

What Is Modern Medicine?

By The MNT Editorial Team
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- **Modern Medicine**

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Economic activity grew rapidly during the 18th Century in Western Europe and the Americas. It was the beginning of the Industrial Revolution. During the 19th century economic and industrial growth gathered pace; it was also a period of scientific discovery and invention.

Old ideas of infectious disease epidemiology (incidence, distribution, and control of diseases) made way to virology and bacteriology. Microbiology made

advances, a science that started with Antonie Philips van Leeuwenhoek (1632 - 1723), who first observed microorganisms with a microscope.

Enormous developments were made in identifying and preventing illnesses. However, one problem still persisted, and that was treating and curing infectious diseases.

During the 19th century the world changed dramatically:

- Industry expanded enormously, and with it came various work-related diseases, such as "phossy jaw" (jaw necrosis among those working with phosphorous, usually in the match industry), lung diseases and dermatitis.
- Hygiene - Ignaz Semmelweis (1818-1865) brought down the childbed fever death rate among new mothers by insisting that doctors wash their hands before touching women during childbirth. It was not until 1865 when Joseph Lister, a British surgeon proved the principles of antisepsis in wound treatment. Even then, it was an uphill struggle to convince all the "conservative" doctors.
- Cities started to grow rapidly, and so did urban sprawl. Health problems, such as typhus and cholera became more common
- Some European countries had empires, including the UK, Spain, Portugal, France and some others. People travelled to and from various parts of the world, bringing back with them various diseases, such as yellow fever.
- Scientific breakthroughs appeared all over Europe and the Americas, including the electrocardiograph.
- Postal services and communications in general improved, allowing medical knowledge to spread rapidly.

- Democracy grew in several countries in Europe and the Americas. This led to people demanding health as a human right.
- Innovative scientists advanced forward despite resistance from the clergy, examples include Charles Darwin (evolution) and Gregor Johann Mendel (genetics).
- Wars - as technology developed, wars became more devastating, causing mass injuries, which required new surgical and medical techniques.

Louis Pasteur

Louis Pasteur (1822-1895), a chemist and microbiologist from France, is known as one of the founders of medical microbiology. After working for several years as a teacher in Strasbourg and Dijon, he became professor of chemistry at the University of Lille in 1854. The science faculty had among other things, been asked to find solutions to some of the problems that existed in local industries, such as the manufacture of alcoholic beverages.

Pasteur demonstrated that bacteria caused the souring of wine and beer, and later on showed that a similar process occurred in milk. He also explained that by boiling and the cooling a liquid, such as milk, the bacteria could be removed. The process we know as *pasteurization* comes from his surname.

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He then set out to determine where these bacteria originated from, and eventually proved that they came from the environment. Initially, the scientific community disagreed with him, saying that germs could appear out of nowhere (spontaneously generate). However, in 1864, his findings were accepted by the French Academy of Sciences.

Later on, as head of scientific studies at the École Normale, he was given the job deciding what to do about an epidemic among silkworms in the silk industry in the south of France. He eventually determined that parasites were the cause and that only healthy silkworm eggs (with no parasites) should be used. The epidemic was resolved and the silk industry recovered.

His subsequent research convinced him further that pathogens attack the body from outside (germ theory of disease). Many scientists could not conceive that microscopic beings could harm and even kill comparatively huge ones, like us. He went a step further and said that many diseases, including TB, cholera, anthrax, and smallpox are caused by germs that come into the body from the environment. He believed they could be prevented with vaccines.

He went on to develop vaccines for rabies, for which he is probably the most famous.

In 1888 the Institute Pasteur was founded. He was director there until 1885, when he died. Louis Pasteur was given a state funeral. In France he is a national hero.

Louis Pasteur worked closely with **Claude Bernard** (1813-1878) a physiologist; together they perfected pasteurization of liquids. Bernard was the first to define *milieu intérieur* (homeostasis - a healthy state that is maintained by the continuous adjustment of biochemical and physiological pathways). Bernard was the first to suggest using "blind" experiments when aiming for maximum objectivity in scientific observations. Harvard University Professor, Bernard Cohen says that Bernard was "one of the greatest of all men of science".

