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A.G. Kalinin, V.A. Postoev

History of Medicine and Public Health

Training manual

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The publication is intended for self study of students in practical classes and in extracurricular time.

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Министерства здравоохранения Российской Федерации

А.Г. Калинин, В.А. Постоев

История медицины и общественного здравоохранения

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Учебное пособие подготовлено на кафедре общественного здоровья, здравоохранения и социальной работы ФГБОУ ВО СГМУ (г. Архангельск) Минздрава России в соответствии с образовательными программами высшего образования и рабочими программами дисциплины «История медицины» для обучающихся по направлению подготовки 31.05.01 «Лечебное дело» (международный факультет врача общей практики). Состоит из 17 разделов, содержит материал для самостоятельной работы по всем разделам изучаемой дисциплины.

Издание предназначено для самостоятельной работы обучающихся на практических занятиях и во внеаудиторное время.

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Content

The Northern State Medical University.
The history of our University: from Arkhangelsk state medical institute to world-famous University

Dear reader! We are glad to welcome you as a student at Northern State Medical University, one of the most famous and northernmost medical University in Russia. Before you get to know the basics of the history of medicine as a science, we consider introducing you with history of our University in general and International Faculty of General Practitioners.

Northern State Medical University (NSMU) was founded in 1932 as Arkhangelsk State medical institute (ASMI). The first director of the ASMI was Mikhail Yurjevich Krivitsky. The first graduation of doctors took place in 1937, and the first defenses of candidate thesis by the lecturers at the institute were in 1938 by G.A. Orlov and G.F. Nikolaev.

Arkhangelsk State medical Institute in 1937

According to the results of the spring examination session in 1939, the ASMI was ranked as the first among the medical universities of the RSFSR and the third place among the medical universities of the Soviet Union.

In 1994, the ASMI was transformed into the Arkhangelsk State Medical Academy (ASMA), and in 2000 - into the Northern State Medical University (NSMU).

The rectors of the Institute-Academia-University:

M.Yu. Krivitsky (1932-36)

P.L. Rappoport (1936-40)

P.P. Erofeev (1940-47)

S.N. Guildenskiold (1947-52)

I.N. Matochkin (1952-53)

A.A. Kirov (1953-61)

I.G. Chernetsov (1961-63)

V.D. Dyshlova (1963-65)

N.P. Bychikhin (1965-87)

V.A. Kudryavtsev (1988-93)

P.I. Sidorov (1993-2012)

L.N. Gorbatova (2014).

During the period of its existence, NSMU has passed a long and difficult path of formation and development, having trained more than twenty-five thousand doctors not only for the European North, but also for other regions of Russia, presenting outstanding scientists to the country who have enriched domestic and world medical science and practice with many achievements. Once a small provincial institute has grown into a major medical educational and scientific center of the European North of Russia.

The university staff is rightfully proud of its rich history. The first professors at the Arkhangelsk Medical Institute were unique specialists, personalities with remarkable professional and human qualities. Among them, the head of the Department of Obstetrics and Gynecology, Professor V.V. Preobrazhensky. There is an assumption that he might be the prototype of Professor F.F. Preobrazhensky from «A Dog's Heart». Like the hero of M. Bulgakov, Vasily Vasilyevich was an experimenter, the main topics of his research were in the field of human anatomy, histology, experimental physiology, and genetics.

Professor D.V. Nikitin who was the first head of the Department of Infectious Diseases was the family physician of L.N. Tolstoy. In 1933, this highly educated and devoted man was exiled from Moscow to Arkhangelsk, where he had worked as a doctor, and later headed the department in ASMI.

Another talented graduate of the University is N.M. Amosov who was a pivot of cardiovascular surgery in our country. Nikolai Mikhailovich graduated with honors from the Arkhangelsk State Medical Institute in 1939.

The outstanding ophthalmologist S.N. Fedorov was a head of the Department of Eye Diseases in 1961-1967. Svyatoslav Nikolaevich was the first in the Soviet Union who began original research on replacing altered eye lens with an artificial one made of plastic. A great contribution to the development of space medicine was made by graduates of the Arkhangelsk Medical Institute, Professor N.M. Rudny, I.I. Kasyan, N.A. Razolov.

At all stages of history, Arkhangelsk medical scientists have solved and continue to solve urgent problems in the field of medical education, science, and practice. Even during the difficult years of the Great Patriotic War, the Institute trained 912 doctors for the needs of the front using the shortened training program.

It is no coincidence that in 1982, by the Decree of the Presidium of the Supreme Soviet of the USSR, the Arkhangelsk State Medical Institute was awarded the Order of the Red Banner of Labor. Later, in 2007, by order of the President of the Russian Federation, official gratitude was announced to the staff of the Northern State Medical University for many years of fruitful scientific, pedagogical and medical activities.

NSMU is the leader of medical science and education in the European North of Russia, the central university of the de facto existing Northern Medical University District, which includes the Arkhangelsk, Murmansk, Vologda regions, the Nenets Autonomous District, the republics of Komi and Karelia. It is NSMU that plays a leading role in the implementation of regional policy in the field of medical education and science. Within the framework of continuing medical education, the university provides training at pre-university, undergraduate, postgraduate, and additional professional levels. The recognition of the quality of training of medical personnel is evidenced by the fact that the university is in the top ten in the rating of 55 medical universities. In 2007 NSMU became a winner, and in 2008 - a laureate of the competition «Quality system for training graduates of educational institutions of vocational education.» In 2016, the Northern State Medical University became the winner of the regional competition «Property of the North».

