PUERPERAL FEVER was for several centuries the most common cause of maternal death following childbirth, reaching epidemic proportions in the lying-in hospitals of Europe and the United States in the 19th century. *Streptococcus pyogenes*, the bacterium responsible for puerperal fever, was discovered in 1879, but it was not until the 1930s, following the introduction of the sulphonamides and then penicillin, that puerperal fever – also called childbed fever – ceased to be a major problem in developed countries. However, streptococcal infection still remains a serious threat for mothers and babies in parts of the world with limited health facilities.

In 1797 Mary Wollstonecraft (1759–97), pioneering feminist and author of *A Vindication of the Rights of Women*, gave birth to her second child at home with the assistance of a midwife from the Westminster Lying-in Hospital in London. On Wednesday, 20 August a healthy baby daughter was born. Following some difficulties with the placenta, Mary was attended by a doctor from the hospital. A few days later she developed a 'shivering fit', followed by a high fever and agonizing abdominal pain. She died on Sunday, 10 September, aged 38. Her daughter, also Mary, later married the poet Shelley, and achieved enduring fame in her own right with the novel *Frankenstein*. Her mother was just one of countless women who, several days after the joy of giving birth, died of puerperal fever.

A FEMALE EVENT

Puerperal fever was first identified as a specific disease in the 18th century – its name being derived from the Latin *puer*, 'boy', and *parere*, 'to bring forth'. The term 'puerperium' was used to denote the period immediately following childbirth – the 'lying-in' or 'confinement'. Puerperal fever had probably been a cause of maternal mortality for centuries, but it was not until the 18th and 19th centuries that it captured the attention of the medical profession.

Giving birth had always been an ordeal, a risky time for both mother and child. With no anaesthetics apart from opiates and alcohol, no antibiotics and little in the way of antiseptics, the risk of infection was high. In the Middle Ages and early modern period, most mothers gave birth at home – sometimes alone, sometimes with a group of other women or 'gossips', and occasionally with the assistance of the local (untrained but often experienced) midwife. It was an exclusively female event.

Only in the case of difficult deliveries would a male practitioner be summoned. Fathers and siblings would huddle outside the birth chamber in hushed silence, listening to the screams of the mother, and anxiously awaiting the first cries of the new baby.

In a 17th-century Dutch birth room a maid hands round sweets to 'gossips' – females who attend the birth.

timeline

1800 *The British chemist Humphry Davy (1778–1829) experiments with laughing gas (nitrous oxide), to which he becomes addicted. Others later develop the use of anaesthetics for operations and to help alleviate the pain of childbirth.*

1844 *The American dentist Horace Wells (1815–48) uses nitrous oxide as an anaesthetic while extracting a tooth.*

1846 *William Morton (1819–68) conducts the first operation using ether at Massachusetts General Hospital, Boston.*

1846 *The Scottish surgeon Robert Liston (1794–1847) becomes the first European to operate using anaesthesia.*

1846 *In Vienna Ignaz Semmelweis (1818–65) begins to investigate the cause of high mortality from puerperal fever in hospitals and concludes that hand-washing is vital to prevent the spread of infection.*

1847 *The Scottish physician James Young Simpson (1811–70) gives chloroform (pleasanter and more potent than ether) for the first time to a woman in labour.*

1853 *John Snow (1813–58) administers chloroform to Queen Victoria during the birth of her eighth child. Queen Victoria describes the effects as 'soothing, quieting and delightful beyond measure'.*

1854–6 *During the Crimean War, Florence Nightingale (1820–1901) emphasizes the importance of cleanliness in hospitals.*

1865 *Joseph Lister (1827–1912) uses carbolic acid as an antiseptic in the course of treating a fractured tibia poking through the skin of an 11-year-old boy.*

1871 *Joseph Lister operates on a 15-centimetre (6-in) abscess under Queen Victoria's armpit, using his carbolic spray. Thirty years later, Lister claims: 'I am the only man who has ever stuck a knife into the queen'.*

1879 *Louis Pasteur (1822–95) describes the micro-organisms responsible for puerperal fever.*

1935 *Introduction of sulphonamides, effective against the bacteria responsible for puerperal fever.*

1940s–50s *With the introduction of penicillin, cases of puerperal fever eventually fall.*

21st century *In the Western world, there is less than a 1 in 10,000 risk of mothers dying during pregnancy and childbirth.*

An early 19th-century cartoon depicting a midwife on her way to a labour in the early hours of the morning.