Florence Nightingale

Florence Nightingale

Florence Nightingale (1820-1910) was a British nurse, statistician and writer. Her pioneering nursing work during the Crimean War, where she cared for wounded soldiers, brought her to prominence. Nightingale was the daughter of wealthy parents who were in Florence, Italy, as part of a tour when she was born - hence her name.

In 1837 she sensed a "calling from God", telling her to do some work, even though at the time she said she had no idea what that work was. She was interested in nursing, but well-to-do women in those days did not go into the medical professions. Her parents did not allow her to study nursing. She had been expected to marry well and have children.

Nightingale eventually got her way and went to Kaiserswerth, Germany, in 1851 to do a three-month nursing course. By 1853 she became superintendent of a hospital for well-off women in Harley Street, London (a street famous for top doctors).

The Crimean War broke out a year later. Nightingale read reports of dreadful lack of medical facilities for British soldiers who had been wounded in action. Nightingale, who already knew Sidney Herbert, Minister for War, was asked by Herbert to be in charge of a team of nurses in the military hospitals in Turkey. She arrived in Scutari, Turkey in 1854 with 38 women volunteer nurses who had all been trained by her, including her aunt Mai Smith.

Nightingale was shocked by what she saw at Scutari - wounded soldiers in unbearable pain, many of them dying unnecessarily, being tended by overly-tired medical staff and official indifference. There was a serious shortage of medications, hygiene standards were shocking, and there were mass infections. There was nothing to process food for the patients; no equipment at all.

She sent a plea to *The Times* asking the government to do something about the atrocious conditions in Scutari. A prefabricated hospital was built in England and transported to the Dardenelles. When it was built it was called the Renkioi Hospital, which had a death rate 90% lower than what existed before in Scutari.

The presence of Nightingale and her team of nurses resulted in a significant drop in the mortality rate of wounded soldiers.

In 1860 Nightingale founded the Nightingale Training School for nurses at St Thomas' Hospital, London. It was the first secular nursing school in the world. Nurses who trained there worked all over the UK, and spread what they had learnt.

Her book *Notes of Nursing* was published in 1860. In it she stressed the importance of sanitation and hygiene, good hospital planning, and the best ways to achieve optimum military health - many of her practices are still in force today.

Nightingale reduced death rates from 42% to 2%, according to the 1911 edition of the *Dictionary of National Biography*.

The arrival of Florence Nightingale is seen as a turning point for women in the medical profession. Before she came onto the scene, women in hospital and medical settings possibly worked as midwives, cleaning ladies and sitters, and not much else.

Timeline of medical milestones during the 19th century

- **1800 - Humphry Davy (1778- 1829)**, a British chemist and inventor, described how nitrous oxide (laughing gas) has anesthetic properties. It is said he was addicted to the stuff.
- **1816 - Rene Laennec (1781-1826)**, a French doctor, invented the stethoscope. He also pioneered stethoscope use in diagnosing chest infections.
- **1818 - James Blundell (1791-1878)** was a British obstetrician. He performed the first successful blood transfusion on a patient who had a hemorrhage.
- **1842 - Crawford Long (1815 -1878)**, an American pharmacist and surgeon, now recognized as the first doctor to have used inhaled ether anesthesia on a patient for a surgical procedure. For many years only a few colleagues in his inner circle knew about this achievement.
- **1847 - Ignaz Semmelweis (1818 -1865)**, a Hungarian doctor, known as the *savior of mothers*. He found that childbed fever (puerperal fever) incidence could be considerably reduced if doctors, midwives and nurses disinfected their hands before touching the mother during

childbirth or a miscarriage. Childbed fever was common in the 19th century; between 10% and 35% of mothers who became infected died.

