services in some countries. In fact, the appalling conditions in which the poor lived in the industrialised nineteenth century are also significant, with nutritional deprivation leading to rickets or vitamin A deficiency within a context of hygienic deficiency. These deficiencies had a direct impact on maternal mortality, for example rickets on obstructed labour, or vitamin A on the capacity to resist infection.<sup>12</sup>

### Before the Emergence of a 'Scientific Approach'

Before the eighteenth century, no nation recorded vital statistics, and therefore no population-based maternal mortality measurements exist. It is therefore difficult to evaluate the impact of birth attendants on maternal mortality before this time. However, anecdotal evidence shows that, in general, birth attendants were rarely able to prevent maternal deaths and may even have been one of its causes.

Levels of maternal mortality have been studied in the few places where maternal deaths can be related to total number of deliveries. Wilmott-Dobbie reported a ratio of between 2,440 and 2,940 per 100,000 live births in three Somerset parishes between the sixteenth and eighteenth centuries.<sup>13</sup> On the basis of the London Bills of Mortality, he calculated the rate of women recorded as dead in childbirth at 1,590 per 100,000 baptisms. He considers this to be an underestimate of the true maternal mortality ratio since ectopic pregnancies, fatal abortions and late deaths would probably not have been noted

<sup>8</sup>Andersson *et al.* 2000.

<sup>9</sup>Loudon 1992a, p. 33.

<sup>10</sup>Shorter 1982.

<sup>11</sup>Deneux-Tharaux *et al.* 2005.

<sup>12</sup>Kaufman 1995; Green *et al.* 1931.

<sup>13</sup>Wilmott-Dobbie 1982.

as maternal. These very high levels are not exceptional and other studies in Europe show levels between 1,200 and 2,400 maternal deaths per 100,000 deliveries before 1800, even if on average only 1.3 per cent of deliveries ended with a maternal death.<sup>14</sup>

Birth attendants before the nineteenth century were predominantly female. In urban areas, midwives were experienced, independent and superintended by qualified and respected peers, while in rural areas, where the majority of the population lived, traditional birth attendants were neither trained nor superintended.<sup>15</sup>

In rural Europe, traditional birth attendants intervened when the delivery did not progress naturally. Even during normal labour, some thought it important to demonstrate their usefulness by artificially rupturing the membranes or pulling out the placenta before delivery. In the event of a problem, different popular remedies were used, ranging from magic charms to drugs. Some of these were effective, others toxic. If labour did not progress, the baby was pulled out by taking hold of it. If the baby was still completely *in utero*, some attendants tried an internal, podalic version-extraction, as described in 1550 by Ambroise Paré.<sup>16</sup> Others used sharp hooks to perforate the baby's head and pull out the body. Only a few surgeons and physicians knew how to use a forceps before the nineteenth century. In summary, although traditional know-how was well adapted to normal deliveries, bringing social support and encouragement, it was generally of little or no use in the event of complications.

As a consequence of frequent vaginal examinations and unhygienic intervention, infection occurred in about 4 per cent of home deliveries with a fatality rate of 20 per cent.<sup>17</sup> More than 50 per cent of maternal deaths were due to puerperal sepsis.<sup>18</sup> As an epidemic, puerperal fever, due to *Streptococcus pyogenes*, seems to have first appeared in 1652 in Leipzig and then spread to the whole of Germany and to Paris in 1664, London in 1760 and Dublin in 1770, followed by all other European countries in the eighteenth century.<sup>19</sup>

### Emergence of an 'Art of Midwifery' and Training

Midwifery became more of a 'science' during the seventeenth century. Louise Bourgeois, the royal midwife to Queen Marie de Médicis, wrote a manual in 1609.<sup>20</sup> In France, at the beginning of the seventeenth century, *accoucheurs*, usually male surgeons, were called in to assist if there had been several days of unsuccessful labour. During this period, they were consulted in cases of emergency, when strength and the use of sharp instruments were required. This introduced men into childbirth.<sup>21</sup> François Mauriceau published his textbook of obstetrics in France in 1668, followed by colleagues like Cosme Viardel

<sup>14</sup>Shorter 1982.

<sup>15</sup>Gélis 1984.

<sup>16</sup>Shorter 1982.

<sup>17</sup>Ibid.

<sup>18</sup>Bardet *et al.* 1981; Shorter 1982.

<sup>19</sup>DeLacy 1989; Gélis 1984.

<sup>20</sup>An earlier printed illustrated manual for midwives was published in 1506 by Rösslin in Germany, and this was improved upon in 1554 by Rueff (Edmonson and Kassen 2006).

<sup>21</sup>McTavish 2001; Knibielher and Fouquet 1977.

(1671), Paul Portal (1685), Philippe Peu (1694) and Pierre Dionis (1718). Johan Von Hoorn published a textbook for Swedish midwives in 1697.

These textbooks contributed to the foundation of modern midwifery in France and neighbouring countries. During the seventeenth century, French male midwives were not opposed to female practitioners. Their entry into a woman's domain of delivery was indeed rather soft.<sup>22</sup> Increasing control of childbirth by male physicians would only come in the nineteenth century.

The training of midwives became a concern in many European countries at the beginning of the eighteenth century when the first schools were established. In France, the Hotel Dieu maternity hospital, founded in 1630, trained midwives under the supervision of famous surgeon obstetricians. The Strasbourg School of Midwifery opened in 1737. Between 1760 and 1783, Angélique Marguerite Le Boursier du Coudray, a Parisian certified midwife, travelled through provincial France and the Netherlands, instructing more than 10,000 local women in the practice of childbirth. She wrote a textbook in 1777 with colour-printed plates on the physiology of delivery, and designed a life-size birthing mannekin for teaching.<sup>23</sup> At the end of the eighteenth century, during the Republican period, French districts were required to fund women for a six-month course at the Paris Maternité.<sup>24</sup> In Sweden, Von Hoorn began lectures to midwives in 1708 in Stockholm and became 'the first paid, state-employed teacher of midwives' in 1723.<sup>25</sup> The first professor of obstetrics was appointed in 1761. In 1757, the Collegium Medicum proposed a national training programme for midwives covering all parishes. The government supported it and each parish was expected to pay for students' allowances.

Joseph Gibson was appointed by the Town Council of Edinburgh in 1726 as the first professor of midwifery in Britain.<sup>26</sup> At the end of the century, approximately 25 midwives from all over Scotland were trained annually. In Prussia, a school of midwifery was created in 1751 in Charité Hospital in Berlin based on the Hotel Dieu model, with classes on anatomy, obstetrics and the practice of delivery under supervision. In the same year, Göttingen founded the first German university clinic for obstetrics and in 1779 an independent professorship in midwifery was established in Berlin.<sup>27</sup> In Denmark, a School of Midwifery was set up in 1787 at the Royal Lying-in Hospital of Copenhagen.<sup>28</sup> The rise of these schools reflected a consensus in European states that improvements to midwifery education were the answer to reducing maternal and infant mortality.<sup>29</sup> The regulation of the 'profession' was initiated in some European states before the definition of the midwifery education programmes. In Paris, the first ordinance regarding midwives was introduced in 1560, a century before the opening of the midwifery school. In Angers, a professional oath was imposed on midwives in 1617. Similarly, according to a law of

<sup>22</sup>McTavish 2001.

<sup>23</sup>Bower 2003.

<sup>24</sup>Donnison 1988.

<sup>25</sup>Romlid in Marland and Rafferty (eds) 1997, p. 39.

<sup>26</sup>Nuttall 1999.

