General Certificate of Secondary Education
June 2013

General Studies 47601/PM

Unit 1 (Case Study)

Case Study Material

Case Study material on ***'The impact of medical developments on mankind'***

Instructions
- To be issued to teachers and candidates on or after **1 March 2013**.
- You may write notes in this copy of the Case Study, but you will **not** be allowed to bring this copy, or any notes you may have made, into the examination.
- You will be given a clean copy of this material at the start of the examination on Tuesday 11 June 2013.

Advice (See Specification, 2.1 Summary of Assessment)
- Teachers are allowed to discuss this material with candidates.
- Candidates are encouraged to do their own research and wider reading around the topic and sources provided.

Source: MICHAEL AVETO/Getty Images

There is no source material printed on this page

Study **all** the information in this booklet.

The impact of medical developments on mankind

The information in this booklet comprises the following:

*(See **Advice** on the front cover of this booklet.)*

Source 1

Smallpox: Historical significance

Smallpox is an acute contagious disease caused by the variola virus.

Smallpox, which is believed to have originated over 3000 years ago in India or Egypt, is one of the most devastating diseases known to humanity. For centuries, repeated epidemics swept across continents, decimating populations and changing the course of history.

Smallpox killed Queen Mary II of England, Emperor Joseph I of Austria, King Louis I of Spain, Tsar Peter II of Russia, Queen Ulrika Eleonora of Sweden, and King Louis XV of France.

The disease, for which no effective treatment was ever developed, killed as many as 30% of those infected. Between 65–80% of survivors were marked with deep pitted scars (pockmarks), most prominent on the face.

Blindness was another complication. In 18th century Europe, a third of all reported cases of blindness were due to smallpox. In a survey conducted in Vietnam in 1898, 95% of adolescent children were pockmarked and nine-tenths of all blindness was ascribed to smallpox.

As late as the 18th century, smallpox killed one in ten children born in Sweden and France. During the same century, one in seven children born in Russia died from smallpox.

Edward Jenner's demonstration, in 1798, that inoculation with cowpox could protect against smallpox, brought the first hope that the disease could be controlled. However, it was to be well over a hundred years before Jenner's vision finally began to be realised.

In the early 1950s – 150 years after the introduction of vaccination – an estimated 50 million cases of smallpox occurred in the world each year. In 1959 the World Health Assembly passed a resolution to undertake the global eradication of smallpox. The number of cases then fell to around 10–15 million by 1967 because of vaccination.

In the 1960s, people of all ages around the globe queued to receive free smallpox vaccinations

In 1967, when WHO (World Health Organisation) launched an intensified plan to eradicate smallpox, the 'ancient scourge' threatened 60% of the world's population, killed every fourth victim, scarred or blinded most survivors, and eluded any form of treatment.

Through the success of the global eradication campaign, smallpox was finally pushed back to the Horn of Africa and then to a single last natural case, which occurred in Somalia in 1977. A fatal laboratory-acquired case occurred in the United Kingdom in 1978. The global eradication of smallpox was certified, based on intense verification activities in all countries, by a commission of eminent scientists in December 1979 and subsequently endorsed by the World Health Assembly on the 8th May 1980.

Source: all images © Getty images
Smallpox historical significance © WHO 2011

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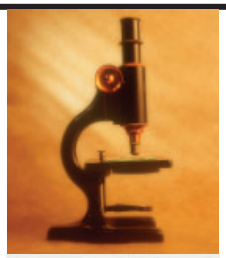
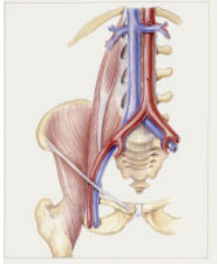
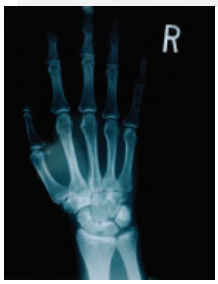
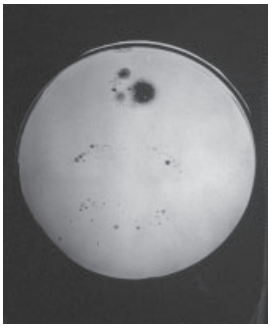
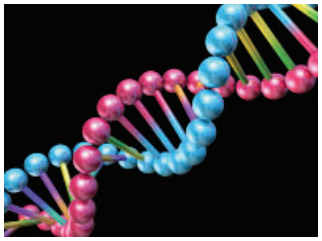
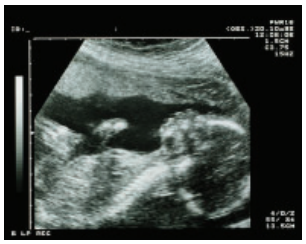
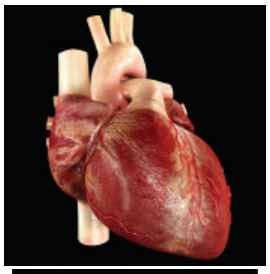
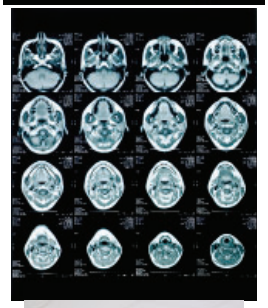
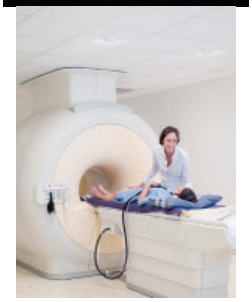
Source 2