- **1849 - Elizabeth Blackwell (1821-1910)**, an American, was the first woman to become a fully qualified doctor in the USA, and also the first female to be on the UK Medical Register. Blackwell dedicated much of her time to promoting the education of women in medicine.
- **1867 - Joseph Lister**, 1st Baron Lister OM, FRS, PC (1827-1912), a British surgeon and a pioneer of antiseptic surgery. He introduced phenol (then known as carbolic acid) successfully to clean wounds as well as sterilizing surgical instruments. His work contributed greatly towards a reduction in post-operative infections. He published a book *Antiseptic Principle of the Practice of Surgery*, which was strongly influenced by Louis Pasteur's work.
- **1870 - The Germ Theory of Disease** is established by Louis Pasteur and Robert Koch.
- **1879 - Louis Pasteur** produced the first laboratory-developed vaccine - the vaccine for chicken cholera.
- **1881 - An anthrax vaccine** developed by Louis Pasteur. Pasteur made a public demonstration with 50 sheep. He tested his vaccine, created by attenuating the anthrax bacterium with carbolic acid. All the 25 unvaccinated sheep died, while only one of the vaccinated ones perished, which was probably due to a miscarriage.
- **1882 - The first rabies vaccine.** Louis Pasteur managed to prevent rabies in Joseph Meister, a 9-year old boy, by post-exposure vaccination.
- **1890 - Emil von Behring Emil Adolf von Behring** (1854-1917), a German physiologist, discovered antitoxins and utilized them to develop diphtheria and tetanus vaccines. He received the Nobel Prize in Physiology or Medicine; the first time the prize was ever awarded.

- **1895 - Wilhelm Conrad Röntgen (1845-1923)**, a German physicist. He produced and detected electromagnetic radiation in a wavelength range; what we call today Röntgen rays or X-rays. In 1901 he received the Nobel Prize in Physics. The International Union of Pure and Applied Chemistry named element 111, Roentgenium after him.
- **1897 - Aspirin was invented.** Chemists working in the German company Bayer AG produced a synthetic version of salicin, which was derived from the species *Filipendula ulmaria*(meadowsweet). This synthetically altered version was easier on the stomach than pure salicylic acid. Bayer says that the invention of aspirin should be attributed to Felix Hoffmann; however, Arthur Eichengrün, a Jewish chemist later said that he was the lead researcher, but records of his participation were erased under the Nazi regime.
Bayer AG named the new drug *Aspirin*. Within two years Aspirin became a global blockbusting drug.

Timeline of medical milestones during the 20th century

- **1901 - Different human blood types were discovered** by Karl Landsteiner (1868-1943), an Austrian biologist and physician. He identified the presence of agglutinins in blood and developed the modern system of classifying blood groups. He received the Nobel Prize in Physiology or Medicine in 1930.
- **1901 - The first case of Alzheimer's disease** was identified by Alois Alzheimer (1864-1915), a German psychiatrist and neuropathologist. He called it "presenile dementia". His colleague, Emil Kraepelin, later called the it Alzheimer's disease.

- **1903 - The first practical electrocardiogram (ECG or EKG)** was invented by Willem Einthoven (1860-1927), a Dutch doctor and physiologist. In 1924 he received the Nobel Prize in Medicine in 1924.
- **1906 - Vitamins were discovered** by Frederick Hopkins (1861-1947), an English biochemist. He also suggested that scurvy and rickets were caused by a lack of vitamins. Along with Christiaan Eijkman, he received the Nobel Prize in Physiology or Medicine.
- **1907 - A chemotherapeutic cure for sleeping sickness** was developed by Paul Ehrlich (1854-1915), a German doctor and scientist. Ehrlich's lab also discovered Arsphenamine (Salvarsan), the first treatment for syphilis that was effective, and thus initiated and named the concept of chemotherapy.
- **1908 - The stereotactic method** (stereotactic device) was invented by Victor Horsley (1857-1916) and R. Clarke. It allows experimental and surgical intervention in deep-seated structure of the brain.
- **1910 - The first laparoscopy** performed on a human was done by Hans Christian Jacobaeus (1879-1937), a Swedish internist. Jacobaeus became a professor at the prestigious Karolinska Institute in Stockholm, and was also a member of the Nobel Prize Committee.
- **1921 - Vitamin D discovered** by Sir Edward Mellanby (1884-1955), a British physician. He also explained Vitamin D's role in preventing rickets.
- **1921 - Insulin was discovered** by Sir Frederick Banting (1891-1941), a Canadian medical scientist, and Charles Herbert Best (1899-1978), an American-Canadian medical scientist. Banting received the Nobel Prize in Medicine in 1923 (along with John James Rickard Macleod) when he was 32 years old. He is still the youngest ever Nobel Laureate for Medicine.

