### Timeline of events

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1830s</td>
<td><strong>Industrial Revolution.</strong> This had a dramatic effect on public health. As more and more families moved into town and cities, the standards of public health declined. Families often shared housing, and living and working conditions were poor. People worked 15 hour days and had very little money.</td>
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<tr>
<td>1831</td>
<td><strong>Cholera Epidemic.</strong> People infected with cholera suffered muscle cramps, diarrhoea, dehydration and a fever. The patient would most likely be killed by dehydration. Cholera returned regularly throughout the century, with major outbreaks in 1848 and 1854.</td>
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<td>1842</td>
<td>Edwin Chadwick reports on the state of health of the people in cities, towns and villages to the Poor Law Commission (fore-runner to the Public Health Reforms). He highlights the differences in life-expectancy caused by living and working conditions. He proposes that simple changes could extend the lives of the working class by an average of 13 years.</td>
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<td>1846</td>
<td>First successful use of Ether as an anaesthetic in surgery. The anaesthetic had some very severe drawbacks. In particular, it irritated the lungs and was highly inflammable.</td>
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<tr>
<td>1847</td>
<td><strong>James Simpson discovers Chloroform</strong> during an after dinner sampling session with friends. He struggles to get the medical world to accept the drug above Ether. Doctors were wary of how much to give patients. Only 11 weeks after its first use by Simpson, a patient died under chloroform in Newcastle. The patient was only having an in-growing toenail removed (non-life threatening). It took the backing of Queen Victoria for chloroform and Simpson to gain worldwide publicity.</td>
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<td>1847</td>
<td>Ignaz Semmelweiss orders his students to wash their hands before surgery (but only after they had been in the morgue).</td>
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<td>1847</td>
<td>Elizabeth Blackwell becomes the first woman doctor in USA</td>
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<td>1848</td>
<td><strong>First Public Health Act</strong> in Britain - It allowed local authorities to make improvements if they wanted to &amp; if ratepayers gave them their support. It enabled local authorities to borrow money to pay for the improvements. It was largely ineffective as it was not made compulsory for Councils to enforce it. This was an element of the “Laissez-Faire” style of government.</td>
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<tr>
<td>1854</td>
<td>Crimean War - <em>Florence Nightingale and Mary Seacole</em> contribute majorly to the improvements in Hospitals.</td>
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<tr>
<td>Year</td>
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<tr>
<td>1854</td>
<td>John Snow proves the link between the cholera epidemic and the water pump in Broad Street, London. Unfortunately, he was unable to convince the government to make any substantial reforms.</td>
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<tr>
<td>1857</td>
<td>Queen Victoria publicly advocates use of Chloroform after birth of her eighth child.</td>
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<td>1858</td>
<td>Doctors’ Qualifications had to be regulated through the General Medical Council.</td>
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<tr>
<td>1861</td>
<td>Germ Theory developed by Louis Pasteur whilst he was working on a method to keep beer and wine fresh - changed the whole understanding of how illnesses are caused.</td>
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<tr>
<td>1865</td>
<td>Elizabeth Garrett-Anderson - first female doctor in the UK</td>
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<td>1867</td>
<td>Joseph Lister begins using Carbolic Spray during surgery to fight infection. It reduces the casualty rate of his operations from 45.7% of deaths to just 15.0 % dying.</td>
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<td>1875</td>
<td>Second Public Health Act - now made compulsory. Major requirement is that sewers must be moved away from housing and that houses must be a certain distance apart.</td>
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<tr>
<td>1876</td>
<td>Public Health improvements - in the UK, the government introduced new laws against the pollution of rivers, the sale of poor quality food and new building regulations were enforced.</td>
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<tr>
<td>1881</td>
<td>Robert Koch discovers the bacteria that causes anthrax. He establishes a new method of staining bacteria. Using Koch’s methods, the causes of many diseases were identified quickly: 1880 - Typhus 1882 - Tuberculosis 1883 - Cholera 1884 - Tetanus 1886 - Pneumonia 1887 - Meningitis 1894 - Plague 1898 - Dysentery</td>
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<tr>
<td>1889</td>
<td>Isolation Hospitals were set up to treat patients with highly infectious diseases.</td>
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<tr>
<td>1895</td>
<td>William Röntgen discovers X-Rays. Though it is an important discovery, it is only WW1 and the treatment of soldiers that propels it into the medical spotlight.</td>
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<td>Year</td>
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<tr>
<td>1895</td>
<td>Marie Curie discovers radioactive elements radium and polonium</td>
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<tr>
<td>1901</td>
<td>Scientists discover that there are different blood groups- this leads to the first 100% successful blood transfusions.</td>
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<tr>
<td>1905</td>
<td>Paul Ehrlich discovers first “magic bullet“ - Salvarsan 606 to treat Syphilis. The problem was it was based on arsenic and so could kill the patient too easily.</td>
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<tr>
<td>1911</td>
<td>National Health Insurance introduced in Britain</td>
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<td>1914-1918</td>
<td>World War One - development of skin grafts to treat victims of shelling</td>
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<tr>
<td>1928</td>
<td>Alexander Fleming - discovers Penicillin. The mould had grown on a petri dish that was accidentally left out. Fleming writes articles about the properties of Penicillin, but was unable to properly develop the mould into a drug.</td>
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<tr>
<td>1932</td>
<td>Gerhardt Domagk discovers Prontosil (the second magic bullet). Slight problem is that it turns the patient red.</td>
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<tr>
<td>1937-45</td>
<td>Florey, Chain &amp; Heatley work on producing penicillin as a drug. Their success will make the drug the second most finded project by the USA in WW2. They fund it to the tune of $800 million and every soldier landing on D-Day in 1944 has Penicillin as part of his medical kit.</td>
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<tr>
<td>1939</td>
<td>Emergency hospital scheme introduced - Funded and run by Government</td>
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<tr>
<td>1942</td>
<td>William Beveridge publishes the Beveridge Report. The report was the blueprint for the NHS</td>
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<tr>
<td>1946</td>
<td>National Health Service Act - provides for a free and comprehensive health service. Aneurin Bevan convinces 90% of the private doctors to enrol.</td>
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</table>
Medicine through time thematic view

Medical knowledge and understanding in the mid nineteenth century

- Lack of understanding of causes of disease.
- Dangers in surgery.
- Attitudes to women and medicine, nursing, anaesthetics and public health provision.
- Problems in public health.
- Impact of cholera.
- Awareness of the miasma theory.

Changes in surgery and in understanding the causes of disease

- The battle against germs: work of Pasteur, Lister, Koch, Ehrlich, Fleming, Florey and Chain.
- Importance of penicillin.

Changes in hospital treatment and the role of women in medicine

- Florence Nightingale and Scutari.
- Changes and improvements in nursing.
- Elizabeth Garrett and progress of women in medicine.
- Improvements in hospitals.
- Work of Lister.

Developments in public health provision

- Impact of cholera.
- The work of Chadwick and Snow and public health reform in the nineteenth century.
- Liberal measures 1906-11.

The importance of the two world wars in bringing about change

- Importance of First World War for women and medicine, surgery, X-rays, blood transfusion and fighting infection.
- Importance of Second World War for development of penicillin, treatment of burns and skin grafts, blood transfusion and public health.
The Age of Enlightenment

Jenner's vaccination was a landmark in the development of preventative medicine.

