

Medieval civilisation

The Middle Ages (or Medieval period) were the period in between the Roman Empire (often said to have ended in AD476) and the Renaissance (often dated from 1453). The Dark Ages are the first part of this period, following the collapse of the Roman Empire (476-1066). The High Middle Ages are the second part of this period (1066-1453). The Middle Ages were initially represented (by Renaissance scholars) as a period of stagnation and ignorance, in between the wonders of the Romans and the glories of the Renaissance.

Summary

Some knowledge of Medieval civilisation will help you understand Medieval medicine.

In the 5th century AD, waves of **barbarians** such as the Goths, Vandals, Saxons and Vikings invaded western Europe. Europe disintegrated into a huge number of small fiefdoms, each governed by a local lord, who protected his peasants - owned by him as 'serfs'. These tiny states could not afford universities for study, or public health systems.

Communications were difficult and dangerous, so **ideas travelled slowly**. During the Dark Ages, the monasteries alone managed to hang onto learning and knowledge, and even the ability to read and write. Many of the medical ideas of the Greeks and Romans were **lost** at this time, and survived only in the Muslim cities of the Middle East.

Similarly, technology was limited, and much of the advanced technical knowledge of the Romans was lost.

Medieval beliefs



11th-century ruins of Melrose Abbey, Scotland

Medieval Europeans believed in the Christian God, so politics and everyday life, as well as medicine, were dominated by the **Roman Catholic Church**. Most peasants were extremely superstitious.

The **key** aspect of the Middle Ages was the emphasis on **authority** - people would believe what they were told against the evidence of their own eyes, and people who questioned authority risked execution.

After 1066, civilisation began to recover. Universities were established (eg in Paris in 1110, Oxford in 1167). Kings grew more powerful, and established courts as centres of culture and wealth. Trade and communications, especially, by sea, developed. Towns grew up, which created public health problems.

In 1258, Baghdad was destroyed by the Mongols, and much **ancient knowledge** that had been retained in the east but lost to the west was carried **back** to the west by fleeing scholars.

Medical stagnation in the Middle Ages

Causes of medical stagnation in the Middle Ages included:

- the loss of medical knowledge/ bad doctors

- the forbidding by the Church of dissection, and its encouragement of prayer and superstition)
- the encouragement by the Church of prayer and superstition
- the emphasis on 'authority' rather than on observation and investigation
- the lack of resources to build public health systems
- social disorder and war, which disrupted communication and learning

The **Church** played a big part in **medical stagnation** in the Middle Ages. It discouraged progress by:

- forbidding dissection of human corpses
- insisting that people agree with the writings of Galen
- encouraging people to rely on prayers to the saints and superstition to cure them of disease
- encouraging the belief that disease was a punishment from God - this led to fatalism and prevented investigation into cures

However, the Church did encourage people to go on **Crusades**, meaning that people travelled to the Middle East. Here they came into **contact** with Muslim doctors, who were significantly more skilled than their counterparts in Britain.

Medieval medical knowledge

Knowledge was hard to come by in Medieval times, especially during the Dark Ages when barbarian tribes roamed western Europe. The knowledge gained by the ancient Greeks and Romans was largely lost to Europeans, and superstition reigned - although learning was more advanced in the Muslim Middle East.

Summary

Knowledge went into reverse in the west in Medieval times - many of the books of the **Greeks and Romans** were **lost**, and the knowledge they contained was replaced by mere speculation and **superstition**.

Even when universities developed, after 1100 (Montpellier, Bologna and Salerno had famous medical schools), lectures on anatomy were **rudimentary**. They consisted simply of a butcher pointing to the different parts of a body, while the lecturer read a text by an authority such as Galen.

Although students did debate the ideas of Galen, any new ideas were judged on the debating skills of the student, **not on scientific proof**. The Church said that Galen's ideas were so correct that there was no need to investigate any further.

Generally, the Church forbade the dissection of human bodies, so knowledge was hard to come by - and ignorance led to **numerous errors** and misunderstandings on the part of Medieval doctors. For example, the Italian doctor Alderotti claimed that combing the hair 'comforts the brain'.

Medieval superstitions and Muslim knowledge



This illustration is by Leonhart Thurn-Heisser(1574) and represents the four humours

Although many Medieval doctors continued to believe in the theory of the **four humours**, they also said disease was caused by demons, sin, bad smells, astrology and the stars, stagnant water, the Jewish people etc.

Ultimately, they believed that life was controlled by God and his saints, and a plague such as the Black Death was seen as a punishment from God. Guy de Chauliac, the Pope's doctor, blamed the Black Death on a conjunction of Saturn, Jupiter and Mars.

Things were different only in the Muslim Middle East where, during the reign of Harun al-Rashid (786-809), the books of Hippocrates were **translated into Arabic**. At first, Muslim doctors like al-Razi ('Rhazes known as the Galen of Islam') conserved the ideas of the Greeks and Romans.

Later, Muslim doctors such as Avenzoar and Ibn an Nafis actually began to **challenge errors** and to develop new ideas. However because the Christian Church was at war with Islam, Muslim ideas spread only **slowly** to western Europe. The exception was a book by Ibn Sina (often known as Avicenna) - the 'Canon of Medicine'.

Medieval surgery

Surgery made some surprising leaps forward in Medieval times. This was thanks partly to ingenious barber-surgeons on the battlefield, and partly to the discovery of some natural anaesthetics and antiseptics.

Progress of Medieval surgery

During the Middle Ages, surgery was left to **barber-surgeons**, not to trained doctors.

It was a time of **frequent warfare**, and the constant fighting meant that surgeons' skills were much in demand. Perhaps as a result, surgery actually progressed in Medieval times. Certainly Theodoric of Lucca, in the 13th century, wrote how:

Every day we see new instruments and new methods [to extract arrows] being invented by clever and ingenious surgeons.

Theodoric of Lucca

This is completely different from the **normal picture of stagnation** given to us about Medieval medicine.

Techniques of Medieval surgery



13th-century artwork of a patient undergoing trephination (surgery to the skull), possibly being performed by a surgeon's apprentice

Medieval surgeons realised how to use wine as an **antiseptic**, and they used natural substances (mandrake root, opium, gall of boar and hemlock) as **anaesthetics**.