Medical developments over time

Technological invention or discovery	Year		Impact
The microscope	1590		Small micro-organisms could be seen for the first time.
William Harvey discovers the circulation of the blood	1628		Doctors began to understand how blood moved through the human body. (The blood supply carries oxygenated blood around the body and transports waste gases away.)
The stethoscope	1816		The stethoscope allowed doctors to listen to sounds from within the human body. Doctors could diagnose chest problems and listen to the heart.
The hypodermic syringe	1853		Drugs and vaccines could be injected into the body safely and blood samples could be taken easily.
X-rays discovered by Röntgen	1895		X-rays pass through skin and soft tissue but not through more dense materials such as bone, metal, etc. An X-ray image can show bones in great detail.
Penicillin discovered by Sir Alexander Fleming	1928		Penicillin was the first antibiotic drug. Antibiotics can kill the germs that cause a wide range of infections and diseases.

Watson and Crick discover the structure of DNA	1953		DNA is the building block of the human body. DNA contains the instructions needed for an organism to develop, survive and reproduce.
Ultrasound	1955		Ultrasound allows images to be created without the use of harmful X-rays. Pregnant women are usually given ultrasound scans to check on the progress of the pregnancy.
Heart transplant	1967		Dr Christian Barnard carried out the first human heart transplant. Since then, many people have had their lives extended by being given new hearts.
First CT scan in a UK hospital	1971		A CT scan consists of multiple X-rays that are assembled by computer into a 3D image. CT images can be looked at from different angles. The body can also be looked at in 'slices'.
MRI scanner	1977		An MRI scanner uses a large magnet and radio waves to produce images. It does not use X-rays. This makes it highly suitable for soft tissue imaging.
The human genome is sequenced	1999		A complete genetic map of the human body can be made. This allows scientists to research diseases that are caused by faulty genes, with the aim of developing new treatments.
Stem cells	2007		Stem cells have the potential to become any cells in the human body. Using a person's own stem cells, scientists expect to grow new cells as needed – for example, if an organ fails. (Stem cell research is still in its early stages.)

Turn over ▸

Source 3

Ethics left behind as drug trials soar in developing countries

A report from the 7th World Conference of Science Journalists, in Qatar (June 2011)

Ethical rules to protect participants in developing countries are not keeping pace with the increase in clinical trials of new drugs, the conference was told.

By 2008 there were three times as many developing countries participating in clinical trials registered with the US Food and Drug Administration as there were in the entire period between 1948 and 2000. By 2008, many countries, such as Brazil, China, India, Mexico and South Africa, were taking part.

The number of clinical trials in developing countries has surged in recent years but the legal and ethical frameworks to make them fair are often not in place.

For the pharmaceutical industry, the attractions are the lower costs and the availability of 'treatment-naïve' patients, who are much less likely to have been previously exposed to trials.

The main incentive for developing countries is the promise of advanced medical science and access to the latest medications. However, the process of putting in place a legal and ethical framework to protect participants is not going at the same pace in many of these countries.

"Less stringent ethical review, anticipated under-reporting of side effects, and the lower risk of litigation make carrying out research in the developing world less demanding," said Ames Dhai, director of the Steve Biko Centre for Bioethics at the University of Witwatersrand, South Africa.