<sup>27</sup>Tuchman 2005.

<sup>28</sup>Løkke in Marland and Rafferty (eds) 1997.

<sup>29</sup>Tuchman 2005.

1672 in Denmark, medical doctors were to be recognised as *medici* by the professors of the medical faculty and were responsible 'for ensuring that towns were provided with good midwives, whom they were to instruct and examine'. A decree of 1714 issued the requirement for a midwife to be authorised to practise by a special Board of Midwifery. The first Danish School of Midwifery was set up in 1787.<sup>30</sup> A similar sequence was followed in Prussia, Sweden and the Netherlands. Britain was an exception. The first regulation was imposed as belatedly as the Midwife Act in 1902, much later than the creation of midwifery schools.

In the USA, the situation was less uniform. Some states had a midwifery school as early as the mid-nineteenth century. Regulation requiring registration followed in the 1870s. However, some states initiated regulation much later, as late as 1909 in Wisconsin. On the other hand, states such as Massachusetts forbade midwifery practice in 1894 by refusing to license midwives and by recognising attendance at childbirth as medical practice.<sup>31</sup> This was driven by obstetricians who wanted to avoid competition from trained midwives. However, enforcement was clearly not rigid, as in 1913 more than a dozen active midwives attended almost 100 deliveries a month.<sup>32</sup>

The purpose of such regulation was primarily to clarify the domain of male physicians or surgeons (women were not authorised to learn medicine or surgery), and that of midwives, the latter being hierarchically dependent on the former. Importantly, the training of midwives preceded the training of medical students in many of these countries.<sup>33</sup> Interpretation is of course complex. On the one hand, one can consider this order of preference as a rational policy since it may appear logical to start the training with those who perform the most deliveries. On the other hand, one can see it as a gender and hierarchical issue reflecting the aim of physicians to control midwives.

During the eighteenth century, caesarean section was often used in an attempt to save mothers' lives. The first documented caesarean section in Britain was performed by a Mr Smith, a surgeon in Edinburgh, in 1737. However, at the end of the eighteenth century in Britain, only 19 caesareans had been performed. The reasons appear to have been small pelvis due to rickets.<sup>34</sup> Only two mothers and seven children survived.<sup>35</sup> While British doctors were not in favour of caesareans, the situation was different in France where in 1798 Baudelocque claimed a success rate, judged in terms of the survival of the mother, of 31 out of 73 caesarean sections. However, such successes remained anecdotal until the improvement of the technique at the end of the nineteenth century.

Between 1750 and 1800, maternal mortality decreased by 30 per cent in Sweden and by 40 per cent in England and Wales (Figure 1). It is not possible to attribute this decrease to an improvement in midwifery practice but there is no other convincing explanation to

<sup>30</sup>Løkke in Marland and Rafferty (eds) 1997.

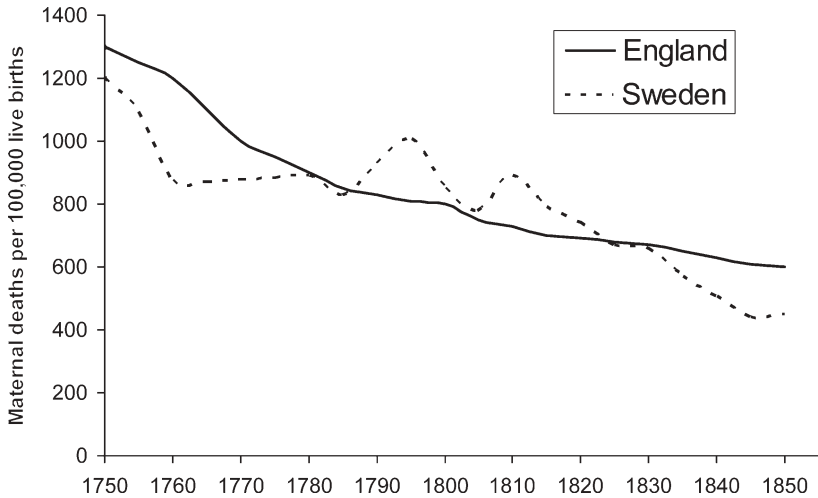
<sup>31</sup>Borst 1988.

<sup>32</sup>Declercq and Lacroix 1985.

<sup>33</sup>It was documented for Sweden where midwifery became available for medical students in 1775; compulsory in 1791 in Germany for physicians and surgeons who wanted to practise obstetrics; in Brazil in 1832, together with midwives, but without clinical training before 1880; compulsory in 1833 in Scotland; compulsory in 1886 in England.

<sup>34</sup>Kaufman 1995.

<sup>35</sup>Francome *et al.* 1993.



**Fig. 1.** Maternal mortality in England and Wales and Sweden, 1750–1850. *Source:* Loudon 1992a; Högberg *et al.* 1986; Högberg and Wall 1986a.

challenge this. Indeed, the proportion of instrumental deliveries by physicians remained very low. Neither economic nor nutritional conditions improved and the virulence of *Streptococcus* remained high. Progress towards the reduction of maternal mortality was slow but steady and this would continue to be the case in all western countries, though noticeably faster in Denmark, Norway, Sweden and the Netherlands, until the early twentieth century.

### Elaboration of Safe Motherhood Policies

With the exception of the early examples of Denmark and Sweden, it was not until the nineteenth century that most western countries became aware of the high level of maternal mortality following the collection of vital statistics.

The decline in maternal mortality observed in Sweden was attributed to community midwives and the actions of the government.<sup>36</sup> Professional regulations were continually evolving after the first formal training of midwives at the beginning of the eighteenth century. The first national midwife status was introduced in 1777 and this status did not allow midwives to use instruments. In 1819, the status changed, authorising midwives to give medicines but not to use instruments. Ten years later, the government authorised midwives, under strictly defined conditions, to attend an additional three-month training programme in the use of obstetrical instruments.<sup>37</sup> The use of forceps and hooks was strictly regulated and midwives were required to report their use. The proportion of instrumental interventions never rose above 0.5 per cent of deliveries. Later, care of infants, health education of the population, vaccination and

<sup>36</sup>Högberg 2004.

<sup>37</sup>Romlid in Marland and Rafferty (eds) 1997.

the application of leeches and blood-letting were added to their duties. Indeed, the relatively low workload of rural midwives—37 deliveries per year on average in the 1860s—made this feasible.<sup>38</sup> Basic training was extended to nine months and in the 1860s, midwives were taught gynaecology and care for the diseases of childhood. This medical role, sometimes challenged by Swedish doctors, may have succeeded because of the low number of medical doctors compared to midwives. The figure was 3.11 midwives per doctor in 1870. The number of doctors only exceeded the number of midwives after 1935. However, the process of replacing traditional birth attendants by trained midwives was slow, mainly due to resistance by the rural population. Not until 1900 did the proportion of births attended by licensed midwives reach 78 per cent. The figure had been 40 per cent in 1860.

At the turn of the twentieth century, licensed midwives were respected both by the population and the medical doctors with whom they had very few conflicts. An explanation may lie in the very small number of obstetricians working exclusively in the three major towns. It may also have been the result of a shared public health vision. According to Högberg, the two professional bodies 'complemented rather than competed against each other'.<sup>39</sup>

Maternal mortality fell from 850 in 1800 to 228 per 100,000 live births in 1900 (Fig. 2). This steep decline was, however, interrupted by general epidemics of communicable diseases. A particularly significant fall can be noted between 1860 and 1900. This was attributed to the use of antiseptics, discovered by Lister in 1867 and imposed by decree. The technique has been estimated by Högberg *et al.* to have reduced mortality from puerperal sepsis by 48 per cent.<sup>40</sup> The assistance of midwives reduced non-septic mortality by 46 per cent. In other words, non-septic maternal mortality has been reduced from 414 to 122 per 100,000 live births.