Medieval surgeons could therefore do **external surgery** on problem areas such as facial ulcers and even eye cataracts. There was also, surprisingly, some **internal surgery** undertaken (eg to remove bladder stones).

However, they still had **no idea** that dirt carried disease, and most operations of Medieval times, if carried out today, would end in a suit for criminal negligence. Deep wounds still caused **death from bleeding, shock and infection**. Some surgeons even believed it was good to cause pus in wounds.

A medieval surgeon might cure an epileptic patient by **trephining** the skull to let the demon out.

Medieval public health

Medieval towns and public places may not have been clean by modern standards, but Medieval people understood the connection between clean living and good health. Occasionally, they even took a bath.

Overview

Medieval towns did not have systems of **sewers or water pipes** like Rome had. Medieval towns were probably **filthy**. Garbage and human waste was thrown into the streets. Houses were made of wood, mud and dung.

Rats, lice and fleas flourished in the rushes strewn over the clay floors of people's houses (often changed only once a year).

However, we can't conclude that Medieval people were personally filthy, or careless of their health:

- They had their own version of the Greek's **Programme for Health**. The doctor Alderotti advised people to stretch their limbs, wash their face, clean their teeth, exercise etc.
- Guy de Chauliac (the Pope's doctor) realised the importance of a **good diet**, and that a poor diet made people more vulnerable to the plague.
- Monasteries developed comprehensive systems of public health, including fresh running water, 'lavers' (wash rooms), flush 'reredorters' (latrines) with running sewers, clean towels and a **compulsory bath** four times a year.
- Nobles took **regular baths** (perhaps two a year).
- Towns had **bath houses** (which were also restaurants and brothels).
- People realised that a room next to a privy was unhealthy, and towns paid '**gongfarmers**' to clear out the cess pits.
- Medieval kings passed laws requiring people to keep the **streets clean**.
- Leaders in Venice realised that sexually transmitted diseases were infectious, and **ordered checks** on the city's prostitutes.
- During the time of the plague many towns developed quarantine laws, and boarded up the houses of infected people. People with leprosy, likewise, were confined to **lazar houses** (a place for people with infectious diseases).
- During the Middle Ages the first **hospitals** were built since Roman times (eg St Bart's in London).

Medieval doctors

Medieval doctors retained some medical knowledge from the Greek and Roman eras, despite the fact that much was lost during the Dark Ages. Unfortunately these doctors accepted the ideas of the ancients without question, and held many superstitious beliefs. This meant that patients often got worse, rather than better, under their care.

Overview

Medieval doctors flattered to deceive, although there were developments that gave the **appearance of progress**:

- Schools of medicine were set up in Universities such as Bologna and Salerno, and there were lectures in anatomy.
- New writings of Muslim doctors (such as Rhazes) became available.
- Doctors debated the best methods of treating disease.
- Padua University (alone) insisted that doctors visited the sick during their training.



A French manuscript illumination from Guy de Chauliac's 'Chirurgia Magna' of 1363, showing a dissection at the Faculty of Montpellier

These signs, however, were **deceiving** . For example:

- The anatomy 'lectures' consisted only of the doctor reading from a book while a prosector pointed to parts of the body.
- The **ancients** were held unquestioningly as the **true authorities**, any debates was seen merely as an opportunity to practice the art of arguing.
- Doctors had a **terrible reputation**. During the Black Death, "...doctors were useless and indeed shameful as they dared not visit the sick for fear of becoming infected" wrote Guy de Chauliac.

Methods of diagnosis

Many Medieval doctors carried with them a **vademecum** (meaning 'Go-with-me') book of diagnoses and a **urine chart**. Usually, they examined the colour, smell and taste of the patient's urine, and made an on-the-spot guess as to what they might be suffering from. Pictures from the time make it clear that doctors also did clinical observation, and took their patient's pulse.

Other essential doctor's equipment included **posies, oranges or lighted tapers**. Since they believed that bad smells carried disease, they believed that they could protect themselves from catching the disease by carrying something nice-smelling.

Methods of treatment

Since they still believed in the theory of the **four humours**, many of their cures involved balancing the 'humours overflowing'. They did this by bleeding, applying leeches, or causing purging or vomiting in their patients. Other ways of balancing the 'natural heat' included the taking of hot baths, drinking a soup of yellow lentils, or applying water cooled with snow.



Medieval apothecary brewing one of his medicines

The Medieval English poet Chaucer describes how a doctor was followed by a 'tribe' of apothecaries (medicine-makers), and it is known that medieval doctors had access to a huge range of **natural healing herbs** and substances. These included red rose ground fine with 'bamboo juice' for smallpox, and fig poultices for plague sores.

However, **superstition increased** throughout the period. Monarchs thought that by touching patients suffering from the 'King's Evil' (scrofula) they could cure them. Peasants prayed to St Roch to cure their toothache or the plague, or turned to St Anthony to cure them of 'St Anthony's Fire' (ergotism).

During the time of the plague, huge Christian processions were held, at which people flagellated (whipped) themselves, to try to show God how sorry they were for their sins.

Renaissance civilisation

During the 15th century Western civilisation experienced a process of profound change, which historians call the Renaissance (meaning 'rebirth'). The beginning of the Renaissance is often dated from AD 1453, when the fall of Constantinople drove many scholars with knowledge of Greek and Roman learning westwards. The period historians call the Early Modern Age lasted from about 1450 to about 1750.

Six key changes

Some knowledge of Western civilisation at the time of the **Renaissance** will help you understand the medicine of the Early Modern Age. In the 15th century AD, there was a 'rebirth' of European civilisation.

1. Governments - such as that of Henry VIII - were strong and **rich**. The economy boomed and trade prospered. People could afford doctors.
2. Artists (such as Michelangelo, Leonardo da Vinci and Titian) revolutionised painting - this led them to study the body in more detail, and was connected to improved **knowledge of anatomy** (eg the fabulous illustrations for 'Fabric of the Human Body' by John Stephen of Calcar, one of Titian's students).
3. There was a revival of learning. Universities established schools of medicine. The Renaissance saw the beginning of **scientific method** - which involved conducting an experiment, collecting observations, then coming to a conclusion. At first, scholars merely claimed that they were renewing the perfection it had amongst the ancient teachers', but soon they began to conduct experiments which led them to question the knowledge of the Greeks and Romans. This was vital for the development of medicine.
4. The invention of the **printing press** allowed new ideas to spread more quickly around Europe.
5. The discovery of America by Columbus meant that new foods and medicines were brought back from the **New World**.
6. The invention of **new weapons** (especially gunpowder) led to soldiers getting different sorts of wounds, which battlefield doctors had to deal with.