**Lady Montagu introduced Inoculation from Turkey**

1) In the 18th century, smallpox was a major killer. The disease was frequently fatal and usually left any survivors badly scarred and disfigured.

2) Lady Mary Wortley Montagu learnt about inoculation in Turkey and introduced it to Britain. Inoculation had arrived in Turkey from China.

3) Montagu discovered that a healthy person could be immunised against smallpox using pus from the sores of someone suffering with a mild form of the disease.

   A thread soaked in pus was drawn through a small cut in the person to be inoculated. After a mild reaction, they were immune to smallpox.

4) Unfortunately inoculation sometimes led to full-blown smallpox and death. The fear of smallpox led people to take the risk of inoculation. Doctors could become rich doing inoculations.

**Jenner was very interested in Milkmaids**

1) Edward Jenner (b. 1749) was a country doctor in Gloucestershire. He heard that milkmaids didn't get smallpox, but they did catch the much milder cowpox.

2) Using careful scientific methods Jenner investigated and discovered that it was true that people who had had cowpox didn't get smallpox.

3) In 1796 Jenner was ready to test his theory. He took a small boy called James Phipps and injected him with pus from the sores of Sarah Nelmes, a milkmaid with cowpox. Jenner then injected him with smallpox. James didn't catch the disease.

4) The Latin for cow, vacca, gives us the word vaccination.

**Jenner became World Famous, but not everyone was happy**

1) Smallpox was taken to America by European settlers — Jenner's vaccinations made him famous even amongst the Native Americans, who sent a delegation to England to thank him.

2) In 1802 and 1806 Parliament gave Jenner £10,000 and £20,000 respectively — equivalent to millions today.

3) Vaccination was made free for infants in 1840 and compulsory in 1853.

4) Some people were opposed to vaccination. Some doctors who gave the older type of inoculation saw it as a threat to their livelihood, and many people were worried about giving themselves a disease from cows.

**If only there was a vaccination against exams...**

Vaccination is a brilliant example of how government action can improve public health — by 1979 smallpox had been completely eradicated worldwide. Excellent stuff. Don't forget that the causes of disease weren't understood, so how vaccination worked was a mystery until much later. Its development was solely based on Jenner's observation and clear thinking.

Section Seven — The Age of Enlightenment
Developments in Nursing

Horrific conditions during the Crimean War (1854-1856) brought two nurses to the public’s attention.

The “Lady with the Lamp” changed nursing

1) Florence Nightingale (1820-1910) brought a new sense of discipline and professionalism to a job that had a very bad reputation at the time.
2) She became a nurse despite the opposition of her family, and studied in Europe from 1849.
3) The Crimean War broke out in March 1854. The use of telegraphic communications by war correspondents to get stories home fast encouraged people to have opinions and comment.
4) Horror stories emerged about the Barrack Hospital in Scutari, where the British wounded were being treated.
5) Sidney Herbert, who was both the Secretary of War and a friend of the Nightingale family, requested that Florence went to Scutari to sort out the nursing care in the hospital.
6) Despite opposition from the military, Florence went — taking with her 38 hand-picked nurses. Before she arrived, the death rate in the hospital stood at 42%. Two years later it had fallen to just 2.4%. This was partly the result of huge improvements Florence made to ward hygiene.

Florence Nightingale returned with a Mission

1) Florence Nightingale used her fame to help her change the face of nursing forever.
2) Her book, Notes on Nursing, explained her methods — it was the standard textbook for generations of nurses.
3) The public raised £44,000 to help her train nurses, and she set up the Nightingale School of Nursing in St. Thomas’ Hospital, London. Discipline and attention to detail were important.
4) By 1900 there were 64,000 trained nurses in Britain, from colleges across the country.
5) The 1919 Registration of Nurses Act made training compulsory for nurses.
6) It wasn’t until 1960 that men were admitted to the Royal College of Nursing.

“Mother Seacole” also nursed in the Crimea

1) Mary Jane Seacole (1805-1881) learnt nursing from her mother, who ran a boarding house for invalid soldiers in Kingston, Jamaica.
2) In 1854, she came to England to volunteer as a nurse in the Crimean War. She was rejected — possibly on racist grounds — but went anyway, paying for her own passage.
3) Financing herself by selling goods to the soldiers and travellers, she nursed soldiers on the battlefields and built the British Hotel — a small group of makeshift buildings that served as a hospital, shop and canteen for the soldiers.
4) She couldn’t find work as a nurse in England after the war and went bankrupt — though she did receive support due to the press interest in her story. She wrote an autobiography.

Like it or lamp it, you’ve got to learn it...

When you think of turning points, it’s so easy to just think of watershed discoveries — and forget about things like nursing, which have often made just as much difference. Like with Paré, Nightingale’s work is an example of how wars sometimes help lead to advances in healthcare.

Section Eight — The Industrial Revolution
Germs and the Fight Against Them

In France, Pasteur had the germ of an idea.

1857 — the start of the War on Germs

The Uphill Struggle against Germs

- 1941 Florey — mass-produced penicillin
- 1932 Domagk — sulphonamides
- 1928 Fleming — discovers penicillin
- 1910 Ehrlich — develops Salvarsan 606
- 1891 von Behring — develops diphtheria antitoxin
- 1882 Koch — identifies TB microbe
- 1857 Pasteur — Germ Theory

Pasteur was the first to suggest that Germs cause disease

1) Micro-organisms had been seen through 18th century microscopes, but scientists thought they were caused by disease and appeared because of illness. This was the theory of spontaneous generation. Instead of blaming the microbes, people looked for noxious gases called miasmas.

2) Louis Pasteur was employed in 1857 to find the explanation for the souring of sugar beet used in fermenting industrial alcohol. His answer was to blame germs in the air.

3) Pasteur proved there were germs in the air by sterilising some water and keeping it in a flask that didn’t allow airborne particles to enter. This stayed sterile — but sterilised water kept in an open flask bred micro-organisms again.

Robert Koch used dyes to identify microbes

1) The German scientist Robert Koch began the process of linking diseases to the microbe that caused them.

2) Koch developed a solid medium to grow cultures, and dyeing techniques to colour microbes, which he viewed through high-powered microscopes. He used his daughter’s pet mice to experiment with.

3) He identified anthrax spores (1875) and the bacteria that cause septicaemia, tuberculosis (1882) and cholera (1883).

Koch-a-leekie — my favourite antipasteur...

Pasteur’s germ theory was a monumental breakthrough — and the springboard for all the other developments in this section. Remember that none of these breakthroughs came straight out of the blue — they all built on the work of others before them — usually many others.

Section Eight — The Industrial Revolution
Vaccines and Antitoxins

Fuelled by ambition and personal rivalries, the race for further discoveries was on.

**Pasteur found the Vaccine for Chicken Cholera**

1) Hearing of Koch’s work, Pasteur came out of retirement in 1877 and started to compete in the race to find new microbes and combat them.

2) Many other scientists joined this new field of bacteriology.

3) Pasteur looked for cures to anthrax and chicken cholera. Both he and Koch worked with large teams of scientists in this Franco-German competition for national prestige. Charles Chamberland was in Pasteur’s team.

4) One day Chamberland was told to inject some chickens with chicken cholera, but it was the day before his holiday and he forgot (as you do). He left the cholera culture on his desk and injected the chickens when he returned.

   Where are you going with that needle?