- **1921 - The technique of epidural anesthesia** was pioneered by Fidel Pagés (1886-1923), a Spanish military surgeon.
- **1923-1927 - The first vaccine for diphtheria, pertussis (whooping cough), TB (tuberculosis) and tetanus** were developed and used successfully.

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Sir Alexander Fleming, FRSE, FRS, FRCS(Eng)

1928 - Penicillin from the mould *Penicillium notatum* was discovered by Sir Alexander Fleming (1881-1955), a Scottish biologist and pharmacologist. He was awarded the Nobel Prize in Physiology or Medicine in 1945, along with Howard Florey and Ernst Boris Chain. The discovery of penicillin changed the course of history and saved hundreds of millions of lives.

Fleming said: "When I woke up just after dawn on September 28, 1928, I certainly didn't plan to revolutionized all medicine by discovering the world's first antibiotic, or bacteria killer But I suppose that was exactly what I did."

- **1929 - Human electroencephalography** was discovered by Hans Berger (1873-1941), a German doctor. He was the first to record brain waves or EEGs (electroencephalograms). He discovered the alpha wave rhythm in the brain, which is also known as "Berger's wave".
- **1932 - A chemotherapeutic cure for streptococcus** was developed by Gerhard Domagk (1895 -1964), a German pathologist and bacteriologist. He is credited with discovering Sulfonamidochrysoidine (KI-730), the first antibiotic to go on the market (brand name: Prontosil). He was awarded the Nobel Prize in Physiology or Medicine in 1939.
- **1933 - Insulin shock therapy for patients with some mental illnesses** was discovered by Manfred Sakel (1900-1957), a Jewish Austrian neurophysiologist and psychiatrist who later became an Austrian-American.
- **1935 - The first successful vaccine for Yellow Fever was developed.** The yellow fever virus was isolated in West Africa in 1927; this led to the development of two vaccines in the 1930s. 17D was developed by Max Theiler, a South African microbiologist at the Rockefeller Institute. He used chicken eggs to culture the virus. Theiler was awarded the Nobel Prize in 1951.
- **1943 - The world's first dialysis machine** was built by Willem J Kolff (1911-2009), a Dutch doctor. He is known as a pioneer of hemodialysis and artificial organs. In 1950, Kolff emigrated to the USA.
- **1946 - The first effective cancer chemotherapy drug** - nitrogen mustard - was discovered by Alfred G. Gilman (1908-1984) an American pharmacologist, and Louis S. Goodman (1906-2000), also an American pharmacologist, while doing research together at Yale University. They discovered that the blood of soldiers who had been exposed to nitrogen mustard had exceptionally low levels of white cells.