In 1881, in England and Wales, slightly less than half of all deliveries were performed by about 10,000 mainly untrained midwives. Until the beginning of the twentieth century, most of these practitioners were untrained and looked down upon by physicians. Training was by apprenticeship to a more experienced birth attendant. This contributed to a stereotypical image of 'ignorant midwives' cultivated by general practitioners who were in direct competition with them.<sup>41</sup> The remainder of the deliveries were performed by 18,000 general practitioners, of the 19,000 registered, and this 'excess' of supply made competition fierce.<sup>42</sup>

The reform of the midwife statute was slow but facilitated, in spite of the opposition of general practitioners, by a small group of advocates, among whom was William Farr, senior statistical officer at the General Registry Office. The case of Sheffield, described by McIntosh, well illustrates the situation of midwives before and after the Midwife Act of 1902.<sup>43</sup> Midwives in Sheffield belonged to three groups: trained midwives

<sup>38</sup>Högberg 2004.

<sup>39</sup>*Ibid.*

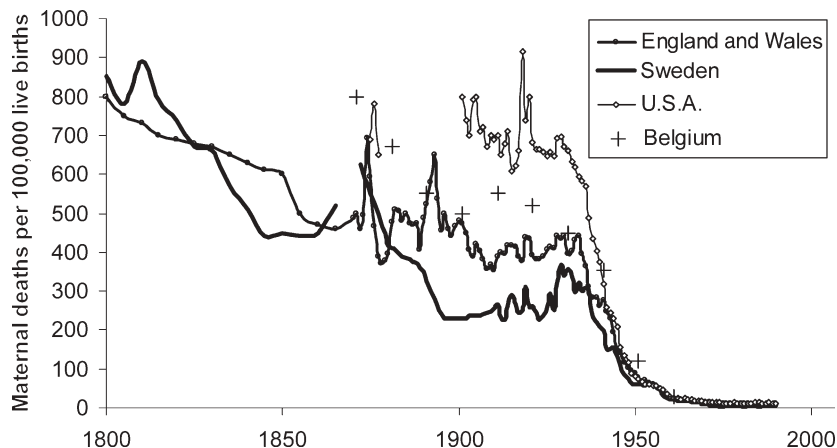
<sup>40</sup>Högberg *et al.* 1986.

<sup>41</sup>Pelling *et al.* in Webster (ed.) 1993.

<sup>42</sup>Loudon 1992.

<sup>43</sup>McIntosh 1998.





**Fig. 2.** Maternal mortality in Sweden, USA, Belgium and England and Wales, 1800–1990. Sources: Howard 1921; Högberg *et al.* 1986; Högberg and Wall 1986a; Loudon 1992a; WHO and Unicef 1996; Masuy-Stroobant and Humblet 2004.

working in Sheffield Hospital for Women, opened in 1864; independent practitioners in the city; and ‘handywomen’, employed casually to assist in or perform a delivery. Untrained midwives could be registered on the Roll after 1905.<sup>44</sup> They were called *bona fides* because they were certified ‘by virtue of bona fide practice’.<sup>45</sup> As training became a condition for inclusion in the Roll after 1910, the number of *bona fides* progressively fell (Fig. 3). The data suggest that 87 per cent of midwives were trained by 1925, rising to 97 per cent by 1935.<sup>46</sup>

The purpose of the 1902 Midwife Act was ‘to secure the better training of midwives and to regulate their practice’, and accelerate the replacement of untrained midwives by trained midwives.<sup>47</sup> It was part of a national policy to improve quality of obstetric care. The process was slow and even if the number of *bona fides* fell, the number of deliveries performed by untrained midwives continued to be higher than those performed by trained midwives. This is illustrated in Figure 4.

McIntosh has concluded that the Midwife Act of 1902 had ‘more of an impact on doctors’ impressions of midwives than on the way midwifery actually was practised or the type of women undertaking it’.<sup>48</sup> If most deliveries were performed by general practitioners, obstetrics was a low-status domain of medicine in England and Wales. Obstetrics was taught in universities only after 1840, and only became compulsory for

<sup>44</sup>Following the Midwife Act of 1902, the Central Midwives Board was created with the responsibility of issuing midwives’ certificates and of keeping the Roll of midwives. Midwives who did not register on the Roll would have problems in practising: it was considered a criminal offence and liable to a fine by the local magistrate’s court (Stevens 2002).

<sup>45</sup>Ettinger in Smith and Tomes (eds) 2006.

<sup>46</sup>McIntosh 1998.

<sup>47</sup>Stevens 2002.

<sup>48</sup>McIntosh 1998.

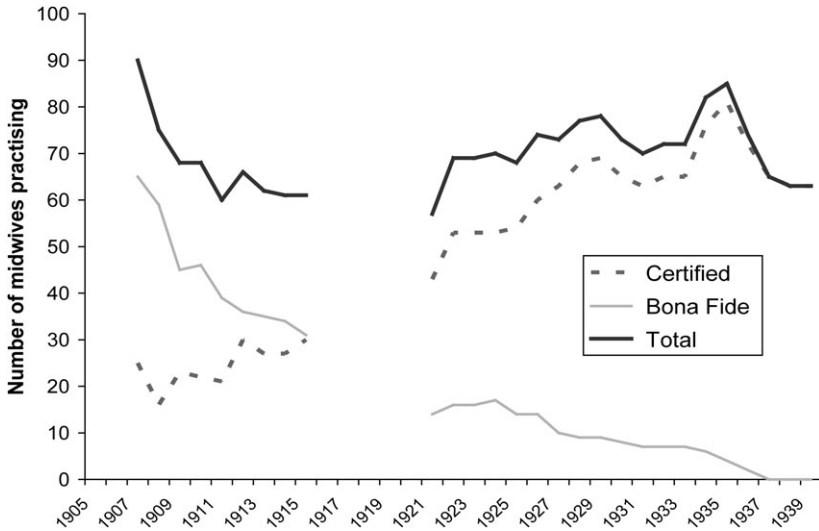


Fig. 3. Number of midwives in Sheffield, 1907–1940. Source: McIntosh 1998.

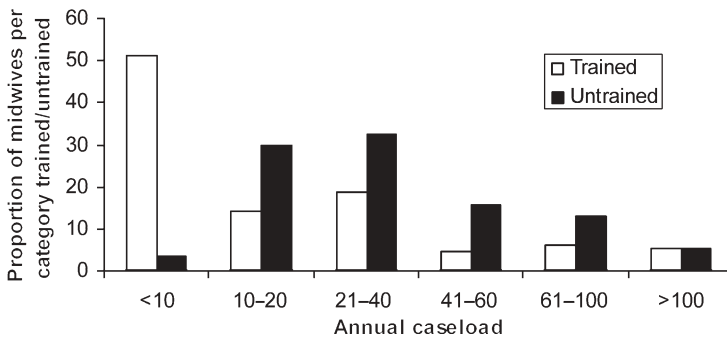


Fig. 4. Distribution of Midwives According to Training Status and Annual Case-Load Category in the West Riding, 1916. Source: Bullough 1917; McIntosh 1998.

physicians in 1886. Meanwhile, half of deliveries continued to be performed at home by general practitioners not trained in obstetrics. Home birth was the rule until the Second World War with only 15 per cent of deliveries taking place in hospitals or nursing homes in 1927, 24 per cent in 1933 and 35 per cent in 1937.<sup>49</sup> The problem with general practitioners was undue interventionism, abuse of chloroform, and forceps delivery performed in the absence of aseptic conditions. At least a third of maternal deaths between 1910 and 1935 were caused by unjustified intervention.<sup>50</sup> Although the

<sup>49</sup>Loudon 1986.