   5) The chickens survived. They tried again with some newly cultured cholera, but the chickens still survived.

   6) They worked out that the cholera had been weakened by being left on the desk for a few days, and that the weakened (attenuated) cholera had made the chickens immune — in the same way that Jenner’s cowpox vaccine had worked for smallpox. Chamberland’s error had produced a chance discovery.

**Vaccines for Anthrax and Rabies soon followed**

1) Pasteur’s team then managed to produce an attenuated version of the anthrax spore that would make sheep immune. They demonstrated this in a public experiment in 1881.

2) Next on their hit list was rabies. Emile Roux had used dried rabbit spines to discover how long the rabies microbe remained dangerous. Pasteur borrowed (OK, nicked) Roux’s idea to create a series of inoculations of increasing virulence (liveliness). He hoped these would lead to immunity.

3) In 1885 a distraught woman arrived with her son, who had been horribly bitten by a rabid dog. Knowing that the child was bound to die if nothing was done, Pasteur agreed to try out the new treatment on him. Fortunately, the treatment worked.

**More help came for those Already Ill...**

1) The diphtheria germ had been discovered by Edwin Klebs in 1883.

2) Friedrich Loeffler cultured the germs and thought that their effect on people was due to a poison or toxin they produced. Emile Roux proved Loeffler right.

3) In 1891 Emil von Behring produced an antitoxin or serum — a substance that cancels out the toxins produced by germs — from the blood of animals that had just recovered from diphtheria. This could be used to reduce the effect of the disease.

**Goodbye to germs — Pasteur la vista, baby...**

Pasteur and Koch were legendary rivals. This was partly because Pasteur was French and Koch German — the two were working around the time of the Franco-Prussian War (1870-1871), in which France suffered a crushing defeat to Germany. The pair’s rivalry helped to spur the two scientists on — each wanted to be responsible for making the greatest discovery.

Section Eight — The Industrial Revolution
Antibodies and Penicillin

The diphtheria antitoxin was only the first of many effective cures found by modern science.

Paul Ehrlich found a chemical treatment for Syphilis

Antibodies were identified as a natural defence mechanism of the body against germs. It was known that antibodies only attacked specific microbes — so they were nicknamed magic bullets.

In 1889, Paul Ehrlich set out to find chemicals that could act as synthetic antibodies.

1) First, Ehrlich discovered dyes that could kill the malaria and sleeping sickness germs.
2) Then, in 1905, the spirochete bacterium that causes the sexually transmitted disease syphilis was identified.
3) For many years arsenic and mercury had been used with some success to cure syphilis. Unfortunately both are poisonous, so it was a fine line between curing and killing.
4) Ehrlich and his team decided to search for an arsenic compound that was a magic bullet for syphilis. They hoped it would target the spirochetes without poisoning the rest of the body.
5) Over 600 compounds were tried, but none seemed to work.
6) In 1909, Shibasiro Hata joined the team. He rechecked the results and found that compound number 606 actually appeared to work. It was first used on a human in 1911 under the trade name Salvarsan 606.

Fleming discovered Penicillin — the first Antibiotic

1) The discovery of penicillin is a great example of a chance finding helping science.
2) Alexander Fleming saw many soldiers die of septic wounds caused by staphylococcal bacteria when he was working in an army hospital during the First World War.
3) Searching for a cure he identified the antiseptic substance in tears, lysozyme, in 1922 — but this only worked on some germs.
4) One day in 1928 he came to clean up some old culture dishes on which he had been growing staphylococci for his experiments. By chance, a fungal spore had landed and grown on one of the dishes.
5) What caught Fleming’s eye was that the colonies of staphylococci around the mould had stopped growing. The fungus was identified as Penicillium notatum. It produced a substance that killed bacteria. The substance was given the name penicillin.
6) Fleming was unable to take his work further. The industrial production of penicillin still needed to be developed.

Ehrlich in the morning, when the dye was dawning...

Paul Ehrlich’s work was basically trial and error, based on a hunch. The fact that so many different compounds were tested is some measure of his perseverance — a key quality of all these scientists. Chance played a big role in Ehrlich’s discovery, but probably not as much as in Fleming’s. When you think you know the facts, cover the page, note them down, then check.

Section Eight — The Industrial Revolution
Sulphonamides and Penicillin

There were lots more surprises to come — including another dye-hard and pure penicillin.

Gerhard Domagk found a dye that stopped Streptococci

1) In 1932, Gerhard Domagk found that a red dye, prontosil, stopped the streptococcus microbe from multiplying in mice — without being poisonous to the mice.

Streptococcus caused a frequently fatal blood poisoning that could be contracted from very minor wounds. Many surgeons contracted it after cutting themselves in the operating theatre.

2) In 1935, Domagk’s daughter pricked herself with a needle and caught the disease. Afraid she would die, Domagk gave her a large dose of prontosil. The girl turned bright red, but recovered.

3) The active ingredient of prontosil was identified as a sulphonamide by French scientists. A whole group of drugs based on sulphonamides followed, including M&B 693, which worked on pneumonia without turning you any strange colour.

4) Sadly more serious side-effects were discovered later. Sulphonamide drugs can damage your liver and kidneys.

Florey and Chain found a way to Purify Penicillin

1) Being a natural product, penicillin needed purifying. The breakthrough was made by Howard Florey’s team in Oxford between 1938 and 1940. Ernst Chain, a member of the team, devised the freeze-drying technique which was an important part of the purification process.

2) At first Florey and Chain didn’t have the resources to produce penicillin in large amounts. They made penicillin for their first clinical trial by growing Penicillium notatum in every container they could find in their lab. The patient began to recover, only to die when the penicillin ran out.

3) Florey knew that penicillin could be vital in treating the wounds being received by soldiers at the time (WWII). British chemical firms were too busy making explosives to start mass production — so he went to America.

4) American firms were not keen to help — until America joined the war in 1941. By 1944 mass production was sufficient for the needs of the military medics.

5) Fleming, Florey and Chain were awarded the Nobel Prize in 1945.

A cure for all ills? — not Fleming likely...

Yet another example of war helping to advance medicine. And another use of dyes. The stuff on penicillin’s really important. Make sure you understand the effect it had on medicine. But don’t forget it was no use in minute quantities — so technology was essential for its production. Just think what a difference that would have made in earlier centuries.
Anaesthetics

Pain, bleeding and infection were the three bugbears of surgery.

Anaesthetics made life easier for all concerned

Natural drugs like alcohol, opium and mandrake had long been used to reduce pain — but effective anaesthetics that didn't make the patient very ill were more difficult to produce.

1) Nitrous oxide (laughing gas) was identified as a possible anaesthetic by Humphry Davy in 1799 — but he was ignored by surgeons of the time.
2) The gas had been relegated to use as a fairground novelty before Horace Wells suggested its use in dentistry. He did a public demonstration in 1845, but had the bad luck to pick a patient unaffected by nitrous oxide — it was again ignored.
3) In 1842, Crawford Long discovered the anaesthetic qualities of ether — but he didn't publish his work.
4) The first public demonstration of ether as an anaesthetic was carried out in 1846 by John Warren.
5) Ether is an irritant and is also fairly explosive, so using it in this way was risky. In 1847 James Simpson experimented on himself to find an alternative. He discovered the effects of chloroform.
6) Chloroform was widely used in operating theatres and to reduce pain during childbirth — but it turned out to cause liver damage, leading to a return to ether.
7) General anaesthesia (complete unconsciousness) is risky, so local anaesthesia (numbing of the part being treated) is better for many operations. In 1884, William Halsted investigated the use of cocaine as a local anaesthetic. Unfortunately, his self-experimentation led to a severe cocaine addiction.