7. Growth of knowledge

8. Although the Renaissance saw an improvement in medical knowledge, particularly of anatomy and physiology, many people rejected the new ideas.
9. Further, doctors still did not manage to use their discoveries to develop better cures for their patients, because they had still not discovered the role that **germs** play in causing disease.

Renaissance medical knowledge

The Early Modern Age was an exciting time for medicine, with knowledge of the human body progressing in fundamental ways - although the causes of disease remained a mystery.

Knowledge about the body

Two key practitioners moved knowledge forwards in the Early Modern Age:

Vesalius



Follower of Vesalius in graveyard, searching for bodies to dissect

The first was **Vesalius**, whose patron was Charles V of Spain. He trained at Louvain, Paris and Padua universities, and ransacked cemeteries and gibbets for bones and for bodies to dissect.

1536

He discovered the **spermatic vessels**. He also realised that the famous doctor Galen could be wrong, when he discovered that the great man was mistaken about there being two bones in the jaw, and about how muscles were attached to the bone.

1537

He became professor of medicine at Padua University. He said that medical students should perform **dissections for themselves**, stating that: "... our true book of the human body is man himself."

1543

He published 'Fabric of the Human Body' (with high-quality annotated illustrations).

William Harvey

The second important practitioner was **William Harvey** - who discovered the principle of the **circulation of the blood** through the body. He trained at Cambridge and Padua universities, and became doctor to James I and Charles I of England.

1616

He calculated that it was impossible for the blood to be burned up in the muscles (as Galen had claimed).

1628

He published 'Anatomical Account of the Motion of the Heart and Blood', which scientifically proved the principle of the circulation of the blood. This book marked the end of Galen's influence on anatomy.

Renaissance medical knowledge

Knowledge about disease

Despite progress in some areas of medicine, Early Modern doctors did not advance understanding of the causes of disease.

- **Paracelsus** declared "Galen is a liar and a fake" but still believed in the **four humours**. He believed in **alchemy**, and believed it was possible to find the elixir of everlasting life.
- **Thomas Sydenham** insisted that doctors should visit the sick, rather than the other way round, which showed some progress in his thinking - but he taught that disease was caused by 'atmospheres'.
- **Nicholas Culpeper** believed that illness was caused by the stars.
- **Anton van Leeuwenhoek** discovered bacteria in 1683, using a single-lens microscope, but no one realised their significance, or that they caused disease.

Syphilis - a terrible sexually transmitted disease which became prevalent at the time - was thought variously to be a punishment from heaven, or caused by small worms that floated through the air, the planet Saturn at certain times, sexual contact between a man and a sick woman, or contact with the New World.

Despite the lack of progress in some areas, doctors did come to realise that the plague was a **contagious** disease.

Development through time and question

The discovery of the circulation of the blood is an excellent example of how knowledge can accumulate over time

Discovering the circulation of blood through time

Name	Date	Who	Contribution to debate	Influence
Start point - Galen	c.200	Doctor in Rome	Said blood passes through the septum , and the heart pumps it to the muscles, where it is burned up.	Main authority for 1,500 years
Ibn an Nafis	c.1250	Persian doctor	Said blood does not go through the septum, and is pumped past the lungs.	Muslim doctor, not known in Europe
Leonardo da Vinci	d. 1519	Artist	Made detailed drawings of the anatomy of the heart.	Drawings not discovered until 1850
Vesalius	1543	Professor at	Said blood does not pass through the septum.	Well-know anatomical

Name	Date	Who	Contribution to debate	Influence
		Padua		textbook
Servetus	d.1553	Italian preacher	Said blood does go through the septum, and is pumped past the lungs.	No effect - burned as a heretic
Columbo	1559	Professor at Padua	Said blood does not go through the septum, and is pumped past the lungs.	William Harvey read his book
Caesalpino	1571	Professor at Pisa	First used the word 'circulation' in relation to blood, but could not explain the process.	William Harvey did not know of his book
Fabricius	1603	Professor at Padua	Discovered valves in the veins only allow the blood to go one way.	William Harvey's teacher at university
William Harvey - End point	1628	London doctor	Proved that blood circulates round the body, and described how it happened.	

Renaissance surgery

Early Modern surgery was a gruesome procedure, but physicians and surgeons such as Paracelsus and Paré started to make some progress, and passed their knowledge on.

Overview

Ambroise Paré changed people's ideas about surgery. He developed his ideas during his 20 years as a barber-surgeon, when he accompanied the French army on its campaigns.

Despite the unpleasant procedures that were part of medicine in his day, it is clear from his writings that Paré cared deeply about his patients.

- In **1536** he discovered by chance (when the cautery oil he used to **cauterise** the wounds of his patients ran out) that wounds healed better if they were treated with a 'soothing digestive' (boiled **poultice**) of yolks and rose oil.
- He used catgut ligatures to tie arteries during amputations instead of cauterising the wound.
- In **1575** he published his 'Apology and Treatise', which advocated changes to the way surgeons treated wounds and amputations.

Paracelsus, a famous German **alchemist** and surgeon of the period, discovered that **laudanum** (a derivative of opium) was a **painkiller** that could be used to help his patients. For many years it was used for general pain such as headaches and period pain (and many people became addicted to it).

Diagnosis and treatment



17th-century engraving by Paulus Furst, of a physician wearing protective clothing, including a mask, to protect him against the plague

Methods of diagnosis in the Early Modern Age did not change from the time of the Middle Ages.

Doctors were utterly unable to cure infectious disease, and were **powerless** in face of diseases such as the plague and syphilis.

They did get some new drugs (eg quinine for malaria) from the New World, but generally treatment was a mixture of **superstition and errors**. Charles II was still asked to touch sick people, as it was said this would cure them of the 'King's Evil' (scrofula).