<sup>50</sup>Loudon 1992a.

Royal College of Gynaecologists and Obstetricians was founded in 1929 with the intention of creating an obstetric specialty and improving standards of care, it only became effective after the Second World War.

Public awareness played an important role in putting maternal mortality on the agenda. Under the pressure of public opinion, the Ministry of Health set up a commission in 1928 to reduce maternal morbidity and mortality. Two years later, the report identified 'primary avoidable factors' and recommended confidential enquiries of maternal deaths involving obstetricians and midwives.<sup>51</sup> In 1938, the 'Mothers' Charter' Conference was attended by women from over 60 local associations.<sup>52</sup> By 1935, maternal mortality ratios began to fall, mainly as a result of a steady decline in puerperal infection.<sup>53</sup> During and after the Second World War, the capacity to handle major emergencies in a hospital environment further reduced levels to around 85 maternal deaths per 100,000 live births in 1950. It was not until 1949 that confidential enquiries into maternal deaths drew attention to other preventable causes of maternal mortality.<sup>54</sup> With the development of new knowledge, and under strong pressure from the public, obstetric specialists and primary care-providers became aware of their role and started assessing the need for improvements; control of bleeding, safe anaesthesia and effective emergency obstetric services.<sup>55</sup> These enquiries constituted a medical audit, and resulting awareness among care-providers contributed significantly to the decline from 87 to 25 per 100,000 between 1950 and 1965.<sup>56</sup>

In summary, compared with Scandinavian countries, British policies lacked vigour and, despite the fact that the technical knowledge was similar, the decline of maternal mortality only occurred after 1935. Low standards of obstetric practice, poor leadership at the Ministry of Health and insufficient funding by local authorities explain British tardiness.<sup>57</sup>

In the early nineteenth century, America's population was predominantly rural with only about 20 per cent of its people living in cities. Around the mid-nineteenth century, rapid urbanisation set in. In rural areas, the practice of obstetrics was less interventionist than in cities. In the former, physicians and midwives had similar maternal outcomes in terms of mortality with low frequency of intervention with forceps or ergot.<sup>58</sup> The incidence of puerperal fever was also lower than in urban areas, partly due to more scattered households and low frequency of deliveries by physicians, and partly to the non-interventionist approach of practitioners.

At the turn of the twentieth century, about 50 per cent of births were assisted by a midwife. Most were either European or Mexican immigrants or southern-born African-American birth attendants. European immigrant midwives were very well

<sup>51</sup> Godber 1994.

<sup>52</sup> Oakley 1984.

<sup>53</sup> Loudon 1988; Baird 1960.

<sup>54</sup> Lewellyn-Jones 1974.

<sup>55</sup> Klein and Clahr 1958.

<sup>56</sup> Lewellyn-Jones 1974.

<sup>57</sup> Loudon 1992*b*.

<sup>58</sup> Berman 1995.

educated compared to indigenously trained physicians.<sup>59</sup> In 1930, only 15 per cent of births were attended by midwives, mainly in the South.

Vital statistics began to be collected for the whole country only after 1920, although maternal deaths recorded in large cities suggested maternal mortality ratios well above European levels with ratios of 885 per 100,000 live births in 1918.<sup>60</sup> This was as high as Sweden a century earlier.<sup>61</sup>

Official recognition of the need for maternal health programmes emerged in 1920 with the establishment of the National Maternal Welfare Committee, which aimed at encouraging analysis of maternal death and prevention of maternal deaths through education, hospital members, the community and the medical profession.<sup>62</sup> During the same period, obstetricians, seeking to develop obstetrics, and public health nurses, aspiring to establish specialist midwifery, joined forces in a campaign to eliminate so-called traditional birth attendants. This proved to be a racist campaign aimed at discrediting immigrant and African-American midwives.<sup>63</sup> A professional conflict erupted.

A first attempt to introduce midwifery training for nurses, and hence to create a new identity—the nurse-midwife—failed in 1911. A second attempt failed again in 1923, when the Maternity Center Association opened a midwifery education programme for nurses. However, in 1925, Mary Brekinridge, a midwife, established the Frontier Nursing Service in the Appalachian Mountains. The results were impressive: 66 maternal deaths per 100,000 live births in 1935–7, 75 over a 10 year period, compared to 440–530 for the average white population of Kentucky in 1925–37.<sup>64</sup> This experience and the perseverance of the Maternity Center Association, together with the vision of a few nursing leaders and physicians, created conditions for the emergence of the American nurse-midwife in 1955.<sup>65</sup> It also led to the disappearance of the independent midwife.<sup>66</sup>

Meanwhile the campaign against midwives did not end, even in the light of evidence presented in 1927 by J. Baker, director of the Maternal and Children Bureau. This was namely that midwives recorded better maternal outcomes than physicians. Baker contrasted states where virtually 100 per cent of childbirths were assisted by physicians with those where midwives still delivered between 9.4 and 21.7 per cent of births: the maternal mortality ratio was 5.3–6.4 per 1,000 live births with midwives and between 6.8 and 9.0 where obstetricians had a monopoly.<sup>67</sup> Resistance against midwives continued even when, in 1933, the results of the first analysis of maternal deaths, recommended by the National Maternal Welfare Committee, suggested that 61.1 per cent of 1,404 preventable deaths should be assigned to physicians rather than

<sup>59</sup>Dawley 2003.

<sup>60</sup>Pearl 1921.

<sup>61</sup>Howard 1921.

<sup>62</sup>Llewellyn-Jones 1974.

<sup>63</sup>Dawley 2003.

<sup>64</sup>Loudon 1997.

<sup>65</sup>Dawley and Burst 2005.

<sup>66</sup>Borst 1988.

<sup>67</sup>Baker 1927.

midwives.<sup>68</sup> Preventable deaths accounted for 66 per cent of all maternal deaths during the period.<sup>69</sup>

In part, the success of the campaign against midwives can be attributed to the fact that it linked them to abortionists. Abortion was perceived by politicians as a threatening expression of women's new-found sexual freedom.<sup>70</sup> Midwives' autonomy was sacrificed for credibility of and access to the health care system, and the midwife as a health care provider for birthing women disappeared.<sup>71</sup> The price mothers paid for this conflict was extremely high. Loudon calculated that during the 1920s, at least 200,000 lives might have been saved by a maternity system based on trained midwives.<sup>72</sup> In 1921, the federal government's Sheppard-Towner Act targeted infant and maternal health, but the resulting programmes did not greatly benefit the poor, and particularly not blacks, in rural areas.<sup>73</sup> The Social Security Act of 1935 offered \$3.8 million to states annually for maternity and infant care. During the Second World War, a new programme was established to fill the gap left by the shortage of physicians serving abroad. The Emergency Maternity and Infant Care Program (EMIC) subsidized maternity care for home as well as hospital births for women whose husbands were serving in the army. This programme helped design standards of care in terms of personnel, infrastructure, services and tariffs. The EMIC may have had the most important impact on quality and quantity of maternal care compared to other factors between 1943 and 1945.<sup>74</sup> A few years after the Second World War, nearly all women were delivered in hospitals where new technologies such as caesarean sections, antibiotics and blood transfusion became safe and available for most. As a consequence, maternal mortality ratios fell steeply and reached the same levels as in other western countries in the 1950s.