Early Anaesthetics actually led to a Rise in death rates

1) Some people were suspicious of doctors using anaesthetics — or even objected on religious grounds. Others were afraid of side effects and the dangers of overdose.
2) Surgeons were keen to perform more and more complicated operations because an unconscious patient was cooperative and the surgeon could take longer over his work.
3) As the dangers of bleeding and infection had not been overcome, the attempts at more complicated surgery actually led to increased death rates amongst patients. The period between 1846 and 1870 is sometimes called the "Black Period" of surgery.
4) Modern anaesthetists use complicated mixtures to produce muscle relaxation or paralysis. Getting the balance of the different drugs right is tricky — there have been incidents when patients were paralysed, unable to cry out, but fully conscious and in excruciating pain.

Anaesthetics — learn your stuff and it won’t hurt a bit...

Anaesthetics were definitely a major advance, but don’t forget about that grisly "Black Period" — and what caused it. You should be able to recite the facts in your sleep, but you're not allowed anaesthetic for the exam. If you know it all, it won't be too painful.

Section Nine — The Development of Modern Surgery
Antisepsis and Asepsis

Antisepsis and Asepsis reduce infection

There are two main approaches to reducing infection during an operation:

1) Antiseptic methods are used to kill germs that get near surgical wounds.
2) Aseptic surgical methods aim to stop any germs getting near the wound.

Joseph Lister pioneered the use of Antiseptics

1) Ignaz Semmelweis (1818-1865) had used chloride of lime solution as a hand wash for doctors to control the spread of puerperal fever, an infection suffered by many women following childbirth. However, it was very unpleasant, so wasn’t widely used.

2) Joseph Lister had seen carbolic acid sprays used in sewage works to keep down the smell. He tried this in the operating theatre in the early 1860s and saw reduced infection rates. Having heard about the germ theory in 1865, he realised that germs could be in the air and on surgical instruments and people’s hands. He started using carbolic acid on instruments and bandages. This produced further improvements.

3) Carbolic acid is unpleasant to get on your skin or breathe in — so many doctors and nurses didn’t like or use it.

4) The use of antiseptic conditions reduced death rates from as high as 50% to about 15%. By 1890 antiseptics were being used by most European and American surgeons.

Asepsis reduced the need for Nasty Chemicals

By going from killing germs to making a germ-free (aseptic) environment, surgeons have been able to avoid using large amounts of antiseptic in the theatre.

The Aseptic Operating Theatre

1) Instruments are carefully sterilised before use, usually with high temperature steam (120°C).
2) Theatre staff sterilise their hands before entering — and wear sterile gowns, masks, gloves and hats. Surgical gloves were invented by William Halsted in 1889.
3) The theatres themselves are kept scrupulously clean and fed with sterile air. Special tents can be placed around the operating table to maintain an area of even stricter hygiene in high risk cases.

Make a Lister them facts — then germ up on them...

Right, a couple of tricky words here. The key to the page is to understand the difference between “antiseptic” and “aseptic”. Of course you do need to know about the methods used as well. Remember that Lister started using carbolic acid before he’d heard about the germ theory. He was able to improve his methods later when he understood how they worked.

Section Nine — The Development of Modern Surgery
Blood Transfusion, X-rays and Keyhole Surgery

Blood transfusion, radiography and keyhole surgery have revolutionised 20th century medicine.

Karl Landsteiner discovered Blood Groups in 1900

1) Blood circulates rapidly, so it doesn’t take long to bleed to death if a major blood vessel is cut. Surgery often causes heavy bleeding.
2) The concept of blood transfusion was known from at least the 17th century, when Jean-Baptiste Denys carried out a cross-species transfusion to a human (1667).
3) The problem was that sometimes it worked and sometimes the blood of the recipient clogged — they died and no-one knew why.
4) Then in 1900, Karl Landsteiner discovered blood groups and the importance of compatibility. He found that certain groups of blood couldn’t be mixed together as they would clog the blood vessels.
5) During the First World War sodium citrate was found to stop clotting when blood came into contact with the air. This allowed blood to be stored more easily.
6) In 1946 the British National Blood Transfusion Service was established.

X-rays and Radiography — look before you cut

1) X-rays were discovered by Wilhelm Roentgen in 1895. They pass easily through soft flesh, but less well through bone. They also affect photographic film.
2) These factors allow simple X-ray images to be produced by directing X-rays at a body part in front of a photographic plate.
3) In computerised axial tomography (CAT), a scanner rotates 180° around the body, aiming thin beams of X-rays at receptors on the opposite side of the person. A computer analyses the results and produces an image of a slice of the body. The slices can be built up into a 3D image of the body.
4) Between 1896 and 1898 Antoine Henri Becquerel and Pierre and Marie Curie discovered the first radioactive isotopes. Radioactive isotopes are used:
   - to treat cancers as part of radiotherapy
   - in immunosuppression (see p.67).
   - as tracers in diagnosis — mildly radioactive material is swallowed or injected and medicals can detect its movement around the body.

Keyhole Surgery is also good for investigating illness

1) Keyhole surgery is a technique (developed in the 1980s) which makes surgery less invasive. It’s popular with patients because scars are smaller and recovery is quicker.
2) In keyhole surgery, a surgical instrument called an endoscope is put through a small cut. It gives out light and feeds back a picture to a screen, letting the surgeon see inside the body.
3) Other instruments are needed for the actual surgery, which are introduced through even smaller cuts in the skin. Keyhole surgery is usually performed under a general anaesthetic.
4) This technique is useful for investigating the causes of pain or infertility. It’s also used for vasectomies, removing cysts or the appendix, mending hernias and other minor operations.

Blood confusion? — grouping around in the dark...

Don’t forget that governments often play key roles in discoveries, e.g. supplying money to fund the research. And government spending is often heavily influenced by social attitudes.

Section Nine — The Development of Modern Surgery
Transplants and Repair

Like keyhole surgery, many other surgical techniques came of age in the last half-century.

Transplants — a brand new branch of surgery

Replacing worn out body parts is something we’re still just beginning to get the hang of. Mechanical parts are quite common now for joint replacement and prosthetic (artificial) limbs, but artificial vital organs cannot compare to the real thing. Transplant surgery using donor organs has usually been the only option.

1) The first organ to be transplanted was the kidney (in 1951), closely followed by the cornea of the eye.

2) Livers, lungs, pancreases and bone marrow are also transplanted, but the organ that has excited most interest has always been the heart. Apart from problems with rejection (which you get with all organ transplants), with heart transplants you also have to:
   - keep the body supplied with blood and oxygen
   - get the new heart to beat after the operation

In many patients, you also have to deal with additional problems in other parts of the cardiovascular system and other organs.

3) The first heart transplant was carried out by Christian Barnard on the 3rd December 1967. The patient only survived for 18 days.

4) The poor life expectancy of patients soon led to a temporary stopping of heart transplants.

5) The major problem for any transplant is rejection, which is when the host body’s immune system attacks the implant. The immune system has to be suppressed until the implant is accepted by the body.