Hotbeds of infection

The late 17th and early 18th centuries witnessed the beginnings of lying-in hospitals. These hospitals, often run as charitable institutions, offered poor women a comfortable and safe place to give birth, providing them with free food, warmth and shelter. The delivery was handled by skilled medical accoucheurs (male midwives). Ironically, it was these very maternity hospitals that gave rise to some of the worst outbreaks of puerperal fever.

In some of the larger lying-in hospitals, 5 to 20 per cent of mothers died from puerperal fever, and in the smaller hospitals severe outbreaks might see off as many as 70 to 100 per cent of lying-in women. In the early 19th century, the risk of dying from puerperal fever in Queen Charlotte's Maternity Hospital in London – one of the most prestigious of its kind – was 17 times as high as it was for a woman delivered at home in the worst slums of the East End of the city. The lying-in hospitals soon gained a reputation as 'slaughterhouses' or 'necropolises'.

The more enlightened physicians tried fumigating the wards and the women's clothing, and recommended regular washing and good ventilation. Various concoctions of herbs were tried to help the mothers once infection set in. Purging, venesection (copious bleeding using a lancet) or applying leeches to the mother's abdomen were also popular – but did nothing to stem the tide of death. Doctors grappled with the question as to why so many mothers were dying under their care. Was it a miasma or poison in the atmosphere of the hospitals? Was it some noxious influence that seeped out of soiled bedclothes, or the invasion of the womb by putrid matter? Or was it some inherent complication of pregnancy, labour and birth?

'Epidemics of puerperal fever are to women as war is to men. Like war, they cut down the healthiest, bravest, and most essential part of the population; like war, they strike their victims in the prime of their lives ... '

JACQUES-FRANÇOIS-ÉDOUARD HERVIEUX (1818–95)

Death in the hands of doctors and midwives

Only a small proportion of mothers actually gave birth in these charitable institutions, and epidemics of puerperal fever could also happen outside the hospitals. The disease seemed to affect indiscriminately the rich and the poor, the robust and the weak, younger mothers and older mothers, and could follow both normal and abnormal labours. As doctors began to look more closely at the outbreaks, however, they came up with findings that were uncomfortable for their own

profession. It became clear that there was some kind of link between women who contracted puerperal fever and certain birth attendants – whether midwives or doctors – who came to be seen as 'harbingers of death'. One of the first to point out this connection was Alexander Gordon (1752–99), following an epidemic of puerperal fever in 1789–92 in Aberdeen, Scotland. By 1795 Gordon had come to a disturbing conclusion:

> *'It is a disagreeable declaration for me to mention,'* he confessed, *'that I myself was the means of carrying the infection to a great number of women.'*

One doctor in Philadelphia, Dr Rutter, was so distressed at the number of cases of puerperal fever in his practice that he became fastidious about washing, shaving and changing his clothes, and even made sure he used a fresh pencil to take notes while attending a new case. Yet, despite his efforts, the disease seemed to follow him wherever he went and, in the end, like others in such a situation, he was forced to give up his practice.

From corpses to confinements

In 1843 Oliver Wendell Holmes (1809–94), a young physician and poet in Boston, documented a number of cases which, he believed, illustrated the 'contagious' nature of puerperal fever, its links with another infection – erysipelas – and the possibility that the infection was carried by doctors from corpses to confinements. His observations were reprinted in 1855 as a pamphlet, *Puerperal Fever as a Private Pestilence*, in which he wrote the following:

> *'In view of these facts, it does appear a singular coincidence that one man or woman should have ten, twenty, thirty, or seventy cases of this rare disease, following his or her footsteps with the keenness of a beagle through the streets and lanes of a crowded city, while the scores that cross the same paths on the same errands know it only by name.'*

Holmes cited one distinguished doctor who removed the pelvic organs at the postmortem of a patient who had died of puerperal fever. He then put them in his coat pocket before going on to deliver a number of women – all of whom subsequently died. Such practices, Holmes argued, were criminal, and should be banished. He also recommended that anyone attending an autopsy, or a case of puerperal fever or erysipelas, should take sensible precautions to avoid conveying the contagion to a midwifery case.