Early cures - and first knowledge of vaccination

Nicholas Culpepper's 'Complete Herbal' (1653) was a compendium of healing substances, but:

- he advocated the **use of opposites**

- he advised invoking **sympathetic planets**
- he claimed that garden rue was an **antidote to all poisons** (long after Paré had proved this to be impossible)
- he recommended smoking **tobacco** (then a novel substance from the New World) as a wonder-cure that would expel worms, ease toothache, cure snake bites and kill lice

'Cures' for the plague included pieces of paper with the letters **abracadabra** written in a triangle; a lucky hare's foot; posies and perfume; smoking tobacco; sherry; dried toad; leeches; a potion of rue, wormwood, vinegar and rose-water; and pressing a plucked chicken against the plague-sores until the chicken died.

In 1796, **Edward Jenner** discovered how **vaccination** could prevent disease (he found that infecting people with cowpox protected them from smallpox) - but nothing came of this since no one knew **why** it did so.

Renaissance public health

Rats, lice and fleas were a part of people's everyday lives in Early Modern times, so the need for public health measures was great - but it took the plague of 1665 to get the authorities moving.

Summary

Early Modern towns were similar to Medieval towns. They did not have systems of **sewers or water pipes**. They were probably **filthy**. Garbage and human waste was thrown into the streets.

Houses were made of wood, mud and horsedung. **Rats, lice and fleas** flourished in the rushes that people strewed on the clay floors of their houses. In 1524 the Renaissance writer Erasmus gave a description of English houses, which he described as having floors covered with rushes, which were renewed only infrequently, and were full of "...spittle and vomit and urine of dogs and men, beer that has been thrown out, remnants of fishes and filth unnameable."

Measures to combat the plague

Despite the generally casual attitude to dirt, during the **1665 plague** London did nevertheless establish some public health provisions.



Woodcut, printed 1630, depicting Londoners fleeing from the plague in a cart

- 'Surgeons' were appointed, who examined the dead to establish the extent of the plague.
- Bills of Mortality were published, to publicise the course of the disease.
- 'Examiners' and 'searchers' were appointed, who established whether members of a household had contracted the plague. If so, they then **shut up the house** for a month, and its inhabitants had to stay indoors.

- Constables were appointed, who made sure no one left such houses.
- Bodies were **buried at night** in huge pits, and mourners were not allowed to attend.
- 'Pest houses' were set up, to **quarantine** sufferers.
- Householders were ordered to collect all waste, which was then removed by 'rakers'.
- Stray pigs, dogs, rabbits and cats were killed.

These measures unfortunately did not stop the spread of the plague, which only ended when the weather turned **cold**.

Medicine in Early Modern times was making some progress - but most people's doctors had little or no training.

Early physicians

The Early Modern Age saw advances in **theory**, but not in **practice**. The **most advanced** Early Modern physicians were usually town-based, and also:

- were well educated and trained
- did 'scientific' research
- were prepared to contradict the accepted authority
- disseminated their findings
- relied on royal support
- had limited success

However, they charged very high fees and only the richest people could afford them.



16th-century woodcut, depicting (right) medical treatment of a skin disease and (left) blood letting, by barber surgeons in a barber shop

The medicine available to ordinary people relied on the amount they could afford. The people they turned to for medical advice included:

- country doctors - lower fees than town doctors, but not well-trained
- barber-surgeons - who were paid to perform small operations
- apothecaries (chemists) - no medical training, but sold medicines and groceries
- quacks - travelling barbers, tooth-pullers, who sold medicines which were supposed to cure everything
- wise women, neighbours and local 'witches'

Answer preparation

As part of your revision, think about the **arguments** and **facts** you would use to explain:

1. **How** Early Modern medicine reflected the ideas and practices of early modern times
2. **What** caused people to be healthy or unhealthy in Early Modern times
3. **What** ideas Early Modern people had about the causes and treatment of illness and injuries
4. **Who** provided medical care in Early Modern times
5. **How much** medicine changed in Early Modern times, and what were the main turning points
6. **Why** some diagnoses and treatments changed while others remained the same
7. **How (or whether)** the process of change was influenced by:
 - individuals
 - the government
 - science and technology
 - war
 - attitudes and beliefs in society
 - trade
8. **To what extent** developments in medical understanding and practice in Early Modern times affected people's lives

19th-century civilisation

During the 18th century there was a quickening in economic activity in the western world. Historians call this the time of the Industrial Revolution. The process continued during the 19th century, with an even greater quickening of invention and scientific discovery.

Huge progress was made in identifying and preventing many diseases. People felt that humankind was becoming god-like in its knowledge and achievements, and that nothing was impossible except the cure of infectious disease - a problem that continued to cause much misery.

Ten key developments

Some knowledge of 19th-century civilisation will help you understand 19th-century medicine.

Developments in the 19th-century included:



Cartoon of man defending himself from cholera with a mask, infusion on his head, foot protectors and aromatic herbs

1. A great **explosion of industry** (and industrial diseases such as dermatitis, lung disease and 'phossy jaw').
2. **Urbanisation** (and public health problems that included 'filth diseases' such as cholera and typhus).
3. The **growth of empires** (and contact with new diseases such as yellow fever).
4. The **growth of immense wealth**, based on trade and industry (which created the money to spend on medical research and public health).
5. Great **advances in technology** (which led to medical machines such as the electrocardiograph).
6. **Improved communications** (allowed medical knowledge to spread - doctors gained information from all over the world).
7. The **growth of science and research** (which led to medical breakthroughs).
8. **Democracy and socialism** (people believed they had the right to good health). The right to health was one of the 'rights of man' claimed by working people during the French Revolution (which was why the medical revolution of the 19th century started in France).
9. New ideas about **evolution** (Darwin) and **genetics** (Mendel) - broke the control of the Church over medicine and medical ethics.
10. **Wars** were waged on a greater scale (creating mass injuries that were hitherto unknown, and required new medical and surgical techniques).

19th-century knowledge about the body and disease

There was a general atmosphere of scientific research and advance throughout the 19th century, and this was reflected in the fast build-up of medical knowledge. Pasteur's discovery that germs cause disease was a crucial turning point.

Knowledge about the body

Knowledge about the body increased greatly in the 19th century:

1. **William Beaumont** (America: 1822) studied the digestive system of Alexis St Martin, a Canadian who had an open hole into his stomach.
2. **Theodor Schwann** (Germany: 1839) realised that animal matter was made up of cells, not 'humours'. This was the vital breakthrough of knowledge that at last destroyed belief in the old 'humoral' pathology of the Greeks.
3. **Henry Gray** (Scotland: 1858) wrote 'Gray's Anatomy', which had over 1,000 illustrations. Many people bought a copy to own at home. After the 1870s, pupils started studying anatomy in schools.
4. **Starling and Bayliss** (England: 1902) discovered the first hormone.
5. **Casimir Funk** (Poland: 1912) discovered the first vitamins, and realised that some diseases were caused simply by poor diet.