While many countries have set ethical standards for clinical trials, this is not a guarantee that they will be respected by those who perform the trials. "The problem is implementing these [ethical] guidelines and the imperialistic attitude of researchers and sponsors who come to the country and frequently disregard our process," Dhai added.

Places such as South Africa – where mostly vulnerable poor with low literacy levels are recruited and the culture is to accept authority without question – are fertile land for ethical misconduct, speakers said.

India is another example, where a recent trial of two vaccines against the virus responsible for cervical cancer has had a lot of negative publicity after some deaths that were later shown to be unrelated to the trial, but which exposed ethical irregularities in the Indian system.

According to Sonia Shah, author of *The Body Hunters: Testing New Drugs on the World's Poorest Patients*, up to 80% of patients recruited in some developing countries are not informed about the nature of the study they are taking part in. In addition, many of them do not feel free to quit the trial, because they think that they or their children will lose out on good healthcare or treatment if they abandon it.

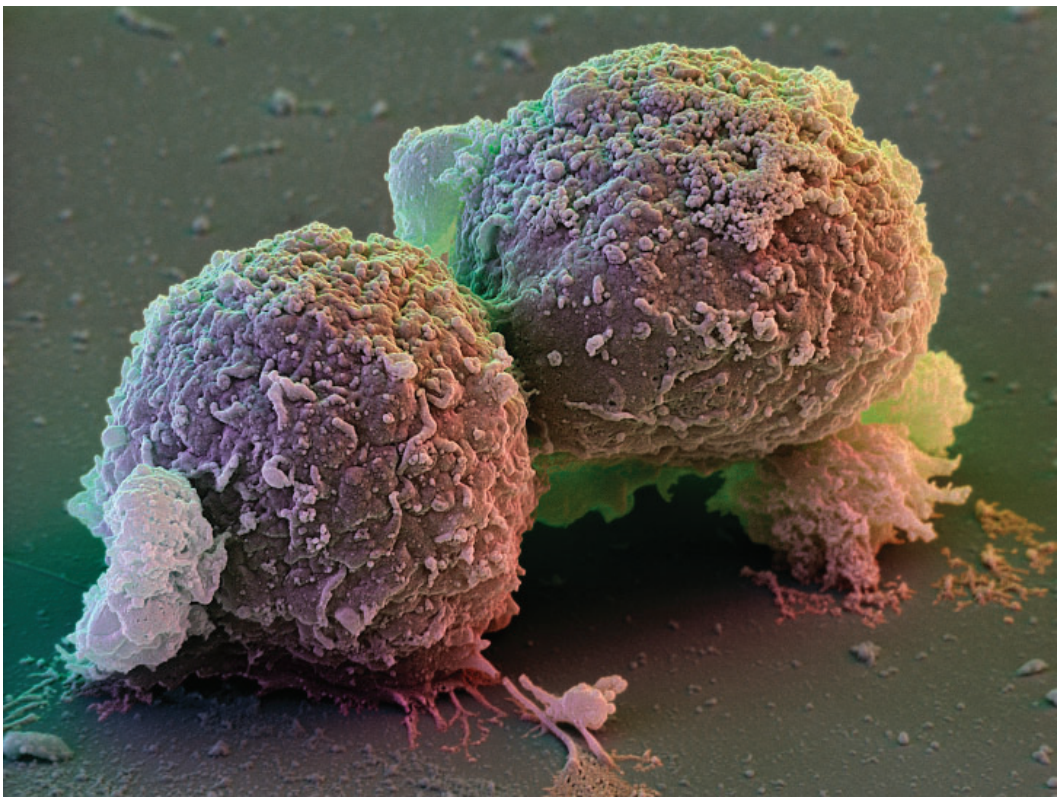
"The greatest challenge in moving to mutual benefit is balancing the needs of biomedical research with the full protection of research participants and communities," said Dhai. If this can be achieved, clinical trials can be highly beneficial for developing countries.

Source: adapted from SciDev Net, part of the Guardian development network
The Guardian, Monday 4 July 2011

Source 4

Look, no embryos! The future of ethical stem cells

For years, ethical issues hampered progress in stem cell research. Now, experts believe that developments in reprogrammed cells will truly revolutionise the treatment of life-threatening illnesses.



Two stem cells complete the process of mitosis (division)

It is unclear at exactly what point the phrase 'stem cell' entered the vernacular, one of very few scientific terms that achieve the status of, say, DNA in not requiring a detailed explanation every time it is written down or spoken.