- **1948 - Acetaminophen (paracetamol, Tylenol)** was invented by Julius Axelrod (1912-2004), an American biochemist, and Bernard Brodie (1907-1989), an American chemist, considered by many to be the founder of modern pharmacology.
- **1952 - The first polio vaccine was developed** by Jonas Salk (1914-1995), an American medical researcher and virologist. The vaccine came onto the market in 1955.
Salk set up a field trial to test the vaccine - a trial of immense proportions; it included 20,000 doctors, 64,000 school staff, and 220,000 volunteers. More than 1,800,000 school kids took part in the study. When news of the trial's success became public in April 12th, 1955, Salk was hailed a "miracle worker". After WWII polio became a serious public health problem in the USA.
In a TV interview, Salk was asked about who owned the patent for the polio vaccine. He answered "There is no patent. Could you patent the sun?"
- **1953 - The Heart-Lung Machine was invented** by Dr John Heysham Gibbon (1903-1973), an American surgeon. He performed the first open heart surgery ever, repairing an atrial septal defect.
- **1953 - Medical Ultrasonography (echocardiography)** was invented by Inge Edler (1911-2001), a Swedish physicist.
- **1954 - The first human kidney transplant (on identical twins) was performed** by Joseph Murray (born 1919). During the following years, as immunosuppressive agents came onto the market and science understood the mechanisms of rejection better, Murray managed to perform transplants with donor organs from unrelated people.
- **1955 - Tetracycline** was produced by catalytic reduction by Lloyd Conover (born 1923), an American chemist. He and his team substituted hydrogen for chlorine chlortetracycline. He was the first scientist ever to make an antibiotic by chemically modifying a naturally-produced drug.

Within three years, tetracycline became the most popular broad spectrum drug in the United States. Conover has nearly 300 patents in his name.

- **1958 - The first implantable pacemaker** was developed by Rune Elmqvist (1906-1996), a medical doctor who later worked as an engineer and inventor. Elmqvist also developed the first inkjet ECG printer.
- **1959 - In vitro fertilization led to the first "test tube baby"**, by Min Chueh Chang (1908-1991), a Chinese American reproductive biologist. M.C. Chang is also famous for contributing towards the development of the combined oral contraceptive pill ("The Pill").
- **1960 - Cardiopulmonary resuscitation (CPR) was invented** by James Jude, Guy Knickerbocker, Peter Safar, William Kouwenhoven and Joseph S. Redding, all Americans. CPR was originally developed at Johns Hopkins University. They first tested CPR successfully on a dog. Not long afterwards, a child's life was saved using the technique.
- **1960 - The first combined oral contraceptive pill (COCP)**, often referred to as the birth-control pill or informally as "The Pill" was approved by the FDA. "Combined" refers to the two hormones within it - estrogen and progestin. Hundreds of millions of women use COCP today.
- **1962 - The first beta blocker was invented** by Sir James W. Black (1924 - 22 March 2010), a Scottish doctor and pharmacologist. After founding the physiology department at the University of Glasgow, Black became interested in how adrenaline might impact on the functioning of the human heart. While working for ICI Pharmaceuticals, he developed Propranolol, a beta blocker, which was used to treat heart disease. Black also developed Cimetidine, a medication used in a similar way for the treatment of stomach ulcers. He received the Nobel Prize for Medicine in 1988.

- **1963 - The first human liver transplant was performed** by Thomas Starzl (born 1926), an American physician and researcher.
- **1963 - The first human lung transplant was performed** by James Hardy (1918-2003), an American surgeon.
- **1963 - Valium (diazepam) was discovered** by Leo H Sternbach (1908-2005), a Polish chemist. Sternbach also discovered chlordiazepoxide (Librium), trimethaphan (Arfonad), clonazepam (Klonopin), flurazepam (Dalmane), flunitrazepam (Rohypnol) and nitrazepam (Mogadon).
- **1964 - The first measles vaccine came out.** It was developed by Maurice Hilleman (1919-2005), an American microbiologist/vaccinologist. Hilleman developed over 36 vaccines, more than anybody else ever.
- **1965 - The rubella vaccine was developed** by Harry Martin Meyer (1928-2001), an American pediatric virologist.
- **1966 - The first human pancreas transplant was performed** by C. Walton Lillehei (1918-1999), an American surgeon. Lillehei also pioneered open-heart surgery, as well as new equipment, prostheses, and techniques for cardiothoracic surgery.
- **1967 - The first human heart transplant was successfully performed** by Christiaan Barnard (1922-2001), a South African cardiac surgeon.
- **1970 - The first vaccine for rubella (German measles) came on the market.** It was developed by Harry Martin Meyer (see 1965).
- **1970 - the first effective immunosuppressive drug, Cyclosporine,** became used in organ transplant procedures. The active ingredient was first isolated from the fungus *Tolypocladium inflatum* (*Beauveria nivea*), which had been collected in a soil sample by Dr. Hans Peter Frey, a biologist who was working at pharmaceutical company Sandoz. Cyclosporine is also used to treat psoriasis, pyoderma gangrenosum,