Knowledge about disease



Louis Pasteur, French microbiologist and the 'father' of the germ theory of disease. Image first published in 1894.

Knowledge about disease also increased greatly in the 19th century.

Louis Pasteur (France: 1860s) discovered (by using a swan-necked flask) that **germs cause disease**. Before he made this discovery, doctors had noticed bacteria, but they believed it was the disease that caused the bacteria (the so-called theory of 'spontaneous generation') rather than the other way round.

One of the spin-offs of Pasteur's discovery was the **pasteurisation** of milk, which prevented it from going sour by killing the germs and sealing it from the air.

Other scientists also made crucial discoveries, among them:

1. **Robert Koch** (Germany: 1878), who discovered how to stain and **grow bacteria** in a Petri dish (named after his assistant Julius Petri). He was thus able to find which bacteria caused which diseases:
 - septicaemia (1878)
 - TB (1882)
 - cholera (1883).
2. In the same period other bacteria were discovered, including those that caused:
 - typhoid (1880s)
 - pneumonia (1880s)
 - plague (1894)
3. **Patrick Manson** (Britain: 1876) discovered that elephantiasis was caused by a nematode worm, and that mosquitoes were the vector (carrier). This was a **breakthrough discovery**, because researchers soon found out that other tropical diseases were transmitted by vectors such as mosquitoes (malaria and yellow fever) or tsetse flies (sleeping sickness).
4. **Charles Chamberland** (France: 1884) found that there are organisms even smaller than bacteria that also cause disease - he had discovered **viruses**.

Causes of improvements in physiology and pathology

1. The Industrial Revolution / inventions

- There was a general atmosphere of scientific research and advance.
- Louis Pasteur's first commission was to find a **cure for sour wine**, which set him off on his revolutionary course.
- Joseph Jackson Lister (Britain: 1826) invented the **multi-lens microscope**, which allowed doctors to see very tiny things accurately.
- Carl Ludwig (Germany: 1847) invented the kymograph, which allowed more accurate measurement of the **pulse**.
- Wilhelm Roentgen (Germany: 1895) discovered **x-rays**.
- Willem Einthoven (Holland: 1900) invented the **electrocardiograph** (measured heart activity).

2. Scientific knowledge

- Jan Purkinje (Czechoslovakia: 1836) set up the first university department of physiology (science of how the body works).
- Louis Pasteur started as a research chemist. He set up a team of researchers at the Pasteur Institute (1888).
- Robert Koch developed his **Postulates** of how researchers should find a disease. These led to four basic procedures - **make sure** the germ in question is present in the sick specimen - **grow** a culture of that germ - **inject** it into a healthy specimen - **see** if the disease develops.

3. Social factors

- Nationalism - eg the rivalry of Pasteur and Koch. Shibasaburo Kitasato (Japan) and Alexandre Yersin (France) raced to discover the plague bacterium in 1894.
- The deaths of his two daughters motivated Louis Pasteur to redouble his efforts in the fight against disease.

19th-century surgery

Before the 19th century operations were horrific procedures, and most patients died from post-operative shock, infection, or loss of blood. In some London hospitals the death rate after operations was over 80 per cent.

The 19th-century up-turn in surgery actually pre-dated anaesthetics and antiseptics. Many new ideas were trialled in America (eg Dr Thomas McDowell performed an ovariectomy in 1809), with some success. One suggestion is that American surgeons were happier to try out new techniques on Black slaves.

The improvements in anaesthetics (to protect patients from pain) and antiseptics (to protect patients from infection) occurred because surgery without them was too traumatic, and patients couldn't survive it. New blood transfusion techniques also saved many lives.

Anaesthetics for pain



Surgeon pictured in USA c.1882, wearing an apron, but without surgical gloves or face mask

- **1842:** Crawford W Long (America) used ether as an anaesthetic while operating on a neck tumour (but did not publish details of his operation).
- **1845:** Horace Wells (America) tried unsuccessfully to demonstrate that laughing gas would allow him to extract a tooth painlessly.
- **1846:** Dr JC Warren (America) removed a tumour from the neck of Gilbert Abbott using ether.
- **1846:** Robert Liston (Britain) removed a leg using ether - 'this Yankee dodge'.
- **1847:** James Simpson (Britain) discovered chloroform.
- **1884:** Carl Koller (Germany) discovered that cocaine is a local anaesthetic.

Antiseptics and blood transfusions

For infection - antiseptics

- **1847:** Ignaz Semmelweiss (Hungary) cut the death rate in his maternity ward by making the doctors **wash their hands** in calcium chloride solution before treating their patients.
- **1854:** Standards of hospital cleanliness and nursing care rose rapidly under the influence of Florence Nightingale.
- **1865:** Joseph Lister (Scotland) - basing his ideas on Pasteur's Germ Theory cut the death rate among his patients from 46 to 15 per cent by spraying instruments and bandages with a 1-in-20 solution of **carbolic acid**.
- **1890:** Beginnings of aseptic surgery - surgeons started boiling their instruments to **sterilise** them - WS Halstead (America) started using rubber gloves when operating - German surgeons started to use face masks.

For blood loss - blood transfusions

- **1901:** Karl Landsteiner (Austria) - discovered **blood groups**. Transfusions had been tried before but usually killed the patient because of clotting. Matching blood groups stopped this happening.
- **1913:** Richard Lewisohn discovered that sodium citrate **stopped blood clotting** during an operation.
- **1938:** The National Blood Transfusion Service was set up in Britain.

More causes for improvements in surgery

The number of operations grew hugely through the century, and surgeons became skilled at internal operations (1880s: first appendectomy; 1896: first open-heart surgery) and even tried (unsuccessfully) to transplant organs such as thyroid glands and testicles. Various factors pushed the process along:

1. The Industrial Revolution / inventions

- Wilhelm Roentgen discovered **x-rays** - helped internal surgery.
- Public demonstrations (eg of anaesthesia) allowed knowledge of new procedures to spread.