'TO DO THE SICK NO HARM'

'Cur'd yesterday of my Disease, I died last night of my Physician.'
Matthew Prior, 1714

Doctors, nurses, midwives and other health workers do all they can to cure diseases and save lives. In the Hippocratic writings of the fifth century BC physicians are reminded: *'As to diseases, make a habit of two things – to help, or at least to do no harm'.* Florence Nightingale (1820–1901) reiterated the point: *'It may seem a strange principle to enunciate as the very first requirement in a Hospital that it should do the sick no harm'.* But as in the story of the great puerperal epidemics of the 19th century, in which doctors and nurses were unwittingly responsible for spreading the infection, there can be times when things go horribly wrong.

Today, there is a worrying upward trend of 'hospital-acquired super-bugs', including MRSA (Methicillin-resistant *Staphylococcus aureus*) and *Clostridium difficile*. Ignaz Semmelweis (see next page) and Florence Nightingale would be seriously concerned. Hand washing using anti-bacterial soaps, the use of masks and other basic preventive measures to stop cross-infections in hospitals remain as critical today as they were in the past.

'I make my confession that God only knows the number of women whom I have consigned prematurely to the grave.'

IGNAZ SEMMELWEIS (1818–65)

Wash your hands

It is the Hungarian physician Ignaz Semmelweis (1818–65) who has gone down in history for making the critical connection between corpses and confinements. In 1846 Semmelweis was an assistant in Vienna's famous teaching hospital, the Allgemeines Krankenhaus. There were two obstetrical clinics in the hospital, and expectant mothers were randomly allocated to either one. The one where Semmelweis worked was used for teaching male medical students, the other for training female midwives. Semmelweis discovered that cases of puerperal fever and mortality rates were far higher in the clinic with the medical students. When a good friend, who was professor of forensic medicine, died, Semmelweis read the autopsy report. His friend had been nicked by a knife while conducting an autopsy, and the report suggested that he had died from the same disease as women who died in childbirth. Semmelweis had a sudden insight. He scrutinized the practices of the doctors in his clinic and observed that they would often go straight from assisting with autopsies to carrying out vaginal examinations of women in labour – without washing their hands or changing their clothes. There had to be a connection.

Semmelweis, unaware of Holmes's paper, put forward his 'cadaveric theory', suggesting that infectious particles from patients who had died of, or were infected with, the fever were conveyed to healthy lying-in women on the hands of the students. He insisted that the students and physicians washed their hands and scrubbed their nails in a bowl of chloride of lime placed at the entrance to the ward, so that '*not the faintest trace of cadaver aroma*' would be left. Cases of puerperal fever on the ward fell dramatically.

This simple and effective method for preventing the spread of puerperal fever was not taken up more widely, however, and mortality from puerperal fever in many countries actually rose in the following years. It was not until some 20 years after his death in 1865 in a lunatic asylum that the significance of Semmelweis's findings was widely realized, and he became hailed as an unsung hero. In the meantime, there had been two further breakthroughs.

Germs and antisepsis

The discovery of the causal agent of puerperal fever is usually credited to Louis Pasteur (1822–95), who in 1879 described the bacterial micro-organisms responsible as *microbes en chapelet* ('microbes like a rosary'). His finding was confirmed by others, and the bacterium causing puerperal fever was