Maternal mortality ratios in France, Belgium, Germany, Italy and Spain never fell at the rate of those observed in Denmark, Norway, Sweden and the Netherlands. However, France and Germany were among the first European countries to regulate and train midwives. Belgium had a policy of home births with trained midwives from 1823 with the creation of midwifery schools in eight of the nine Belgian provinces. The provincial authority organised the allocation of fellowships paid by municipalities with the aim of replacing traditional birth attendants. Antisepsis was introduced in obstetrics in 1880 and the practice of antisepsis was taught in midwifery schools from 1886, five years later than in Sweden, with the organisation of continuing training for midwives already certified. Asepsis was introduced in 1892 and became compulsory for practitioners from 1894. However, Belgian maternal mortality remained stable between 450 and 550 until the Second World War.<sup>75</sup> In South Australia from 1836 until the final decade of the nineteenth century, women were delivered at home with a birth attendant and sometimes a midwife. The first formal training of midwives began in 1902, after the

<sup>68</sup>King 1991.

<sup>69</sup>Porges 1985.

<sup>70</sup>Reagan 1995.

<sup>71</sup>Burst 2005; Ettinger 1999; Stone 2000.

<sup>72</sup>Loudon 1997.

<sup>73</sup>Thomas 2004.

<sup>74</sup>Schmidt and Valadian in Hanlon (ed.) 1969.

<sup>75</sup>Masuy-Stroobant and Humblet 2004.

foundation of the Queens Home, the first maternity hospital in South Australia. However, after the opening of the Adelaide Hospital in 1876, the formal training of nurses began. Community midwives, formally trained or certified by local physicians on the basis of their experience, 'worked with general practitioners in a mutually supportive relationship, with the midwife working sometimes independently of the medical men but the medical men never working independently of the midwife' as far as deliveries were concerned.<sup>76</sup> In 1920, maternal mortality ratio was around 500 per 100,000 live births, in the middle range of western countries.

### The Impact of Skilled Attendance

The best evidence we have of the impact of skilled attendance on maternal mortality is offered by Högberg's calculation of non-septic maternal mortality plotted against the progressive coverage of deliveries by trained midwives between 1861 and 1900.<sup>77</sup> The correlation between coverage and maternal mortality is almost perfect and the steep fall was almost certainly due to the increased proportion of deliveries by trained midwives.

A second example of the impact of skilled attendance is the prevention of puerperal infection, which was the major killer from the seventeenth to the twentieth century. The discovery of the transmission of infection and of antiseptics by Lister in 1867 contributed to prevention.<sup>78</sup> Later in 1880, asepsis and sterilisation of instruments improved prevention, and was applied in surgery and obstetrics from the 1880s. Puerperal sepsis due to haemolytic streptococcus did not disappear until the introduction of sulphonamides in 1937 and penicillin in 1944. According to Loudon, its final disappearance in western countries was partly due to a reduction in virulence. Before antibiotics, incidence of puerperal sepsis was significantly reduced when practitioners managed to apply antiseptic and asepsis. In Sweden and Denmark, teaching of preventive measures was particularly effective compared with Germany, France or Britain.<sup>79</sup> Högberg calculated that the antiseptic technique would have reduced mortality from puerperal sepsis by 48 per cent. There is no clear evidence for this plausible explanation. The non-interventionist approach of Swedish midwives already went a good way to limiting the risk of contamination. In the nineteenth century, general practitioners in Britain contributed to maternal mortality by abuse of forceps: poor women who could not afford a medical doctor had a lower rate of childbirth mortality. The 1933 report of the New York study on maternal mortality stated: 'The data reveal an excessive rate of the caesarean section and as a result a great increase in mortality. . . . A sharp reduction in the number of caesarean sections performed is to be recommended.'

A third example of the impact of skilled attendance is the general fall in maternal mortality after the Second World War, when all western countries made effective obstetric and post-abortion care available for nearly every woman.

<sup>76</sup>Summers 2000.

<sup>77</sup>Högberg *et al.* 1986.

<sup>78</sup>Ackerknecht in Ackerknecht (ed.) 1982; Carter and Tate 1991.

<sup>79</sup>Løkke in Marland and Rafferty (eds) 1997.

## Conclusion

When examining historical trends in maternal mortality through the lens of public health and focusing on health system organisation and policy decisions, the combination of several technical and political conditions appear to have played a decisive role.<sup>80</sup> Figure 5 summarises factors that made early reduction of maternal mortality possible in certain countries, while circles note the obstacles in other countries.<sup>81</sup>

Information on the magnitude of the problem is the first element that characterises countries with an early reduction of maternal mortality. This was the case in Sweden (1749), Denmark (1801) and Norway (1801). In the Netherlands vital statistics only became available in 1839 but the reduction of maternal mortality was similar to that in Sweden. In other countries such as Belgium (1830), England and Wales (1838) and Germany (1841), information on levels of maternal mortality became available later. However, information alone was not enough and the willingness of governments to improve the general health status of the population was certainly a major driver of reform. Public authorities reacted to this information, or at least reaction is better documented in Sweden, where the concept of avoidable death led to the acceleration of the training of midwives. This willingness was associated with a desire to stimulate population growth and the 'quality of its children', a condition considered important to the provision of large numbers of strong and healthy soldiers.<sup>82</sup> Also it was considered important to the general development of the country.<sup>83</sup> Whatever the sources of pressure, whether political or physical, modernisation of a country and of its health service organisation was clearly a concern in Sweden and in Denmark. It was a matter for public debate. The role of public pressure exercised through committees and associations would appear later in the early twentieth century in the USA and England and Wales.<sup>84</sup>

A second element of success was linked to the professionalisation of midwives. Professionalisation meant competent, accountable and autonomous providers of care, at least when no physician was available. Professionalisation occurred in the eighteenth century in Sweden and Denmark. This allowed midwives to be educated to undertake medical intervention. In Sweden, some midwives were trained to use forceps. This was also the case in Denmark and to a lesser degree in the Netherlands, where midwives still occupy the position of primary care providers.<sup>85</sup>

This is not to say that physicians were not professionals. However, so far as childbirth is concerned, except in some rural areas, they had little time to attend to deliveries with the required patience and were prone to use instruments to accelerate delivery. In the USA, abuse of technology in urban practice was identified as a major determinant of consistently high maternal mortality levels until the Second World War. Even untrained

<sup>80</sup>De Brouwere *et al.* 1998.