chronic autoimmune urticaria, and less often for severe cases of rheumatoid arthritis.

- **1971 - Magnetic Resonance Imaging was invented** by Raymond Vahan Damadian (born 1936), an Armenian-American medical practitioner and inventor.
- **1971 - The CT Scan, also known as CAT scan (Computed Tomography)** was invented by Sir Godfrey Hounsfield (1919-2004), an English electrical engineer. He was awarded the Nobel Prize for Physiology or Medicine in 1979 (with Allan McLeod).
- **1972 - The insulin pump was invented** by Dean Kamen (born 1951), an American entrepreneur and inventor.
- **1973 - Laser eye surgery (LASIK) was performed for the first time** by Mani Lal Bhaumik (born 1941), an Indian-born American physicist. Dr. Bhaumik demonstrated the world's first efficient excimer laser - this application would eventually do away with the need for contact lenses or glasses in many cases.
- **1974 - Liposuction was carried out successfully for the first time** by Giorgio Fischer (born 1934), a gynecologist from Rome, Italy.
- **1978 - The last recorded fatal case of smallpox** (Variola minor).
- **1979 - George Hitchings (1905-1998)**, an American doctor, and Gertrude Elion (1918-1999), an American biochemist and pharmacologist, made important breakthroughs with antiviral medications. Their pioneering works eventually led to the development of AZT, the AIDS drug.
- **1980 - Hepatitis B diagnostic test and vaccine developed** by Dr Baruch Samuel Blumberg, an American doctor. Dr. Blumberg received the Nobel Prize in Physiology or Medicine (with Daniel Carleton Gajdusek).

- **1981 - The first human heart-lung combined transplant procedure** was successfully performed by Bruce Reitz (born 1939), an American cardiothoracic surgeon.
- **1985 - Kary Banks Mullis (born 1944)**, an American biochemist, author, and lecturer, invented improvements to the polymerase chain reaction (PCR), a biochemical technology in molecular biology which amplifies one or some copies of a piece of DNA across various orders of magnitude, to generate thousands and possibly millions of copies of that particular DNA sequence. In 1993 he was awarded the Nobel Prize in Chemistry (with Michael Smith).
- **1985 - A surgical robot was created** by Dr Yik San Kwoh (born 1946), a Chinese-American Bioengineer and inventor. Initial experiments were tried with a watermelon; a BB was shot into it, the robot had to locate it and remove it (which it did).
- **1985 - Sir Alec John Jeffreys** (born 1950), a British geneticist, developed techniques for DNA fingerprinting and DNA profiling which every competent forensic department in the world uses today. The technique is also used to resolve immigration and paternity disputes.
- **1986 - (Prozac) (fluoxetine HCl)**, a selective serotonin reuptake inhibitor (SSRI) class antidepressant was launched by Eli Lilly after being approved by the US FDA for the treatment of major depression. It went off patent in August 2001. Fluoxetine is also approved for pediatric depression, bulimia nervosa, panic disorder, obsessive-compulsive disorder (adults and children), and premenstrual dysphoric disorder. In 2010, 24 years after fluoxetine's approval and nine years after it went off patent, it was the third most prescribed antidepressant in the USA (after sertraline and citalopram) - 24.4 million prescriptions were written that year.
- **1987 - The first statin ever**, Lovastatin (Mevacor), was approved by the US FDA. Merck & Co had isolated the active ingredient lovastatin

(mevinolin MK803) from *Aspergillus terreus*, a fungus. Clinical trials had shown that lovastatin reduced LDL cholesterol by 40%; far more than any other treatment at the time.