Whether or not you know exactly what they are or what they do, stem cells imply something very specific: in them is invested the next generation of medicine, revolutionary treatments for everything from Parkinson's to Alzheimer's. On the horizon, there is also the hope of growing genetically matched tissue (even whole organs) to replace anything that has been damaged by disease or accident.

But perhaps the reason stem cells managed to lodge themselves so deep in the public imagination was not just because of their awesome scientific potential, or their ability to turn into the treatments of the future. Perhaps it was politics. For years, stem cells dominated all other science stories in newspaper headlines because they framed an ethical problem – to get to the most versatile stem cells meant destroying human embryos.

Research on stem cells became a 'political football', leading to delays in funding for scientists, particularly in the US. Not that the work itself was straightforward – the process of extracting stem cells from embryos is difficult and there is a very limited supply of material. Inevitable disappointment followed the years of headlines – where were the promised treatments? Was it all over-hyped?

For Paul Fairchild, co-director of the newly founded Oxford Stem Cell Institute, disappointment is just not on the agenda. He explains his vision for the coming, post-hype decade of stem cell science. "It's an exciting time in stem cell biology for a host of reasons," he says. "We've entered a whole new phase in the stem cell field, which has been held up enormously by ethical issues for over a decade."

Key to this is the discovery, in the past few years, of a way to make stem cells that does not require the destruction of embryos. Fairchild says that the technology will "completely revolutionise the whole of medicine this century".

Stem cells are the body's master cells, the raw material from which we are built. Unlike normal body cells, they can reproduce an indefinite number of times and, when prodded in the right way, can turn themselves into any type of cell in the body. The most versatile stem cells are those found in the embryo at just a few days old – this ball of a few dozen embryonic stem (ES) cells eventually goes on to form everything that makes up a person.

In 1998, James Thomson at the University of Wisconsin-Madison announced that he had isolated human ES cells in the lab. Finally, these powerful cells were within the grasp of scientists to experiment with, understand and develop into fixes for the things that go wrong. But the wide genetic variations in humans mean that scientists need lots of different lines of ES cells to treat and understand the wide variety of faults. Each new line of ES cells can only be created by fertilising an egg, and these are a precious, rare commodity.

This is also where the ethical problems lie. Extracting ES cells destroys the embryo – for some, this is akin to killing a potential human life. George W Bush banned the use of federal dollars to support research using human ES cells on all but a limited number of cell lines that already existed in research labs prior to August 2001. Barack Obama reversed that ban, only to be thwarted by a federal court ruling in 2010 that, once again, put the scientists into a state of uncertainty. By contrast, the UK laws are relatively clear – after much debate about the ethics of using human embryos, the government passed strict, but fair, laws that allowed ES research to go ahead.