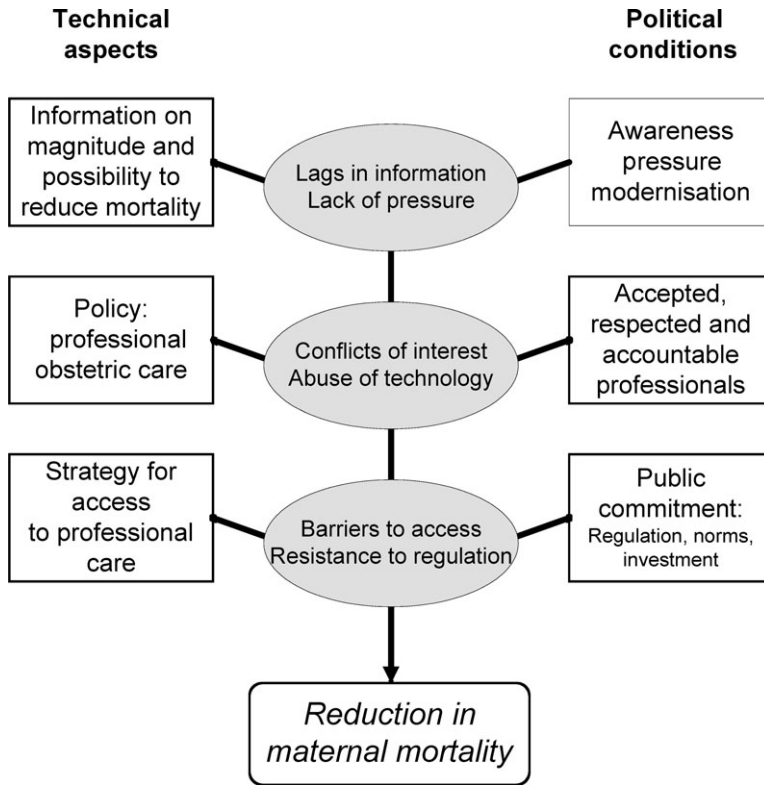
<sup>81</sup>Van Lerberghe and De Brouwere 2001.

<sup>82</sup>Romlid in Marland and Rafferty (eds) 1997.

<sup>83</sup>Løkke in Marland and Rafferty (eds) 1997.

<sup>84</sup>King 1991; Shorter 1982. For example, the 1938 Conference, which gave rise to a comprehensive 'Mothers' Charter' in Britain, was attended by women from over 60 local, non-medical associations (Oakley 1984).

<sup>85</sup>Devries and Barroco in Marland and Rafferty (eds) 1997.



**Fig. 5.** Factors contributing to the reduction of maternal mortality in western countries and related obstacles. *Source:* Adapted from Van Lerberghe and De Brouwere 2001, p. 13.

midwives recorded better maternal outcomes than physicians. Medical doctors also seemed to be less compliant with rules of hygiene and there is evidence that infection was more frequent when physicians delivered (Table 1). The non-interventionist approach

**Table 1.** Maternal deaths due to puerperal sepsis per 100,000 births, 1921–1927

Countries in which midwife deliveries predominated		Countries in which delivery by doctor predominated	
British midwives*	33	New Zealand	182
Holland	77	England and Wales	146
Denmark	95	Scotland	182
Norway	71	Ireland	179
		Australia	170

*Note:* \*The figures shown here for British midwives are those for 317,758 domiciliary deliveries by the Queen’s Institute of District Midwives.

*Source:* H. Jellet, *The Causes and Prevention of Maternal Mortality*, 1929, cited by Loudon 1988, p. 209.



in this era of untreatable communicable diseases seems to have been a major determinant of low maternal mortality levels.

Professionalism also meant accountability: midwives had to report their activities to the medical establishment. As a consequence of the recognition of their status by the government and effectiveness during deliveries, they became respected by the population who progressively stopped using traditional birth attendants.

Conflict between doctors and midwives occurred in all western countries. Although it was termed a 'conflict of Professionalisation', it was in fact an underlying competition for a share of the market. This conflict was less significant in Sweden, probably because of the long-standing existence of large numbers of midwives and also because they had secured the confidence of the public before they were outnumbered by physicians. Conflicts were documented in the USA, Britain, Belgium, Spain, Germany (where midwives were protected by the law) and sporadically in Denmark and the Netherlands. In the last of those countries, it caused little damage, since midwives were supported by the population and by municipalities.<sup>86</sup>

The third element was the implementation of a scaling-up strategy for access to professional care. Those countries that managed to provide professional obstetric care to cover the whole population, including poor and remote areas, achieved a relatively low level of maternal mortality earlier than others, even before the era of modern obstetrics in the second half of the twentieth century. 'It was not, however, merely a question of public authorities making the right policy choice; it was also a matter of being able to implement such a policy with enough authority to make professional delivery care accessible.'<sup>87</sup> Indeed, the Belgian decision was similar to that of Sweden or Denmark, but did not have the same success. For instance, in 1911, only 13 of the 103 municipalities of the Leuven region were able to recruit a certified midwife. Similarly, Spanish universities produced only 2,755 certified midwives between 1853 and 1912, an average of 46 per year. It is therefore not surprising that in a city like Granada, with 76,000 inhabitants in 1900, there were only 10 midwives for 105 physicians.<sup>88</sup>

When analysing the recent success of Malaysia and Sri Lanka in their reduction of maternal mortality, Pathmanathan *et al.* have highlighted similar technical and political conditions that enabled this achievement.<sup>89</sup> Indeed, Sri Lanka managed to halve its maternal mortality level in very short intervals of 3 to 13 years exponentially from more than 2,000 per 100,000 live births in the 1930s to around 20 in 2000. Malaysia shows a similar pattern with a maternal mortality ratio of 550 in 1950 compared to less than 20 in 2000. Information on levels and causes of maternal mortality was monitored and analysed. The package of health and social services included provision of integrated obstetric care by professional midwives, malaria control and family planning. The governments of Malaysia and Sri Lanka implemented human development programmes of synergistic packages of services, basic health care, education, water supply and sanitation, integrated rural development, that reached the underprivileged, including rural

<sup>86</sup>Van Der Borg 1994.

<sup>87</sup>Van Lerberghe and De Brouwere 2001.

<sup>88</sup>Ortiz and Martínez Padilla in Marland and Rafferty (eds) 1997.

<sup>89</sup>Pathmanathan *et al.* 2003.

poor and minorities. Removing financial barriers to care was a key element in their success and skilled attendance reached more than 80 per cent of the population in the 1990s. To support competent and widely accepted rural midwives throughout the country, a network of accessible hospitals was developed.

The development of midwifery started in the second half of the seventeenth century with the publication, mainly by French men-midwives, of textbooks of obstetrics and illustrated manuals for midwives. This was followed in the eighteenth century by the creation of midwifery schools and the teaching of obstetrics and gynaecology in many European countries, as referred to above.<sup>90</sup> The decline in maternal mortality that followed in the nineteenth century in the northern countries of Europe (Denmark, Norway, Sweden and the Netherlands) was attributed to the professionalisation of attendance at birth. However, while almost all European countries applied the same policies, progress in maternal mortality reduction varied from country to country.

In this respect, attention should be drawn to the main thread outlined by the grid of analysis presented in Figure 5. This grid can be used to revisit historical maternal policies and outcomes. It facilitates understanding the extent to which Sweden was modern in its discovery of the concept of avoidable maternal death as early as the mid-eighteenth century. It also highlights the importance of social acceptance of technologies. The availability of these technologies is, of course, a single condition but the very success of Sweden is probably due to the rapid scaling-up of implementation throughout the country. As early as 1829, certified Swedish midwives were allowed to use forceps and hooks; the aseptic technique was made compulsory for all midwives in 1881 with a very large impact on mortality, as demonstrated by Högberg. This achievement was probably the consequence of two conditions. The first was the training of midwives in modern obstetrical techniques and their acceptance of these techniques so that they become acceptable to women. Not all western countries were able to do this: in Britain and the USA, for instance, it was delayed until the beginning of the twentieth century. The second was the political will that made it possible to scale up the strategy and regulate it. Expression of this willingness is demonstrated, for instance, in investment by the government in midwifery schools, in the regulation of midwives, an increasingly even distribution throughout the country, making them accessible for every woman in need, and also the guarantee of a basic salary.

It may be useful to apply this frame to other countries in which the nineteenth- to twentieth-century safe motherhood policies have been documented as well as the profile and numbers of health professionals responsible for deliveries. This would probably confirm part of the frame and highlight new ideas about the other sources of pressure that shaped the policy, including the contribution of midwives to safer motherhood, and about the organisation of the health care system.