6) At first corticosteroids were used as immunosuppressants — but they often stopped all resistance to diseases like pneumonia (Christian Barnard’s first patient died of pneumonia).

7) Cyclosporin was approved for use in 1983 — a fungus-derived drug which has since been used successfully with many patients. A fungus was also the source of tacrolimus (FK506), another immunosuppressant drug approved for use in 1994.

Wars sped the development of Plastic Surgery

1) Skin grafting had been known in Renaissance Europe and since ancient times in India — but infection had limited its usefulness.

2) Harold Gillies began working with burns victims from the First World War.

3) His work was continued during the Second World War by his assistant, Archibald McIndoe — probably the most famous plastic surgeon ever. A lot of McIndoe’s patients were pilots who had been trapped inside burning aircraft.

4) McIndoe’s unit in East Grinstead took advantage of new developments in antibacterial drugs and surgical techniques. The staff there also worked very hard to help their patients through the psychological effects of their injuries.

Plastic surgery — it’s no skin off my nose...

Don’t forget advances like these always build on past advances. You might have to compare advances at different times, so it’s best to get some practice in now. Think of the similarities and differences — think what factors they had in common. And when you think you know the key bits, turn over the page and scribble them down — then check you’ve got them all.

Section Nine — The Development of Modern Surgery
Population Growth and Family Planning

Big improvements were made from the Industrial Revolution onwards.

**Industrial Revolution — mass (re)production**

1) The industrial age saw a huge rise in population growth.
2) This was despite the poor conditions in cities, which made women less likely to survive a normal pregnancy. Lack of exercise, pollution-related diseases and deficiency diseases like rickets all weakened people, as did epidemics of smallpox, tuberculosis and cholera.
3) Some people raised religious objections to using anaesthetics in childbirth. They thought that a line in the Bible said women were meant to suffer pain during childbirth. These ideas were only really defeated when Queen Victoria asked for chloroform during the birth of Prince Leopold.
4) The development of antiseptics did a lot to reduce the deaths of women following childbirth — especially Semmelweis's use of chloride of lime to control post-natal puerperal fever.
5) Gynaecology as a separate branch of surgery dates from the mid-1800s, with much of the pioneering work being done in America. J.M. Simms opened the first gynaecological hospital in New York in the 1850s.

**Family Planning help had to wait till the 20th Century**

1) In 1798 Thomas Robert Malthus was the first to suggest that the human species might increase in numbers beyond its ability to feed itself.
2) The reduction of deaths in childbirth meant an increased rate of population growth — and a greater need for family planning.
3) Clinics providing barrier and chemical forms of contraception and family planning advice were pioneered in the 1920s — by Marie Stopes in Britain and Margaret Sanger in America.
4) Contraceptive pills were first available in the early 1960s. For a while the pill and effective antibiotics seemed to offer security from unwanted pregnancy and sexually-transmitted diseases. This helped fuel the sexual revolution of the 1960s. HIV changed that.
5) The World Health Organisation and the UN Population Fund have been working to bring effective family planning to the developing world.

**There have been Developments in Infertility Treatments**

1) Recently, new infertility treatments have been developed.
2) Most famous is IVF (in vitro fertilisation — or test-tube babies). The external fertilisation of an egg before implantation in the uterus was first done for humans in 1977.
3) Eggs, semen or even embryos can also be frozen and stored for a long time before being allowed to develop into babies. This can be useful — e.g. healthy sperm might be stored before a treatment that could leave a patient infertile.

Children — I give them a wide birth myself...

Queen Victoria's decision to use chloroform was one of those major turning points you need to know about. That's what was needed to change the social and religious attitudes of the day. Communications were also important though — without them, there'd have been no debate, and few people would have known of the Queen's actions — or of chloroform for that matter.

Section Ten — Childbirth
**City Slums and Cholera**

Medieval and Renaissance towns had failed to reach the standards of public health seen in Roman times — but the **Industrial Revolution** (which started about 1750) made things even worse.

**The Industrial Revolution was bad for your health**

1. The towns of the medieval period were not densely packed with rows and rows of buildings as we see them today. Within a town there were **gardens** for growing vegetables and keeping **pigs and chickens**. There were also **orchards** of fruit trees.
2. **Industry** and changes in agriculture brought more people into the towns. The spaces filled up with **factories** and **poor quality housing**. Anyone who owned land could build on it without **planning permission** — and there were no building standards **regulations**.
3. People didn't believe the **government** had the right to tell people what to do with their **land**. They expected “no-intervention” policies from the government (laissé-faire).
4. Attempts at providing fresh water and removing sewage and **rubbish** were often **inadequate**. Sewage was discharged into **rivers**, overflowing cesspits or even into the **street**. **Smoke** from houses and factories filled the air.
5. Diseases like **smallpox**, **influenza**, **typhus** and **tuberculosis** were common.

**Cholera — an epidemic within a year of arrival**

1. Cholera reached Britain from the East in 1831. It was an epidemic by 1832.
2. Cholera spreads when infected sewage gets into drinking water. It causes such extreme **diarrhoea** that sufferers often die from loss of water and minerals. Both rich and poor people caught the disease.
3. The **government** started to introduce **regulations** about the **burial** of the dead, but the epidemic declined and **interest** was lost.
4. People did not know what caused cholera. Epidemics **recurred** in 1848, 1854 and 1866.

**Chadwick's Report got people thinking**

1. In 1842, Edwin Chadwick published a 'Report on the Sanitary Condition of the Labouring Population of Great Britain'. His revolutionary idea was that **improved public health** provision and a **healthy workforce** would save money rather than cost money.
2. The report and statistics describing levels of **sickness and mortality** shocked some of the **privileged classes**. People campaigned for improvements and in 1844 the **Health of Towns Association** was set up.
3. Responding to calls from the Health of Towns Association, the government introduced a **Public Health Bill**. It was opposed at first, but was finally passed when a new cholera **epidemic** broke out. It became the first **Public Health Act**, in 1848.
4. The main provision of the act was for **Central and local Health Boards**. The local boards had to be **approved** by ratepayers, and the Central Board lasted until it was **dismantled** in 1854.

**Learn the facts — give your brain a clean bill of health...**

OK, so basically the Industrial Revolution was a time of very **poor living conditions** for lots of workers. There were loads of large towns without proper **sanitation** or **clean water**. And surprise surprise, there were epidemics. **Chadwick's report** was a landmark.
The Defeat of Laissez-Faire

John Snow linked cholera to contaminated water, while more voices joined the call for action.

**Snow linked Cholera to Contaminated Water**

1) The connection between contaminated water and cholera was discovered by John Snow in 1854.

2) He studied the occurrence of a cholera outbreak in the Broad Street area of London and noticed that the victims all used the same water pump. So he removed the handle from the pump — and ended the outbreak.

The 1860s and 70s saw the Defeat of Laissez-Faire

1) **Snow** was proved right about the spread of disease when Pasteur discovered germs.

2) In 1871 and 1872 the government responded to proposals of the Medical Officer of Health, Sir John Simon. It formed the Local Government Board and divided the country into "sanitary areas" administered by medical officers of health.

3) Another Public Health Act was brought in by Disraeli’s government in 1875, along with the Artisans’ Dwellings Act. The 1875 Act was more effective than the earlier one because it forced local councils to act on public health.

4) The Artisans’ Dwellings Act allowed for compulsory purchase of slum housing and rebuilding by local councils (although the Act was seldom used).