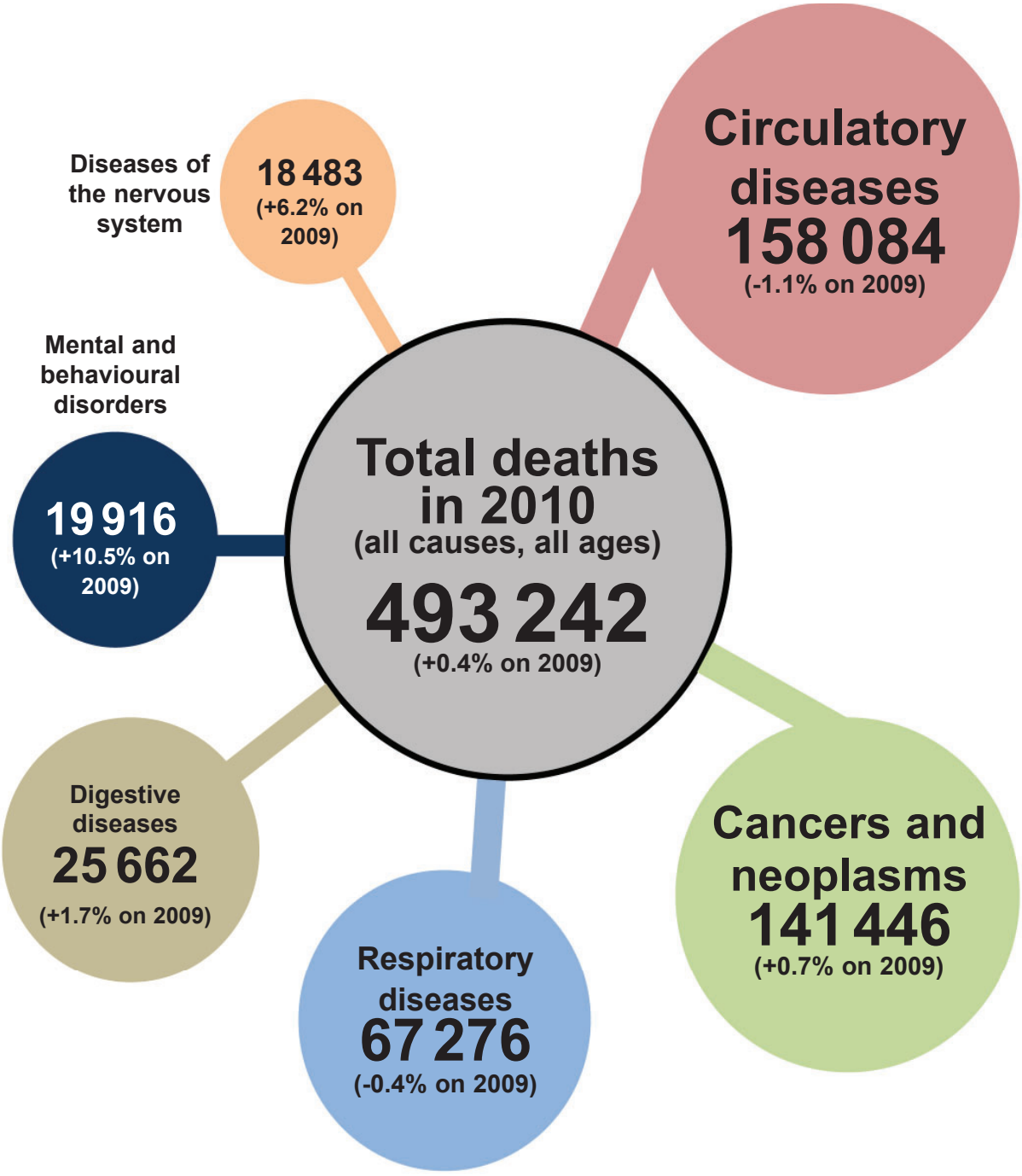
The very things that make some stem cells so useful in lab situations – their immortality and versatility – would be disastrous if left unchecked inside people. But, for a field that is barely a few years old, the remarkable pace of achievement should give plenty of hope that these challenges will be met.

Source: photograph by David Scharf/ Science Faction © Getty Images
article adapted from Alok Jha, *The Observer*, Sunday 13 March 2011

Source 5: Chart A

What we die of:

The six primary causes of death recorded on death certificates in England and Wales, 2010.



Source: chart reproduced by AQA, adapted from an original chart published in the article: 'Mortality statistics: every cause of death in England and Wales', *The Guardian*, 28 October 2011.