From his analysis of maternal mortality, Loudon concluded that 'socio-economic deprivation *per se* was not an important determinant factor in maternal mortality, but the place of delivery and the care and skill of the birth attendant were'.<sup>91</sup> It is important, however, to note that it was no single element that permitted such an achievement.

<sup>90</sup>Drife 2002.

<sup>91</sup>Loudon 1988.

Rather, we must look to a set of technical elements and political conditions. Among these were professionalisation, competent, available and accountable personnel along with the appropriate environment for them to operate, universal access to obstetric care, and a continuous commitment of the government concretely expressed by the careful monitoring of the achievements and the actual application of the strategies decided upon.

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### Bibliography

- Ackerknecht E. H. 1982, 'Surgery and Gynecology in the Nineteenth Century', in Ackerknecht E. H. (ed.), *A Short History of Medicine*, Baltimore: Johns Hopkins Paperbacks Editions, 186–93.
- Andersson T., Bergström S. and Högberg U. 2000, 'Swedish Maternal Mortality in the Nineteenth Century by Different Definitions: Previous Stillbirths but not Multiparity Risk Factor for Maternal Death', *Acta Obstetrica et Gynecologica Scandinavica*, 79, 679–86.
- Baird D. 1960, 'The Evolution of Modern Obstetrics', *The Lancet*, ii, 557–64.
- Baker S. J. 1927, 'Maternal Mortality in the United States', *Journal of the American Medical Association*, 89, 2016–17.
- Bardet J. P., Lynch K.-A., Mineau G.-P., Hainsworth M. and Skolnick M. 1981, 'La mortalité maternelle autrefois: une étude comparée (de la France de l'ouest à l'Utah)', *Annales de Démographie Historique*, 1, 31–49.
- Berman P. 1995, 'The Practice of Obstetrics in Rural America, 1800–1860', *Journal of the History of Medicine and Allied Sciences*, 50, 175–93.
- Borst C. G. 1988, 'The Training and Practice of Midwives: A Wisconsin Study', *Bulletin of History of Medicine*, 62, 606–27.
- Bower F. 2003, 'Early Eighteenth-Century French Obstetric Textbook', *Australian and New Zealand Journal of Obstetrics and Gynaecology*, 43, 262–3.
- Bullough L. A. 1917, 'Midwifery Service in the West Riding Administrative Area', *Public Health*, 31, 126–32.
- Burst H. V. 2005, 'The History of Nurse-Midwifery/Midwifery Education', *Journal of Midwifery and Women's Health*, 50, 129–37.
- Carter K. C. and Tate G. S. 1991, 'The Earliest-Known Account of Semmelweis Initiation of Disinfection at Vienna's Allgemeines Krankenhaus', *Bulletin of History of Medicine*, 65, 252–7.
- Costello A., Azad K. and Barnett S. 2006, 'An Alternative Strategy to Reduce Maternal Mortality', *The Lancet*, 368, 1477–9.
- Dawley K. 2003, 'Origins of Nurse-Midwifery in the United States and its Expansion in the 1940s', *Journal of Midwifery and Women's Health*, 48, 86–95.
- Dawley K. and Burst H. V. 2005, 'The American College of Nurse-Midwives and its Antecedents: A Historic Time Line', *Journal of Midwifery and Women's Health*, 50, 16–22.
- De Brouwere V., Tonglet R. and Van Leberghe W. 1998, 'Strategies for Reducing Maternal Mortality in Developing Countries: What can we Learn from the History of Western Countries?', *Tropical Medicine and International Health*, 3, 771–82.
- Declercq E. and Lacroix R. 1985, 'The Immigrant Midwives of Lawrence: The Conflict between Law and Culture in Early Twentieth-Century Massachusetts', *Bulletin of History of Medicine*, 59, 232–46.

- DeLacy M. 1989, 'Puerperal Fever in Eighteenth-Century Britain', *Bulletin of History of Medicine*, 63, 521–56.
- Deneux-Tharoux C., Berg C., Bouvier-Colle M. H., Gissler M., Harper M., Nannini A., Alexander S., Wildman K., Bréart G. and Buekens P. 2005, 'Underreporting of Pregnancy-Related Mortality in the United States and Europe', *Obstetrics and Gynecology*, 106, 684–92.
- Devries R. and Barroco R. 1997, 'Midwives among the Machines. Re-creating Midwifery in the late Twentieth Century', in Marland H. and Rafferty A. M. (eds), *Midwives, Society and Childbirth. Debates and Controversies in the Modern Period*, London: Routledge, 248–72.
- Donnison J. 1988, *Midwives and Medical Men: A History of the Struggle for the Control of Childbirth*, 2nd edn, London Historical Publications.
- Drife J. 2002, 'The Start of Life: A History of Obstetrics', *Postgraduate Medical Journal*, 78, 311–15.
- Edmonson M. and Kassen J. 2006, *Obstetric Literature and the Changing Character of Childbirth*, Dittrick Medical History Center. <http://www.case.edu/artsci/dittrick/site2/museum/online/ob/index.html> (last accessed in October 2006).
- Ettinger L. E. 1999, 'Nurse-Midwives, the Mass Media, and the Politics of Maternal Health Care in the United States, 1925–1955', *Nursing History Review*, 7, 47–66.
- Ettinger L. E. 2006, 'Nurse-Midwifery: The Birth of a New American Profession', in Smith S. L. and Tomes N. (eds), *Women, Gender, and Health*, Columbus: Ohio State University Press, 1–27.
- Francome C., Savage W., Churchill H. and Lewison H. 1993, *Caesarean Birth in Britain: A Book for Health Professionals and Parents*, London: Middlesex University Press.
- Gélis J. 1984, *L'arbre et le fruit. La naissance dans l'Occident moderne XVI–XIX siècle*, Paris: Fayard.
- Godber G. 1994, 'The Origin and Inception of the Confidential Enquiry into Maternal Deaths', *British Journal of Obstetrics and Gynaecology*, 101, 946–7.
- Green H., Pindar D., Davis G. and Melanby E. 1931, 'Diet as a Prophylactic Agent against Puerperal Sepsis with Special Reference to Vitamin A as an Anti-infective Agent', *British Medical Journal*, 2, 595–8.
- Högberg U. 2004, 'The Decline in Maternal Mortality in Sweden: The Role of Community Midwifery', *American Journal of Public Health*, 94, 1312–20.
- Högberg U. and Wall S. 1986a, 'Secular Trends in Maternal Mortality in Sweden from 1750 to 1980', *Bulletin of the World Health Organization*, 64, 79–84.
- Högberg U. and Wall S. 1986b, 'Age and Parity as Determinants of Maternal Mortality—Impact of their Shifting Distribution among Parturients in Sweden from 1781 to 1980', *Bulletin of the World Health Organization*, 64, 85–91.
- Högberg U., Wall S. and Broström G. 1986, 'The Impact of Early Medical Technology of Maternal Mortality in late Nineteenth-Century Sweden', *International Journal of Gynecology and Obstetrics*, 24, 251–61.
- Howard W. T. 1921, 'The Real Risk-rate of Death to Mothers from Causes connected with Childbirth', *American Journal of Hygiene*, 1, 197–233.
- Jellet H. 1929, *The Causes and Prevention of Maternal Mortality*, London: J. and A. Churchill.
- Kaufman M. H. 1995, 'Caesarean Operations Performed in Edinburgh during the 18th century', *British Journal of Obstetrics and Gynaecology*, 102, 186–91.
- King C. R. 1991, 'The New-York Maternal Mortality Study: A Conflict of Professionalization', *Bulletin of History of Medicine*, 65, 476–502.
- Klein M. D. and Clahr J. 1958, 'Factors in the Decline of Maternal Mortality', *Journal of the American Medical Association*, 168, 237–42.
- Knibielher Y. and Fouquet C. 1977, *Histoire des mères du Moyen Age à nos jours*, Paris: Editions Montalba.
- Llewellyn-Jones D. 1974, *Human Reproduction and Society*, London: Faber and Faber.
- Løkke A. 1997, 'The "Antiseptic" Transformation of Danish Midwives, 1860–1920', in Marland H. and Rafferty A. M. (eds), *Midwives, Society and Childbirth. Debates and Controversies in the Modern Period*, London: Routledge, 102–33.
- Loudon I. 1986, 'Obstetric Care, Social Class, and Maternal Mortality', *British Medical Journal*, 293, 606–8.