2. Scientific knowledge

- The scientist Humphrey Davy had first discovered that **laughing gas** was an anaesthetic when working on the properties of gases in 1800.
- Joseph Lister lectured in King's College London, and published his findings in 'The Lancet'.

3. Social factors

- Queen Victoria **gave birth** to her children under **anaesthesia** (after which the general public's fear of anaesthesia lessened). Edward VII's appendectomy helped reduce fear of operations.

4. War

- The needs of **army surgeons** treating soldiers injured in battle (often requiring amputations) stimulated advance.
- The **Crimean War** led to the development of nursing (Florence Nightingale at Scutari).
- World War One led directly to the development of the National Blood Transfusion Service.

19th-century methods of diagnosis and treatment

The search to combat disease gained enormous momentum in the 19th century. Instruments such as the stethoscope and machines such as the electrocardiogram were invented, and research into inoculation began to bear fruit.

Diagnosis

Methods of diagnosis changed massively during the course of the 19th century.

1. **René Laennec** (France: 1816) invented the stethoscope and started the practice of 'auscultation' (listening to the patient's chest).
2. **Pierre Louis** (France: 1834) argued that symptoms were irrelevant, and that what was happening inside the body was much more important when it came to diagnosing illness. As a result, doctors made diagnoses on the basis of a full clinical examination of the 'signs' made by the disease on the body.
3. **Carl Ruge** (Germany: 1878) developed the technique of biopsy (removing cells to determine if they were cancerous).
4. Doctors **used machines** to measure the functions of the body precisely:
 - **Carl Ludwig** (Germany: 1847) invented the kymograph (which measured the pulse).
 - **Wilhelm Roentgen** (Germany: 1895) discovered x-rays.
 - **Willem Einthoven** (Holland: 1900) invented the electrocardiograph (which measures heart activity).

Treatment - inoculation, magic bullets

The search for new ways to cure disease also gained momentum in the 19th century, and included the discovery of how **inoculation** could prevent disease.

Charles Chamberland (France: 1880) discovered by chance (when he left bacteria exposed to air) that injecting chickens with an attenuated (weakened) form of chicken cholera gave them immunity to the disease (ie he discovered the principle of inoculation).



Charles Chamberland, with chicken

That realisation was the start of an important chain of events.

- **Louis Pasteur** developed an effective inoculation against anthrax (1881), and rabies (1885).
- **Albert Calmette and Camille Guérin** (France: 1906) developed the BCG injection against TB.
- **Emil von Behring** (Germany: 1913) developed an anti-toxin against diphtheria.

Magic bullets

- **Paul Ehrlich** (Germany: 1890s) reasoned that, if certain dyes could stain bacteria, perhaps certain chemicals could kill them. He set up a private laboratory and a team of scientists. By 1914 they had discovered several 'magic bullets' - compounds that would have a specific attraction to disease-causing microorganisms in the body, and that would target and kill them. These were methylene blue (for malaria), trypan red (for sleeping sickness) and Salvarsan (for syphilis) - although Salvarsan was more effective than the other two.

Most **vaccines**, however (eg one developed by Robert Koch against TB in 1891), were not successful. And against **acute infectious disease**, doctors were largely **powerless**. They carried, as one medical historian wrote, 'a box of blanks'. So people looked elsewhere for their cures - sometimes in strange places.

Outlandish or alternative cures

- A home medicine encyclopaedia of 1910 recommended cures that included electrical shocks, injection with animal hormones, and a range of **harmful substances** including cocaine, mercury, creosote and strychnine.
- Other alternative medical treatments included mesmerism (hypnotism), homeopathy (taking tiny doses of poisons), 'health reform' (a religious movement which recommended a healthy lifestyle - it was run by John Kellogg whose brother invented cornflakes) and Christian Science (which taught that disease only existed in the mind).
- Travelling 'quacks' sold patent medicines (such as Lily the Pink's **medicinal compound**).

19th-century public health

Public health provision was completely transformed as the 19th century progressed. Overcrowding, dirt, poverty and disease went hand in hand at the century's start, but by the 1900s energetic social reformers had comprehensively turned things round.

Summary

In the early 19th century, the growing towns of Britain were characterised by **overcrowding**, poor housing, bad water and disease.

In 1842, Edwin Chadwick argued that **disease** was the main reason for poverty, and that preventing disease would reduce the poor rates.

In 1848, a **cholera epidemic** terrified the government into doing something about prevention of disease - through both public and individual health measures.

Public measures



Florence Nightingale, English hospital reformer, who publicised the 'miasma' theory of disease while campaigning for cleaner hospitals

At first the government tried - as the Romans had done - to prevent illness among the population by public sanitation measures.

The first public health measures were based upon the idea that **miasmas** (bad smells) caused disease. Although the idea was wrong, the measures against the miasmas involved a greater focus on cleanliness, and this improved public health.

Further measures included:

- In **1848** the first Public Health Act caused the setting up of a Board of Health, and gave towns the right to appoint a Medical Officer of Health.
- In **1853** vaccination against smallpox was made compulsory.
- In **1854** improvements in hospital hygiene were introduced (thanks in large part to Florence Nightingale).
- In **1875** a Public Health Act enforced laws about slum clearance, provision of sewers and clean water, and the removal of nuisances.

The benefits of these measures soon became clear, and by the late 19th century local councils were **competing with each other** to provide the best public health.

Individual measures

When the Boer War revealed that half the population were unfit for military service, the government accepted that it had to pass laws to improve the situation of the individual poor:

- In **1906** local councils were told to provide free school meals for poor children.
- In **1907** school medical examinations were ordered for all children (among these examinations were those of the 'nitty nurse').
- In **1908** Old-age pensions were introduced.
- In **1911** National Insurance (free medical treatment for workers who fell ill) was introduced.

19th-century doctors

The 19th century was a time of great change for doctors. They started the century able to do very little for their patients, and ended it with a far greater understanding of disease, how to prevent it, and how to help patients through it.

Summary

The 19th century saw great **advances** in the practice of medicine.

In 1800, the doctor may have been a friend of the rich, but many doctors themselves were poor. They could do little to heal disease, and their main role was to provide comfort and reassurance. As the century progressed, however, so did the role of doctors.

- **1803** Thomas Percival wrote the first book on medical behaviour.
- **1823** The first issue of the the medical journal the 'Lancet' was published.
- **1832** The British Medical Association was formed.