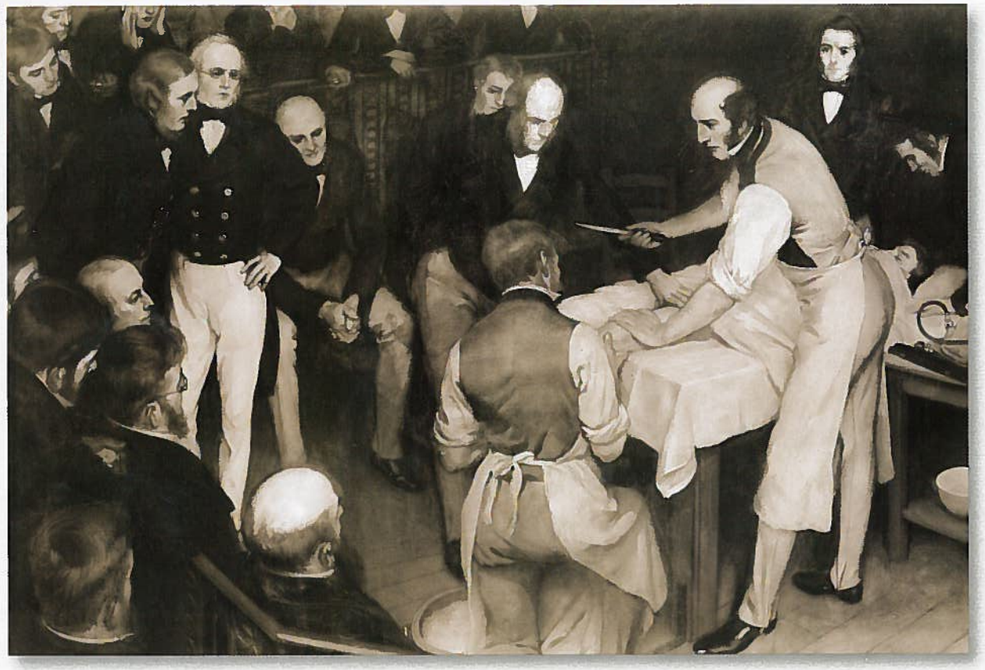
THE FLESH-EATING BUG

In the mid-19th century the USA was struck by a frightening and mysterious epidemic.

A contemporary wrote:

'No language can give an adequate description of the revolting aspects of this form of the epidemic in many individuals ... the flesh would drop off from the limb, or the whole member presenting the disgusting spectacle of a livid mass of putrefaction ... '

This was probably necrotizing fasciitis, formerly known as 'hospital gangrene' – the scourge of hospitals in the pre-antibiotic era. It is now commonly called the 'flesh-eating bug' but, fortunately, it is quite rare. It is caused by the group of bacteria (group-A streptococci) that cause puerperal fever.



THE FASTEST OPERATOR

Before the advent of anaesthetics, patients about to undergo an operation were heavily dosed with rum or opium and forcibly held down or strapped to the operating table. The pre-eminent skill for a surgeon was speed. The Scottish surgeon Robert Liston (1794–1847) was the fastest cutter in the pre-anaesthetic era. It was said that, when he operated, the gleam of the knife was followed so quickly by the sound of the bone being sawn as to make the two actions seem almost simultaneous. With students packing the gallery of the operating theatre, pocket-watches in hand, Liston would stride across the bloodstained floor, often in Wellington boots, and call, *'Time me, gentlemen, time me'.*

Once when he amputated a patient's leg in his usual time of two and a half minutes, his flashing knife also removed the man's testicles. The patient apparently died later of hospital gangrene. During the operation Liston, in addition, inadvertently cut off the fingers of his young assistant, who later also died of hospital gangrene. He managed, too, to slash through the coat tails of a distinguished spectating surgeon, who, fearing the knife had pierced his vitals, dropped dead from fright. It is said that Liston performed the only operation in the history of medicine with a 300 per cent mortality rate.

James Young Simpson (1811–70), who first used chloroform as an anaesthetic for women in labour in 1847, noted the similarity between hospital gangrene (or 'surgical fever') and puerperal fever.

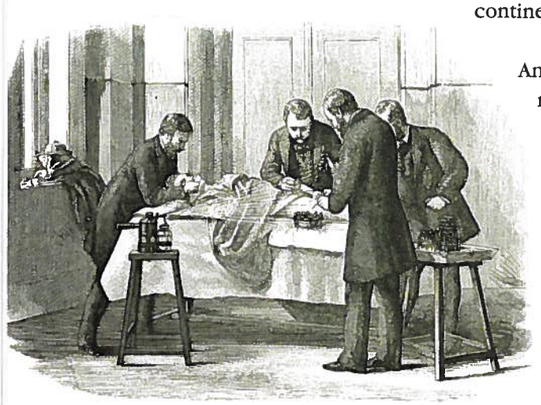
Robert Liston performing an operation. Many of his operations were carried out without anaesthetic, but in 1846 he also performed the first operation in Europe on a patient who was under an anaesthetic.