- **1989 - The birth of the WWW (World Wide Web)**; a major milestone in the way humans globally behave, gather information, express themselves, make friends, work, and go about exchanging data on medical and pharmaceutical issues and innovations. Sir Timothy John "Tim" Berners-Lee, (born 1955), an English computer scientist and MIT professor invented the World Wide Web. With the help of Robert Cailliau (a student at CERN), they implemented the first successful communication between an HTTP (Hypertext Transfer Protocol) client and server through the internet.
- **1998 - James Alexander Thomson (born 1958)**, an American developmental biologist, derived the first human ES (embryonic stem) cell line. Later in 2007, he derived induced pluripotent (iPS) stem cells. Thomson's breakthrough in 1998 generated controversy because the technology involved destroying human embryos. At the same time as Dr. Shinya Yamanaka, in 2007 Thomson wrote that he had discovered a method for creating stem cells which closely resemble human embryonic stem cells from human skin cells; this breakthrough was much more widely accepted because it ended the ethical controversy regarding embryonic stem cell research.

Timeline of medical milestones from 2000 to the present day

- **2000 - The Human Genome Project (HGP)** draft was completed. The HGP is a project involving collaborators from all over the world; their main goal being to determine the sequence of chemical base pairs which make up DNA, and to identify and map the *circa* twenty-to-thirty

thousand genes of the human genome from both a functional and physical perspective.

The Human Genome Project has other objectives, apart from understanding the genetic makeup of human beings. It has also focused on other species, such as the laboratory mouse, *E. coli*, and the fruit fly. The HGP continues to be one of the most important single investigative projects in modern medical science.

- **2001 - Dr. Kenneth Matsumura, of the Alin Foundation**, created the first bio-artificial liver. The liver removes toxins from blood and manufactures nearly 1,000 proteins, metabolites and other crucial substances; it is a very complex organ, and one of the most difficult to replace. Dr. Matsumura and team found a way around the liver's complexities by letting rabbit liver cells sort out the issues.

Dr. Matsumura's bio-artificial liver had a two-part chamber - one side contained the patient's blood, while on the other he placed live rabbit cells suspended in a solution; there was a semi-permeable membrane separating the two chambers. The toxins from the human blood passed through the membrane and were metabolized by the rabbit cells; the resulting proteins and other needed substances were then sent back to the other side. The likelihood of the rabbit cells causing infection or being rejected were minimized because they never came into direct contact with the human blood.

The artificial liver was intended as a bridge to an eventual liver transplant for people with acute liver failure, as well liver transplant recipients whose bodies have rejected the organ. There is even the possibility that damaged livers may be given time to heal themselves, doing away with a transplant requirement altogether.

- **2001 - Jacques Marescaux, a French doctor, carried out the first ever TeleSurgery**; he operated on the gallbladder of a patient who was in Strasbourg, France, while he was in New York, USA (The Lindbergh Operation). A remotely-controlled robot, guided by Dr. Marescaux, carried out the procedure.