- Loudon I. 1988, 'Maternal Mortality: 1880–1950. Some Regional and International Comparisons', *Social History of Medicine*, 1, 183–227.
- Loudon I. 1992a, *Death in Childbirth. An International Study of Maternal Care and Maternal Mortality 1800–1950*, Oxford: Oxford University Press.
- Loudon I. 1992b, 'The Transformation of Maternal Mortality', *British Medical Journal*, 305, 1557–60.
- Loudon I. 1997, 'Midwives and the Quality of Maternal Care', in Marland H. and Rafferty A. M. (eds), *Midwives, Society and Childbirth. Debates and Controversies in the Modern Period*, London: Routledge, 180–200.
- McIntosh T. 1998, 'Profession, Skill, or Domestic Duty? Midwifery in Sheffield, 1881–1936', *Social History of Medicine*, 11, 403–20.
- McTavish L. 2001, 'On Display: Portraits of Seventeenth-Century French Men-Midwives', *Social History of Medicine*, 14, 389–415.
- Marland H. and Rafferty A. M. (eds) 1997, *Midwives, Society and Childbirth. Debates and Controversies in the Modern Period*, London: Routledge.
- Masuy-Stroobant G. and Humblet P. C. 2004, *Mères et nourrissons. De la bienfaisance à la protection médico-sociale (1830–1945)*, Bruxelles: Editions Labor.
- Maternal and Child Health Division, Ministry of Health and Welfare of Japan and Mothers' and Children's Health and Welfare Association 1992, *Maternal and Child Health in Japan*, Tokyo: Mothers' and Children's Health and Welfare Association.
- Mott M. L. 2003, 'Midwifery and the Construction of an Image in Nineteenth-Century Brazil', *Nursing History Review*, 11, 31–49.
- Nuttall A. 1999, 'A Preliminary Survey of Midwifery Training in Edinburgh, 1844 to 1870', *International History of Nursing Journal*, 4, 4–14.
- Oakley A. 1984, *The Captured Womb. A History of the Medical Care of Pregnant Women*, Oxford: Basil Blackwell.
- Ortiz T. and Martinez Padilla C. 1997, 'How to be a Midwife in Late Nineteenth-Century Spain', in Marland H. and Rafferty A. M. (eds), *Midwives, Society and Childbirth. Debates and Controversies in the Modern Period*, London: Routledge, 61–80.
- Pathmanathan I., Liljestrand J., Martins J. M., Rajapaksa L. C., Lissner C., De Silva A., Selvaraju S. and Singh P. J. 2003, *Investing in Maternal Health. Learning from Malaysia and Sri Lanka*, Health, Nutrition and Population Series, Washington: The World Bank.
- Pearl R. 1921, 'Biometric Data on Infant Mortality in the United States Birth Registration Area, 1915–1918', *American Journal of Hygiene*, 1, 419–39.
- Peller S. 1965, *Births and Deaths among Europe's Ruling Families since 1500*, Chicago: Aldine Publishing Company.
- Pelling M., Berridge V., Harrison M. and Weindling P. 1993, 'The Era of Public Health, 1848 to 1918', in Webster C. (ed.), *Caring for Health: History and Diversity*, London: Open University Press, 63–86.
- Porges R. F. 1985, 'The Response of the New-York Obstetrical Society to the Report by the New-York Academy of Medicine on Maternal Mortality, 1933–4', *American Journal of Obstetrics and Gynecology*, 152, 642–9.
- Reagan L. J. 1995, 'Linking Midwives and Abortion in the Progressive Era', *Bulletin of History of Medicine*, 69, 569–98.
- Romlid C. 1997, 'Swedish Midwives and their Instruments in the Eighteenth and Nineteenth Centuries', in Marland H. and Rafferty A. M. (eds), *Midwives, Society and Childbirth. Debates and Controversies in the Modern Period*, London: Routledge, 38–60.
- Schmidt W. M. and Valadian I. 1969, 'Maternal and Child Health Activities', in Hanlon J. J. (ed.), *Principles of Public Health Administration*, Saint Louis, US: C. V. Mosby Company, 367–81.
- Semmelweis I. 1888 [1844], 'The Etiology, Concept, and Prophylaxis of Childbed Fever', in Buck C., Llopis A., Najera E. and Terris M. (eds), *The Challenge of Epidemiology. Issues and Selected Readings*, Washington, DC: Pan American Health Organization, 46–59.
- Shorter E. 1982, *A History of Women's Bodies*, New York: Basic Books.
- Stevens R. 2002, 'The Midwives Act 1902: An Historical Landmark', *Midwives*, 5, 370–1.

- Stone S. E. 2000, 'The Evolving Scope of Nurse-Midwifery Practice in the United States', *Journal of Midwifery and Women's Health*, 45, 522–31.
- Summers A. 2000, 'A Different Start: Midwifery in South Australia 1836–1920', *International History of Nursing Journal*, 5, 51–7.
- Thomas K. K. 2004, '"Law unto Themselves": Black Women as Patients and Practitioners in North Carolina's Campaign to Reduce Maternal and Infant Mortality, 1935–1953', *Nursing History Review*, 12, 47–66.
- Tuchman A. M. 2005, '"The True Assistant to the Obstetrician": State Regulation and the Legal Protection of Midwives in Nineteenth-Century Prussia', *Social History of Medicine*, 18, 23–38.
- United Nations 2000, United Nations Millennium Declaration New York, NY A/RES/55/2; <http://www.un-ngls.org/MDG/A-RES-55-2.pdf> (last accessed 11 January 2006).
- Van Der Borg E. 1994, 'Sages-femmes aux Pays-Bas: image et occupation. Les développements dans la pratique de l'obstétrique à Leyde, Arnhem, Bois-le-Duc et Leeuwarden, 1650–1865', *Histoire des Sciences Médicales*, 28, 57–62.
- Van Lerberghe W. and De Brouwere V. 2001, 'Of Blind Alleys and Things that have Worked: History's Lessons on Reducing Maternal Mortality', *Studies in Health Service Organisation and Policy*, 17, 7–33.
- WHO 2005, *The World Health Report 2005: Make every Mother and Child Count*, Geneva: WHO.
- WHO and UNICEF 1996, *Revised 1990 Estimates of Maternal Mortality. A New Approach by WHO and UNICEF*, Geneva: WHO.
- Wilmott-Dobbie B. M. 1982, 'An Attempt to Estimate the True Rate of Maternal Mortality, Sixteenth to Eighteenth Centuries', *Medical History*, 26, 79–90.