This Act owed much to the work of Octavia Hill, who was concerned with the terrible conditions in which people were living and so developed a model housing scheme. Hill was also determined that people should have access to green spaces for their health and well-being. She campaigned to save open spaces from being built on and ended up co-founding the National Trust in 1895.

5) Victorian engineering produced improvements in the form of brick-lined sewer networks and steam-driven pumped water systems — such as the Boughton Pumping Station.

**But Life in 1900 wasn’t much Better**

1) Slums were still a feature of big cities and industrial towns at the start of the 20th century.

2) Poor people were often housed in tenements — these were damp, insanitary and had no running water. Large families lived together in one room and shared a toilet with their neighbours.

3) The poor worked long hours for low wages. Many people couldn’t afford to see a doctor when they were sick or provide their children with three decent meals a day.

4) There were 140 infant deaths for every 1000 births, today it’s less than 5.

5) Patent medicines continued to be popular. They had secret recipes and were sold with extravagant claims, but they often did more harm than good.

Snow use ignoring them — those germs won’t go away...

We take it for granted now that the government gets involved in public health. But not so long ago that just wasn’t the case. It took a big change in people's beliefs for that to happen.
Philanthropists and Liberal Reforms

The Liberal government elected in 1906 made many important changes.

**Philanthropists were rich people who Helped the poor**

1) In 1889, the shipping owner Charles Booth surveyed living conditions in London's East End and published *Life and Labour of the People in London* — it showed a clear link between poverty and ill health.

2) A similar survey was made in York by Seebohm Rowntree, a member of the family that made Rowntree's chocolate. His work, published in 1901, would go on to heavily influence the policies of the Liberal Chancellor David Lloyd George.

3) The other famous chocolate makers, the Cadburys, tried to provide quality homes and improve lifestyles for workers at their factory in Bournville, near Birmingham. Titus Salt did a similar thing in Saltaire (c.1850) in Yorkshire.

4) These philanthropist businessmen were great examples of how to make money and treat your workers well.

5) When the Boer War broke out in 1899, army officers found that 40% of volunteers were unfit for military service — mostly due to poverty-related illnesses linked with poor diet and living conditions. Similar problems were encountered during the First World War. Britain, like the Romans, realised it needed a healthy population to have an efficient army.

6) Many workers organised Friendly Societies, which were often linked to trade unions. Workers paid a subscription each week and in return received medical help and other benefits.

**Liberal Government Reforms — Social Security measures**

1) By 1906 the link between poverty and ill health had been well and truly established. The newly-elected Liberal government realised it had to take action. Many MPs were especially worried about losing votes to the relatively new Labour Party — which promised to look after interests of the working classes.

2) So — under the guidance of Lloyd George* — the Liberals started to introduce measures that are still important to our social security today:

   - Free school meals — 1906.
   - School medical inspections — 1907.
   - Old Age Pension Act — 1909.
   - Labour Exchanges (Job Centres) — 1909.

* David Lloyd George was Chancellor of the Exchequer at the time of the reforms. He became Prime Minister in 1916.

3) Lloyd George had to overcome a lot of opposition from the House of Lords to get many of these reforms through.

4) National Insurance wasn’t compulsory and it only covered people who paid in. These people could then get sick pay and medical treatment from a panel doctor working for the scheme. The scheme also provided unemployment pay.

5) The reforms weren’t perfect, but they marked the start of the modern welfare state.

David Lloyd George — so good they named him thrice...

All those schemes at the bottom of the page are really important. Make sure you understand just how big a breakthrough they were. Also, don’t forget there was plenty of opposition — people argued that governments shouldn’t interfere in people’s lives.

Section Eleven — Recent Advances in Public Health
The Medical Profession and Women

Women **struggled** for a long time to be **accepted** as qualified **doctors**.

**Women had to fight to re-enter the Medical Profession**

1) **Women** were not allowed to attend **universities** in the early **19th century**. As a result, they couldn’t qualify as doctors. Many **Victorian men** regarded women as being less able to work in jobs requiring professionalism, intelligence or lack of squeamishness.

2) It’s likely that the first British woman to qualify as a doctor had to **pretend** to be a man. **Margaret Ann Bulkley** was born some time in the 1790s. She’s thought to have trained at **Edinburgh University** as “**James Barry**”. After qualifying in 1812, she joined the army in time to serve at the **Battle of Waterloo** and was eventually promoted to **Assistant Surgeon**. She served in the army for 46 years and was only found out when she died in 1865.

3) **Elizabeth Blackwell** (an English-born American) was the **first woman** in modern times to be awarded a medical degree in her own name from a western training college (1849).

4) The first **British women** to practise openly as qualified modern doctors both had to train **privately or abroad**. Their names were **Elizabeth Garrett Anderson** and **Sophia Jex-Blake**.

- **Garrett Anderson** was trained privately before being accepted as a qualified doctor by the **Society of Apothecaries** in 1865. She used the society’s rules to force it to recognise her — but afterwards they **changed** their rules to stop other women doing the same. She was awarded a **medical degree** by the **University of Paris** in 1870.
- **Sophia Jex-Blake** gained entry to Edinburgh University, but was refused a degree when her entry was declared unlawful. She then co-founded the **London School of Medicine for Women** in 1874, and gained her own qualification from the **University of Bern**.

**More Women are now qualifying as doctors**

1) The need for women in **professional roles** increased during the world wars (1914-1918 and 1939-1945).

2) The **1975 Sex Discrimination Act** meant that equal opportunities for men and women had to be available in all jobs.

3) Today around **45%** of doctors are women and female **GPs** could soon **outnumber** their male counterparts.

4) Women are still under-represented at the **top level** though — they make up only **28%** of consultants.

**The lengths some people go to get an education...**

You need to think about what factors **held women back** and which ones allowed them to **succeed**.

You also need to remember that people like **Garrett Anderson** were instrumental in getting women **accepted** as doctors. As usual, learn the stuff, turn the page, then **scribble** it down.

Section Eleven — Recent Advances in Public Health
The National Health Service

The setting up of the NHS in 1948 was a great achievement of the post-war government.

There were Economic and Social Problems 1918-1939

1) After the First World War, Lloyd George promised to make Britain a land “fit for heroes”. A Ministry of Health was set up in 1919, and grants were given to build council houses.
2) But the First World War had drained Britain’s resources. An economic slump in the 1920s caused rising unemployment. The government cut back spending on welfare.
3) During the 1930s, things got worse when there was a global economic depression. By 1932, 22% of British workers were unemployed. Poverty and unemployment were particularly bad in Wales, Scotland and the North of England.
4) Homes in poor areas often had no electricity or sanitation. The 1930 Housing Act planned to clear slum housing. Progress was slowed down by the depression.

The Second World War led to pressure for Social Change

1) The Second World War (1939-1945) broke down social distinctions and brought people together whose lives had been very separate. The raising of mass armies made powerful people take notice of the health problems of the poor. Also the evacuation of children increased awareness in rural middle England of how disadvantaged many people were.
2) Air raids, especially the Blitz of 1940, prompted the government to set up the Emergency Medical Service. This provided a centralised control of medical services and offered free treatment to air raid casualties. It proved successful under great pressure.
3) After the Second World War people looked for improvements in society. Such feelings led to the 1945 victory for the Labour Party.