By 1900, doctors and surgeons occupied a highly respected place in society. They provided treatment increasingly through **hospital provision**, and in certain situations were able to heal their patients with surgery.

Women doctors in the 19th century

In the 18th century, the place of women in medicine was mostly limited to nursing. However, as the 19th century progressed, women began to play a greater part in medicine, and some of their names are familiar to historians to this day.

1. **Elizabeth Blackwell:** gained a medical degree in America (1849) and set up the New York Infirmary for Poor Women before returning to England, where she was accepted onto the Medical Register in 1858.
2. **Elizabeth Garrett:** acquired a licence from the Society of Apothecaries (1865) then set up the Dispensary for Women.
3. **Sophia Jex-Blake:** studied medicine at Edinburgh University (1869), but had to take her degree in Switzerland and get her licence to practise medicine in Ireland. In 1874 she founded the London School of Medicine for Women.



19th-century engraving of Elizabeth Garrett Anderson before the Faculty of Medicine, Paris

These women were, however, **the exceptions**. Most male doctors were opposed to women doctors, and each time a woman found a loophole that allowed her to progress in her career, the medical profession changed the rules to stop it happening again. In 1911 there were only 495 women on the Medical Register in Britain.

20th-century civilisation

During the 20th century the pace of change, which had quickened during the Industrial Revolution, speeded up even more. There was an ongoing explosion of invention and scientific discovery. Huge progress was made in curing disease and manipulating the body.

The feeling of the 20th century is summed up in the 'Can do' motto of the US Navy construction engineers during the Second World War: 'The difficult we do immediately. The impossible takes a little longer.'

Developments in 20th-century



20th-century medical research institution

Some knowledge of 20th-century civilisation will help you understand 20th-century medicine.

Here's a list of some of the many developments and changes that took place during that century:

1. There was a great **explosion** of scientific understanding and technological innovation.
2. Many societies became hugely **rich**, though wealth was still unequally shared.
3. There was considerable **urbanisation** (explosive growth of cities).
4. **Communications technology** made the world seem smaller and more cosmopolitan. This allowed medical ideas to spread rapidly, but also allowed diseases such as SARS to spread.
5. There was more time for **leisure**, less time spent on work.
6. People became **less religious** - so more inclined to look for medical solutions even to spiritual and psychological problems.
7. Many societies were democratic, and thought the duty of the state was to care for its citizens - hence demands for a **welfare state**.
8. American military and economic power, and **American values**, were dominant.
9. **Stress** due to terrorism, the undermining of traditional values and the rapid pace of life took a great toll on people's general health.
10. **Wars, epidemics and famines** killed more people in the 20th century than they had in the whole of the rest of history.

All these factors affected medicine in both **negative** and **positive** ways. Nevertheless, most people in 2000, when compared with their grandparents, were taller, heavier, healthier and lived longer.

20th-century knowledge about the body and disease

Knowledge about the body and disease increased greatly in the 20th century. Developments ranged from the discovery of the cause of diabetes to the creation of 'test-tube' babies for previously infertile couples.

Significant developments

There were many scientific and medical discoveries and developments during the 20th century. The following are among the most significant:



A positronic emission tomograph (PET) scanner

1896: Walter Cannon (America) used a **barium meal with x-rays** to track the passage of food through the digestive system.

1910: Henry Dale (Britain) discovered the chemical **histamine**, which is produced by the body during an allergic reaction. This allowed him to understand allergic response and surgical shock.

1921: Frederick Banting and Charles Best discovered **insulin**, which breaks down sugar in the bloodstream. Thus he found the cause of diabetes.

1923: Edgar Allen (America) discovered **oestrogen** (the hormone that powers femaleness). In 1935 Ernst Laqueur isolated **testosterone**, the hormone that creates maleness.

1931: The invention of the **electron microscope** allowed doctors to see bacteria and viruses for the first time.

1951: The Mexican company Syntex developed norethisterone, which prevents ovulation - leading to production of the first **contraceptive pills**.

1953: Francis Crick and James Watson (Britain) discovered **DNA**.

1953: Leroy Stevens (America) discovered **stem cells**.

1970s: Patrick Steptoe (Britain) developed **IVF fertility treatment**; in 1978 Louise Brown became the first 'test-tube' baby.

1970s: Endoscopes - fibre optic cables with a light source - enabled doctors to 'see' inside the body.

1972: Geoffrey Hounsfield (Britain) invented the **CAT scanner**, which uses x-ray images from a number of angles to build up a 3D image of the inside of the body.

1980s: MRI scans were developed to monitor the electrical activity of the brain.

1986: In the Visible Human project undertaken in the US, the bodies of two criminals (a male and a female) were frozen, cut into 1mm slices, stained, photographed and stored as 3-d images on the internet.

1990s: The Human Genome project undertaken in the US mapped all the genes in the human body - 40,000 of them. Humans share their gene make-up with much of the natural world, leading scientists to joke that because of the genes we share, human beings are 60 per cent banana! In 1997 Scottish researchers bred **Dolly, the first cloned sheep**.

2002: Gunther von Hagens (Germany) performed live dissections on TV.

20th-century surgery

In the 20th century success followed success in the surgical treatment of disease, as surgeons grew in knowledge and skill.

Key developments in surgery

Key steps in the development of the surgery through the 20th century include:

1890s: Victor Horsley (British): first **specialist neuro-surgeon**.

1940s: Archibald McIndoe (British) learned how to rebuild surgically the faces of airmen (the 'Guinea Pigs') burned in the war - this was very early **plastic surgery**. In 2002, nearly 7 million cosmetic surgical procedures were performed in the US alone.

1950: William Bigelow (Canadian) performed the first **open-heart surgery** to repair a 'hole' in a baby's heart, using hypothermia.

1952: First **kidney transplant** (America).

1962: Surgeons at Massachusetts General Hospital **re-attached the arm** of a 12-year-old boy.

1967: Christiaan Barnard (South Africa) performed the first **heart transplant** - the patient lived for 18 days. (In 2002, there were 2,154 heart transplant operations performed in the US - 87 per cent of the patients lived for at least a year.)

1970s: The development of plastic lenses allowed **cataract surgery**. Since 1991 laser eye surgery has obviated the need for glasses.

1970: Roy Calne (Britain) developed the use of the immunosuppressant drug **cyclosporine**, which prevents the body 'rejecting' grafts and transplanted organs.