Turn over ▸

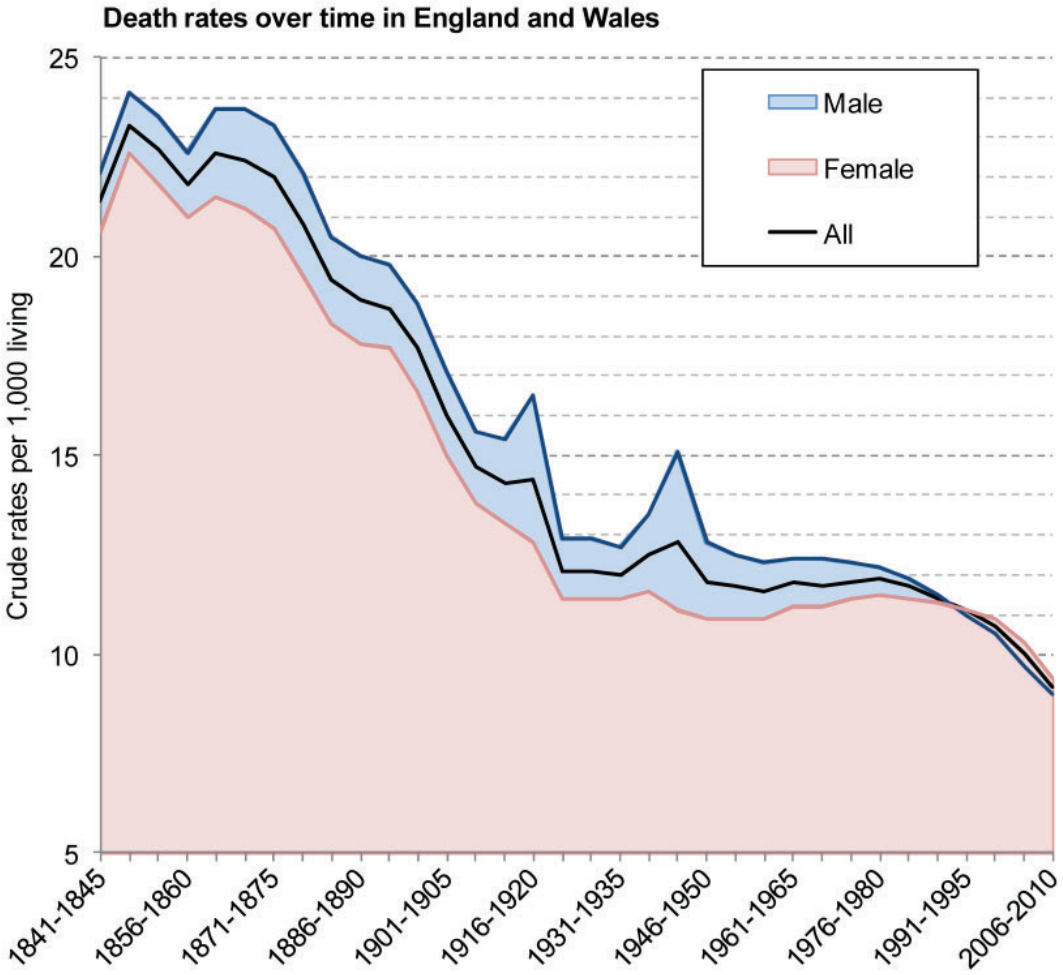
Source 5: Chart B

Main types of death by disease in England and Wales, 2001–2010

Cause of death	2001 population: 52 084 000 — Number of deaths: 2001 — MALE	FEMALE	TOTAL	Rate per 100 000 pop	% change, 2001–10 (figures rounded)	2010 population: 55 240 500 — Number of deaths: 2010 — MALE	FEMALE	TOTAL	Rate per 100 000 pop
Circulatory diseases	101 259	110 583	**211 842**	*407*	**−25**	77 260	80 824	**158 084**	*286*
Cancers and neoplasms	72 058	67 077	**139 135**	*267*	**+2**	74 267	67 179	**141 446**	*256*
Respiratory diseases	31 057	36 334	**67 391**	*129*	**0**	31 563	35 713	**67 276**	*122*
Digestive diseases	10 646	12 740	**23 386**	*45*	**+10**	12 164	13 498	**25 662**	*46*
Mental and behavioural disorders	4 747	9 396	**14 143**	*27*	**+41**	6 299	13 617	**19 916**	*36*
Diseases of the nervous system	6 501	7 830	**14 331**	*28*	**+29**	8 551	9 932	**18 483**	*33*
All causes, all ages	**252 426**	**277 947**	**530 375**	***1 018***	**−7**	**237 916**	**255 326**	**493 242**	***893***

Source: Data from ONS, England and Wales statistics, 2001–2010, © Crown Copyright.

Source 5: Chart C



Significant specific changes

Alzheimer's and dementia are now the third leading cause of death for women, after heart disease and stroke. Falls in other, more preventable and treatable, diseases are largely responsible for a 26% rise in dementia deaths over the five years between 2005 and 2010. In the same period, heart disease deaths dropped by 30% in women. Diseases of the urinary system – also linked to old age – increased by 8.1% in that time and lung cancer deaths rose by 3.5%, as smoking continued to take its long-term toll, but most other trends were down.

Among men, deaths from dementia and Alzheimer's have risen by 21% between 2005 and 2010, while liver disease has shown the other significant increase – up 3%. As in women, heart disease deaths fell substantially over the same period – by 26% - but they are still the leading cause of death, killing 40 721 men in 2010 and accounting for 17% of all male deaths. Dementia comes eighth among the leading causes of male deaths, accounting for 7347 last year.

Essentially, other causes of death are going down - and people have to die of something. And, whatever we may worry about, **this is one of the safest times to be alive**, ever – as the above chart shows.

Source: 'Mortality statistics: every cause of death in England and Wales', *The Guardian*, 28 October 2011.

END OF SOURCES

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