'All that would be needful would be to purify the surface of the skin of the part to be operated upon by means of some efficient antiseptic, to have my own hands, and those of my assistants, and also the instruments, similarly purified; and then the operation might be performed without the antiseptic spray ... and no one would rejoice more than myself to be able to dispense with it.'

JOSEPH LISTER, 1875

subsequently named *Streptococcus pyogenes* (from the Greek *streptos*, 'twisted like a chain', *coccus*, meaning a 'berry' and *pyogenes*, translated as 'pus-producing'). Pasteur's great discoveries in the understanding of germ theory were matched by those of Joseph Lister (1827–1912) in the field of antisepsis and asepsis in surgery. Lister is best remembered for his carbolic acid spray (of 1871), his insistence that instruments, dressings and gowns be sterilized, and his emphasis on scrupulous cleanliness. His methods were not widely adopted by obstetricians in lying-in hospitals until the 1880s, but, once their significance was recognized, puerperal fever was seen as eminently preventable.

The strong smell of disinfectant began to pervade some maternity wards. In the best-managed hospitals, everybody and everything – from the mothers in labour to the doctors and midwives (in their clean caps, gowns, masks and gloves), and all the instruments used to assist the birth – were washed down with soap and hot water or doused in disinfectant or sterilized in heated autoclaves. Those suffering from puerperal fever were isolated. The effect in some hospitals, especially in continental Europe, was startling.



An operation using the Lister carbolic acid spray, 1882. The surgeons' hands, instruments, towels and other equipment are constantly in the cloud of spray, thus ensuring antiseptic conditions.

Antisepsis was a major breakthrough in preventing thousands of needless deaths. But in many maternity hospitals in the USA and Britain, birth attendants continued to practise without the necessary preventive measures. In the USA, where many deliveries took place in hospitals, one-quarter of a million mothers died in childbirth in the 1920s. Even by the 1930s there were still no masks, gloves or sterilized instruments in Queen Charlotte's Maternity Hospital, London. It has since been shown that wearing a mask is one of the most effective preventive measures, as the streptococcal bug is transmitted primarily by carriers via respiratory droplets exhaled onto patients.

In the early 20th century, the majority of women in Europe continued to give birth at home. In Scandinavia, Belgium and the Netherlands home deliveries were attended by midwives strictly trained and fully aware of the vital importance of preventing the spread of puerperal fever – while in some other countries midwives attending home births might have little awareness of simple antiseptic practices. In Great Britain in the first half of the 1930s the risk of women dying from puerperal fever was as high as it had been in the 1860s. It took another medical revolution to radically bring down maternal mortality across the Western world.

Joseph Lister, by then Baron Lister, seen seated front left with members of his staff in Victoria Ward, King's College Hospital, London. The photograph was taken in 1893.

A new era: antibiotics

The introduction of anti-bacterial drugs was the greatest advance for the treatment of bacterial infections in the history of medicine. The first drugs to be used for puerperal fever, in the late 1930s, were the sulphonamides. These proved highly effective against group-A streptococcal infection, and mortality from puerperal fever dropped dramatically. With the availability of penicillin in the mid-1940s, a new era dawned. Penicillin was more active and less toxic than the sulphonamides, and could also treat a rarer cause of puerperal fever, *Staphylococcus aureus*. Mothers in labour could at last be reasonably optimistic that they would live to see their newborn infants grow up.

By the 1950s puerperal fever in the Western world was no longer a life-threatening disorder, and its very name now has an old-fashioned ring about it. Maternal mortality – from all causes – has continued to fall sharply over the second half of the 20th century, and death in childbirth is now the exception rather than the half-expected outcome.

The continuing tragedy of death in childbirth

Sadly, this is not the case in many of the poorer countries of the world, where mothers often give birth in the harshest conditions and without any means to prevent or treat infections. Puerperal sepsis (a term now used to cover a number of causal infectious agents) constantly threatens the life of mothers and babies, especially in Africa and parts of Asia. At least half a million mothers still die every year in pregnancy; 99 per cent of these deaths are in the developing world, and 25 per cent are from infections. The World Health Organization (WHO) has made a commitment, as part of its Millennium Development Goals, to reduce maternal mortality. But the number of mothers and babies dying from preventable infections and complications of pregnancy remains one of the greatest tragedies of the modern world.