After the Beveridge Report, Bevan introduced the NHS

1) Sir William Beveridge published his famous Beveridge Report in 1942. In it he called for the state provision of social security “from the cradle to the grave”.
2) The report became a bestseller. In it Beveridge argued that all people should have the right to be free from want, disease, ignorance, squalor and idleness. He called these the five “giants”.
3) Aneurin Bevan was the Labour Minister for Health who introduced the National Health Service.
4) Compulsory National Insurance was introduced in 1948 to pay for the NHS. Doctors and dentists were wooed with a fixed payment for each registered patient. They were also allowed to continue treating private fee-paying patients.
5) By 1948 nearly all hospitals had joined the NHS and 92% of doctors had.

A big step forward for the sick...

OK, it’s NHS time. It tends to get taken for granted these days, but you’ve got to remember it hasn’t been around that long. It was a major turning point, so make sure you know the factors that led to its formation, and why they were important. Start with these — the Liberal Government 1906-14 (p.73), social attitudes, the Beveridge report, the Labour victory and the war.

Section Eleven — Recent Advances in Public Health
James Simpson - Anaesthetics

**WHAT DID HE DO?**
A young surgeon from Edinburgh, he wanted to discover something better than ether. Ether made patients vomit, coughed while unconscious and was highly flammable. Simpson experimented at home and realised that Chloroform was a highly effective anaesthetic that had less negative impacts than ether.

**WHY WAS HE SO IMPORTANT**
- Chloroform meant patients were not in pain during surgery
- It wasn’t as harmful to patients as much as ether (however doctors still got the dose wrong at times)
- Was easier to use than ether as it was not carried around in large containers
- People would not be unconscious for days

**OPPOSITION**
- Victorians were very religious and some felt pain relief interfered with Gods plan
- People distrusted anaesthetics
- Some doctors thought it was easier for patients to die under anaesthetics
- Number of patients who died after the operation actually increased

Joseph Lister - Antiseptics

**WHAT DID HE DO?**
Lister was an outstanding surgeon who developed the use of antiseptics in surgery. He had seen carbolic spray used to treat sewage and after some experiments he found that a thin mist of carbolic acid over a wound limited infection. When Koch was able to isolate the organism that caused bacteria this helped to back Lister’s theory that aseptic environment was needed for surgery.

**WHY WAS HE SO IMPORTANT**
- It was a turning point in surgery as many began to follow his methods
- Hospitals and operating theatres were rigorously cleaned
- All instruments were steam sterilised
- Sterile rubber gloves began to be used

**OPPOSITION**
- Some surgeons believed carbolic acid was an extreme as it cracked surgeons hand and made everything smell
- Surgeons still believed speed was essential
- People who tried to copy Lister’s methods got different results
- Lister was always changing his techniques and surgeons could not always follow them and thought he didn’t know what he was doing
Louis Pasteur – Germ Theory

**WHAT DID HE DO?**
Louis Pasteur was a French Chemist who made a breakthrough in medicine with his germ theory. He proved that there were microbes in the air which cause decay. It disproved the theory of spontaneous generation – that disease was caused by germs that were produced by flesh and vegetables as they rotted. Through his experiments he realised that heating liquids killed bacteria and stopped liquids going sour. He also realised that no decay would occur if matter was placed in a sealed container. This showed that the microbes causing decay were not produced from the matter itself but were in the air around it. He was also important because he realised that injecting chickens with a weakened version of a virus (in this case cholera) didn’t harm them but in fact made them immune from it. He called this process vaccination after Jenner’s work.

**WHY WAS HE SO IMPORTANT**
Pasteur’s scientific method of explaining what causes disease changed medical understanding. It led to Robert Koch being able to isolate specific microbes that caused specific diseases.

**LIMITATIONS**
Despite being an important breakthrough it had limited impact on medicine at the time because each disease had to be researched individually. Progress in the prevention and treatment of disease was therefore slow.

Robert Koch – Germ theory developed

**WHAT DID HE DO?**
Koch was a German scientist who built on the work of Pasteur. As better microscopes were developed, Koch was able to study different bacteria. He grew them in his laboratory and identified specific bacteria that caused a range of diseases. He developed a solid medium to grow cultures and dyeing technique to colour microbes which he then viewed through high power microscopes. He then experimented on mice. Koch was able to identify anthrax spores (1875) and the bacteria that caused septicaemia, tuberculosis (1882) and cholera (1833).

**WHY WAS HE SO IMPORTANT**
- Koch was important because he developed a way that scientists could study bacteria that made it easy for them.
- He was able to pick out which bacteria caused different diseases.
- Other scientists then went on to develop cures for these diseases.

**LIMITATIONS**
- Koch was only able to complete his work on the back of Pasteur’s germ theory.
- He only identified the bacteria that caused diseases – he didn’t find a cure.
Paul Ehrlich - Magic Bullet

**What Did He Do?**
Ehrlich was part of Koch's research team. Ehrlich spent hours staining bacteria and observing the effects the dye. He was fascinated by the way the body created anti-bodies which killed bacteria but did not harm anything else. In 1905 instead of dyes he experimented with a variety of chemical compounds based or arsenic. His team tried 605 variations before they found one that worked. The first magic bullet was called Salversan and was able to kill the bacteria that caused syphilis.

**Why Was He So Important**
- Ehrlich was able to show that a chemical compound could be used to destroy bacteria
- His work started off more research into chemical compounds being used to cure other diseases
- Remember that his work would not have been able to be done without that of Pasteur and Koch

**Limitations**
- Salversan was very difficult to use
- If not used properly it could kill the patient as well as the microbes causing the disease
- His work was all based on trial and error which meant it took a long time to research

Alexander Fleming - Penicillin

**What Did He Do?**
Fleming discovered penicillin by chance in 1928. When cleaning up some old culture dishes on which he had been growing staphylococci for experiments he realized that there was a fungal spore that had grown on one of them. Upon investigation he realized that the colonies of staphylococci around the mould had stopped growing. The fungus was identified as penicillium - it produced a substance that killed bacteria.

**Limitations**
- He was unable to get funding to carry on his research
- Fleming was unable to mass produce it so lost interest in the drug
- He never tested it on anyone

**Why Was He So Important**
- Although he was not the first person to discover penicilllin he was the first person to publish his findings on it
- He was the first to recognize the significance of the drug in fighting the big problem of infection after surgery
- He was able to work out that penicilllin could be was applied or injected to infected areas
Florey and Chain - Penicillin

**WHAT DID THEY DO?**
Howard Florey and Ernest Chain were two scientists working in Oxford who developed the use on penicillin. They worked out a technique to freeze dry the mould so that they could mass produce it. In 1940 they tested penicillin on mice and in 1941 they conducted tests on a patient. Unfortunately because they were not able to produce enough penicillin, the patient died when the drug ran out.

**LIMITATIONS**
- Florey and chain wanted to mass produce penicillin but no factory in Britain was able to because many had been damaged in the war.
- They then went to America to see if they could get funding there, at first America was reluctant but when they entered the war in 1941 they were prepared to fund the mass production to save as many soldiers lives as possible.

**WHY WAS HE SO IMPORTANT**
- Florey and chain made the mass production of penicillin possible by discovering that drying the mould was the best method of purification.
- They tested it on animals and humans to ensure that use was possible.
- However without the war and American funding the mass production would not have been possible.
- They refused to patent penicillin believing that it should be available to all.