1972: John Charnley (Britain) developed **hip replacements**.

1986: Davina Thompson (Britain) became the first **heart, lungs and liver transplant** patient.

1990s: Increasing use of **keyhole surgery**, using endoscopes and ultrasound scanning, allowed minimally invasive surgery.

2002: Specialists at Massachusetts General Hospital, watching digital **x-rays transmitted by satellite**, helped the medical officer at a research station from the South Pole operate on a damaged knee.

20th-century methods of diagnosis and treatment

Methods of diagnosis changed massively during the 20th century. X-rays, CAT scans, MRI imaging, ultrasound scans, endoscopy etc, together with histology and biopsies, started to allow accurate and exact diagnoses of most illnesses as the century progressed. Treatments had to keep up with all the information, so new drugs and procedures were constantly being developed

Key discoveries in treatments



Premature baby in an incubator, attached to electrodes that monitor its heartbeat

The list of treatments that finally started to help people cure disease and health problems is a long one. Here are some of the main discoveries:

1. The discovery of **vitamins** allowed doctors to prescribe vitamin supplements, which cured beriberi, rickets, pernicious anaemia and pellagra.
2. In 1921 Banting and Best developed **insulin**. They could not cure diabetes, but they were able to alleviate its results. Today, doctors use hormone treatments to correct thyroid problems, help children grow, improve sexual performance and shrink cancers.
3. In 1932, the German scientist Gerhard Domagk discovered that a coal tar product (a sulphonamide called prontosil) killed streptococci bacteria. Other **sulphonamides** were discovered which could cure pneumonia, meningitis and acne.
4. During the Second World War, Florey and Chain learned how to mass-produce penicillin - discovered (by chance) in 1928 by the Scottish bacteriologist Alexander Fleming - the **first antibiotic**. Now, doctors could effectively cure acute infectious disease (although misuse of antibiotics has led to the development of drug-resistant strains of killer diseases such as TB and the MRSA hospital superbug).
5. The work of Peter Medawar (1950s: Britain) on immuno-suppressants led to the development of **anti-histamine**, which prevents allergies and operative shock.
6. After the 1950s, doctors (through **contraception**) were able to prevent pregnancy, and after the 1970s (through IVF) to help childless women become pregnant (although side effects of the contraceptive pill are thromboses, migraine and jaundice). In 2005, a 66-year-old Romanian woman gave birth to twins.
7. In the 1950s, doctors used the drug **thalidomide** to treat morning sickness during pregnancy. It caused terrible deformities in babies, but today is used in the treatment of AIDS, leprosy and some cancers.
8. In 1952, the Danish surgeon Christian Hamburger used large doses of **hormones** and surgical operations to change the sex of George Jorgenson, an American army vet, who returned to the US as Christine.

9. In 1954, Joseph Salk (America) discovered a **polio vaccine**, which helped eradicate polio from the western world in the 20th century, and which may make it extinct worldwide early in the 21st century.
10. Doctors started using technology - such as **incubators and pacemakers** - to help patients. In 2002, American surgeons implanted electrodes connected to a miniature computer into the visual cortex of a blind man. Using a video camera mounted on his glasses, he was able to 'see' well enough to drive a car.

20th-century public health

In the 20th century, the government accepted the need to care for all its citizens 'from the cradle to the grave', and there was a greater focus than ever before on the health of the nation.

Key developments in public health

Key steps in the development of the public health policies of today include:

1918: After the First World War, the British Prime Minister Lloyd George promised the soldiers returning from the battlegrounds of Europe '**homes fit for heroes**'. The government set itself a target of building half-a-million decent homes by 1933.

1919: A Ministry of Health was set up to look after **sanitation, health care and disease**, as well as the training of doctors, nurses and dentists, and maternity and children's welfare.

1921: Local authorities were required to set up **TB sanatoria**.



Walter Elliot, Minister of Agriculture, with two children in 1934, during campaign for free school milk

1934: Although the economic depression of the 1930s caused government to cut back on spending, it passed the **Free School Milk Act** and encouraged local councils to give poor children free school meals.

1942: During the Second World War, the need to give people something to fight for led the government to commission up the Beveridge Report. Beveridge recommended a **Welfare State**, which would provide social security, free health care, free education, council housing and full employment.

1946: The New Towns Act planned **new towns** such as Stevenage and Newton Aycliffe to replace the inner-city slums. The Town and Country Planning Act of 1947 set a target of 300,000 new homes a year, and identified 'green belts' where housing would not be allowed to continue to swallow up the countryside.

5 July 1948: The 'appointed day' for the start of the **National Health Service**.

1956: The Clean Air Act imposed **smokeless zones** in cities and reduced smog.

1980: The Black Report stated that huge **inequalities in health** still existed between the rich and the poor in Britain.

Recently: Worries about the **cost** of the National Health Service have grown.

20th-century doctors

Doctors changed almost beyond recognition during the 20th century. In the early years your doctor was usually a man, with a limited range of medicines and techniques. By the end of the century doctors were as likely to be women as men, with a whole arsenal of pills and treatments to help make you better.

Advances in the practice of medicine



Surgeon scrubbing hands prior to performing an operation

At the beginning of the century local doctors still visited the sick in their homes, usually carrying their sturdy Gladstone bag. Doctors could do **little** to cure disease, although they had learned some ways of **preventing** it, and some new techniques of caring for patients.

The **modernisation** of medicine changed the role of the doctor. Sixty per cent of new doctors are now women. Familiar illnesses, previously dangerous, can often be treated by a course of pills.

Many other diseases now call for the use of expensive **technology** so, by the end of the century, most medicine was delivered in hospitals (in America in 2002 only 2 per cent of doctor-patient contact took place in the home).

Public confidence in doctors

Towards the end of the century, **confidence** in doctors began to **wane**. A survey in America in 1974 found that 2.4 million unnecessary operations were performed every year, at a cost of \$4billion a year. In Britain in the 2000s, a number of scandals (eg that of the GP Harold Shipman, who murdered his elderly patients) reduced confidence.

One in five Britons prefer **alternative** healthcare to conventional medicine, and many more are looking after their own health by visiting a gym or attending self-help health groups.

Even so, a National Health Service survey in 2002 found that 82 per cent of the population had visited a doctor at least once during the year, and that **90 per cent** of those people were **satisfied** with their treatment.