- **2002 - HemCon Medical Technologies Incorporated**, of Portland, Oregon, USA, invented Chitosan Bandages. Chitosan is a substance found in the shells of crabs, shrimps and other crustaceans. They have been used extensively by the American army in Iraq and have been shown to save many lives. Chitosan bandages seal massive bleeding wounds amazingly quickly, in most cases within 30 seconds. The positively charged chitosan material bonds with red blood cells, forming an artificial clot which stops bleeding. HemCon scientists pointed out that chitosan derives its superiority from nature.
- **2005 - A partial face transplant** was performed by Jean-Michel Dubernard, a French transplant specialist. The partial face transplant was carried out on Isabelle Dinoire, whose face had been very badly mauled by a dog. Dubernard had been a Deputy in the French National Assembly.
- **2006 - Gardasil became the first HPV vaccine** to be approved by the US FDA; by the end of 2007 it was approved in 80 countries, according to Merck & Co. In 2009, GSK's (GlaxoSmithKline's) Cervarix (another HPV vaccine) was approved by the FDA.
- **2007 - A bionic eye (a visual prosthetic)**, the Argus II Retinal Stimulation System, was created. It provides visual function to blind patients with severe to profound retinitis pigmentosa. Dr. Robert Greenberg of Second Sight Medical Products Inc., Drs. Mark Humayun, and Eugene DeJuan at the Doheny Eye Institute (USC), and Dr. Wentai Liu at University of California, Santa Cruz, invented the original prototype api-retinal prosthesis. The first generation implant consisted of 16 electrodes and was implanted in 6 completely blind volunteers. After implantation, they were able to perform a surprising number of tasks. A trial of its second generation, 60 electrode implant, called Argus II, was started in 2007 in Europe and the United States. Thirty volunteers took part in the studies which spanned 10 sites in four countries.

Argus II was approved in Europe, and the product was launched in 2011.

- **2010** - [the first full face transplant](#) was carried out by Spanish doctors on a male adult who had injured himself in a shooting accident five years previously. The patient had been left unable to breathe or swallow as a result of the accident. The 20-hour operation was performed by a team of 30 doctors, led by Dr Joan Pere Barret, at Vall d'Hebron University Hospital, Barcelona, Spain.

In March 2011, Dallas Wiens [underwent a full face transplant](#) at Brigham and Women's Hospital, Boston, USA; the first such procedure ever in the USA. Wiens had had his face severely disfigured in a power line accident. The 30-strong medical team, led by Bohdan Pomahac, replaced the patient's nose, lips, facial skin, movement muscles and nerves.

In March 2012, [the largest face transplant ever](#) was successfully performed at the R. Adams Cowley Shock Trauma Center at the University of Maryland Medical Center, USA. The 36-hour operation, led by Eduardo D. Rodriguez, replaced the entire face, including tongue, both jaws and teeth of Lee Norris, a 37-year old male who had been severely injured in a gun accident.

Targeted Cancer Therapy - seen as a major advancement in cancer treatment. Cancer treatment had focused on destroying rapidly dividing cells, which also destroyed a number of healthy rapidly-dividing cells. Cancer patients had to endure some extremely unpleasant side effects from radiation therapy and chemotherapy because of this.

Targeted cancer therapies focus just on specific molecules; the ones that cause tumors to grow. Only the cancer cells are hunted down, resulting in considerably less damage to healthy cells, and subsequently fewer and less severe side effects.

At the moment, this technology is only effective for some forms of cancer. However, experts are sure that eventually most cancers will be effectively treated with Targeted Cancer Therapy.

Anti-smoking legislation - several countries, initially in Western Europe and North America introduced legislation forbidding smoking in public places. Despite resistance from the smoking lobby and organizations representing bars and restaurants, there has been a considerable drop in national smoking rates in several countries, as well as non-smokers' exposure to second-hand smoke (passive smoking).

A Scottish study found that since the country introduced a national [comprehensive smoke-free legislation, rates of preterm deliveries and small-for-date infants have fallen dramatically](#).

[A European study](#) found that smoking bans may even encourage smokers to consume fewer cigarettes at home.

HIV survival extended with combination drug therapy - a 20-year-old AIDS patient in 1996 had an expected survival time of three to five years, today he/she is expected to live till the age of 69 years (average). This is thanks to the introduction of HAART (highly active retroviral therapy), a combination therapy, which has turned HIV/AIDS from a deadly disease into a serious but chronic one with good long-term survival.

Combination drug therapy has also improved treatment outcomes for patients with cancer, heart disease and other illnesses.

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