Florence Nightingale - Nursing

**WHAT DID SHE DO?**
Florence Nightingale bought a new sense of discipline and professionalism to a job that had a bad reputation at the time. She became a nurse despite opposition from her own family. Nightingale gained her excellent reputation through the work she did during the Crimean war. Despite opposition from the military Nightingale organised the hospital emphasising cleanliness and fresh air (she believed disease was caused by miasma). Her actions contributed to the death rate falling from 42% to 2%.

**LIMITATIONS**
- Nursing for the poor was not effected by nightingale’s changes - central government actually helped more here in setting up hospitals specifically for the poor.
- District nursing was set up by William Rathbone to serve people in Liverpool in their homes.
- Nightingale believed in the miasma theory - that stale air carried disease and did not believe that specific germs carried specific diseases.
- She did not get the government to officially recognise the nurses qualifications.

**WHY WAS SHE SO IMPORTANT**
- Her work in Crimea was reported in the press and people began to take notice of what she was saying.
- The public contributed money towards establishing a school for nurses in 1860.
- She wrote 200 books on hospital organisation.
- She encouraged all nurses to be properly trained and have proper qualifications.
- The 1919 Registration of Nursing Act made training compulsory for nurses.
### Elizabeth Garret - Doctors

**What Did She Do?**
At the start of the nineteenth century women were allowed to be doctors but by 1850 they were fighting back. Elizabeth Garret Anderson was the first woman doctor in England. She came from a wealthy background and was inspired by feminists to qualify as a doctor. She was repeatedly turned away from medical schools. Whilst working as a nurse she would attend lectures for doctors but was forced to stop. In the end Elizabeth learned French and gained her qualification at Paris University.

**Why Was She So Important?**
- Elizabeth showed that women were good enough to become doctors and fought against the law to get her place.
- In 1872 she founded the New Hospital for Women in London.
- In 1874 she helped set up the London School of Medicine for Women.
- In 1885 an Act of Parliament allowed women to enter the medical profession.
- Overall she pushed women forward in the field of medicine and this started more and more entering the profession.

**Opposition**
- Male students at university protested that Garret should not be allowed to attend lectures as it was a distraction to them.
- Many men did see doctor as a woman's profession and believed they should stick to nursing.
- Some men believed that women were not able to deal with the complications of surgery and that they would not understand what to do.
- University's said that they could only give degrees to men.
- The college of Apothecaries refused to allow women members but her father took them to court - they allowed Elizabeth in but then changed their rules so that women could not be members.

### Edwin Chadwick - Public Health

**What Did He Do?**
Edwin Chadwick was employed by the government to write a report on the living condition and health of the poor. The government were becoming concerned about the conditions that they were living and the spread of diseases such as cholera. Chadwick concluded that poverty was due to ill-health caused by the foul conditions that people lived in.

**The Public Health Act 1848**
- A medical officer to be in charge of each district.
- Improved drainage, remove rubbish from houses, streets and roads.
- Improve water supply.
- Improve sewers and drains so rubbish is flushed away.

**Why Was He So Important?**
- Although the changes that Edwin Chadwick bought about were only temporary it made people realise the full extent of the living conditions that the poor lived in. Chadwick's report shocked Britain and parliament was forced to make changes.

**Opposition**
- Many people had a laissez faire attitude meaning that they didn't think the government should get involved in such matters.
- The water companies objected because changes would cut into their profits.
- Middle-class people did not want to pay the extra taxes for improvements for the poor.

**Limitations**
- The Act was not compulsory so not all cities implemented.
- The general board of health was abolished when three commissioners resigned.
- Over 80,000 people still died of cholera.
- There was no link to cholera and water as Chadwick believed in the miasma theory.
Overcoming the Problems of Surgery

Surgery in the early 1800s was **dangerous** and **painful**. **Infection** was the greatest danger to patients.

**Problems of Surgery pre 1845**

- **PAIN** – No (reliable) anaesthetic, despite earlier discovery of nitrous oxide (laughing gas) in 1799. Patients held down during operations despite use of alcohol etc. Speed was of the essence which led to mistakes. Death from Shock was fairly common. Only basic surgery was possible – no internal surgery, only amputations.

- **INFECTION** – The greatest killer before the Germ Theory (1861) was understood. Death rate was approx 50%. Surgeons practised in blood-stained coats or in their own clothes and surgical instruments may not have been even washed. They didn’t even wash their hands and often re-used the same bandages. Operations were often observed by trainees (operating THEATRE) and the chances of spreading infection were greater. Many operations also took place in the patient’s home.

- **BLOOD LOSS** – A tourniquet was used to stem the flow of blood and ligatures had replaced the use of the cautery iron or boiling oil to seal wounds. Ligatures were silk threads which were used to tie up blood vessels, yet these were not sterilised at first which meant they could carry infection.
Exam questions

There will be three questions in the Changes in Medicine section

**Question 1**

This will be a three mark question which asks you to make inferences from the source. An inference is something you can tell from the source - not just something you can see.

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<th>Answer</th>
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| (a)             | One point: 1 mark  
|                 | Two points: 2 marks  
|                 | Three points: 3 marks  
|                 | *e.g.* Not enough doctors, too long before treatment, too many patients, not enough room, spread of disease, many will die. | Maximum 3 marks |

**Question 2**

In this question you will be asked to describe the key features of a key individual or event. You will need to make links between the different and then explain any limitations or opposition.

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<td>Level 1</td>
<td>Simple explanation of key features</td>
<td>(1-2)</td>
</tr>
</tbody>
</table>
|       | The candidate gives an explanation which lacks detailed contextual knowledge or makes unsupported generalisations.  
|       | *e.g.* Pasteur invented pasteurisation OR Koch found the causes of some diseases.  
|       | 1 mark for one simple explanation.  
|       | 2 marks for two or more. | |
| Level 2 | Supported explanation of key features | (3-4) |
|       | The candidate supports the explanation selecting relevant contextual knowledge.  
|       | *e.g.* Pasteur’s work with sheep - discovery of what causes disease. Importance of scientific methods of Koch - isolated germs.  
|       | 3-4 marks for one or more supported explanations. Award marks according to range/depth of support | |
| Level 3 | Developed explanation, analysing key features | (5-7) |
|       | An explanation analysing feature(s) supported by selected knowledge. (One explained feature should be marked at top of Level 2.)  
|       | *e.g.* As level 2. Additionally shows how Pasteur's and Koch's more scientific methods changed medical understanding.  
|       | 5-6 marks for one or more features. Award marks according to range/depth of support.  
|       | 7 marks for answers which show links between features. | |
A good way to structure your answer is:

**Statement:** This is the introduction to the essay. First of all, you need to show that you understand the focus of the question. Outline the main points that you are going to make.

**Support:** This is the main body of your answer. You need to write a series of paragraphs explaining the points that you referred to in your introduction. There may be three, four or more paragraphs. Make sure that the paragraphs are in a logical order and that they are linked together. For example, if you are referring to long- and short-term causes, make sure that you explain the long-term causes first. But, if you are referring to long- and short-term effects, make sure that you refer to the short-term effects first.

**Paragraph 1:** Point support
- Link

**Paragraph 2:** Point support
- Link

**Paragraph 3:** Point support
- Link

**Paragraph 4:** Point support
- Link

**Conclusion:** In this section you need to make a judgement on the relative importance of the factors you have explained in your essay.