Today NSMU is a world-famous scientific and educational complex, that combine high-level of theoretical and practical training with and applied science in the European North of Russia. The historically accumulated experience, the created infrastructure of the NSMU, the qualifications of the staff, the scale of scientific and teaching activities makes our university one of the leading in the field of higher medical education and science. All activities of the University are aimed at training highly qualified medical personnel and maintaining the health of the population. NSMU currently hosts about 9000 students from 17 countries at 16 faculties and institutes. There are 80 Professors and 250 Candidate of Science among teaching staff, 15 of them obtained international degrees Doctor of Medicine and Philosophy Doctor from European Universities.

University buildings are provided with up-to-date equipment: computers, films, video aids, and other modern appliances. University has modern simulation center there a plenty of state-of-the-art medical mannequins and simulation training equipment are presented.

International students at the Simulation Center of NSMU

A half of all departments at NSMU are situated at the best hospitals of the city. Well equipped clinical bases allow training highly qualified specialists of different profiles according to modern requirements of the health care systems. Today NSMU is the main medical training center not only for Northern Russia. More than 300 graduates of NSMU are working abroad (India, Nigeria, Egypt, Peru, Thailand, USA, UK, Canada, Israel, Norway, Sweden, Finland, Germany, Netherlands, Denmark), about 30 graduates are preparing their PhD now in Norway, Sweden, Finland and Germany [1].

Northern State Medical University nowadays (NSNU)

The International Faculty of General Practitioners is one of the largest faculties of the Northern State Medical University. Foreign citizens study here in the specialty «General Medicine».

The history of the International Faculty is very interesting. The first foreign students were 13 people from India, who, after a year's course at the preparatory faculty, studied together with Russian students at the medical faculty. The Department of Public Health, Health Care and Social Work actively participated not only in teaching disciplines to foreign students, but also assist them in adaptation in Russian North. For example, the first curator of foreign students was A.L. Sannikov.

In 1994-1995, 50 people studied at the international faculty. In the same year, the Department of Russian as a Foreign Language was established at the NSMU. During this period, foreign students actively participated in the life of the University. In 1999, the Council of Foreign Students began its work, for example, the Council attracted foreigners to participate in the international television festival «Bravo, Student!» in the city of Severodvinsk and the 1st International Festival of Students of the Nordic countries.

In March 1999, the dean of the preparatory faculty of the AGMA A.G. Kalinin, who later became the first dean of the International Faculty of General Practitioners, made a working trip to Nigeria. As a result of this trip NSMU got the first bench of students from Nigeria. There were 14 of them at the first time, but every year the number of representatives from Nigeria and other African countries increased.

The independent faculty for foreign students was established in 2000, when export of education became continuous. Among the students were citizens of India, Paki stan, Thailand, Syria, Nigeria, Uganda, Ghana, Sudan, Somalia, Peru. The education process was done in Russian that time, so students had to study Russian for the one year at co-called "preparatory faculty" in addition to six-year medical training.

Delegation of Republic of India with international students of NSMU

Since 2007, the university have been starting to provide fully English-speaking medical education for foreign students. Representatives of different countries (for example, Thailand, Nigeria, Ghana) still study here, but the majority are residents of India.

The faculty is growing and developing now, there are more 1200 students at the faculty now and it is considered as the largest Faculty at the NSMU. He plays an important role in the life of the university. It has its own traditions: Faculty Day, days of Indian national holidays at NSMU, cricket competitions. Foreign citizens actively defend the sports honor of the university in basketball and volleyball.

But the main thing is that more and more students are participating in scientific work. They take part in the international youth forum «Medicine of the Future for the Arctic» and special international scientific symposium «Medicine in English» has been organized for them.

History of medicine in Ancient India and Ancient China. Homeopathy. Ayurveda, Siddha and Unani systems of medicine. Sushruta as a father of Indian surgery

ANCIENT INDIAN MEDICINE. Prehistoric times: This is the period pertaining to all peoples of the Indian subcontinent from the Stone Age to the time when written history begins in the third and second millenia B.C. with the Indus Valley civilization. The script of those times is yet to be deciphered. With the Aryan Invasion of India about 1500 B.C., the Vedic period of the Indian system of medicine may be said to have begun. Thus, the origin of the Indian system of medicine goes back to several centuries before the birth of Christ. From time immemorial religious and other teachings and philosophy of life propounded by the ancients of the Indian sub-continent are contained in the earliest sacred books of unknown antiquity, called the Vedas. The Vedas are four in number, viz. Rigveda, Samaveda, Yajurveda and Atharvaveda. They were handed down by teachers to pupils by word of mouth throughout the ages. The teachers were enlightened sages called Rishis and their teachings are believed to be words of God expressed through these Rishis. The Indian system of medicine is said to have roots in the Vedas.

The main part of the Vedas are the samhits collections of mantras, as well as the brahmanas, aranyakas and Upanishads — texts that are commentaries on the Vedic samhits: Rig-Veda — «Veda of hymns", Ayur-Veda - «Veda of sacrificial formulas", Sama-Veda — «Veda of chants", Atharva-Veda - « Veda of spells".

The term Ayurveda was given to the ancient Indian system of medical sciences, which literally means knowledge of life. Ayurveda is strictly not a Veda like the four Vedas. The origin of Ayurveda is also uncertain. This is believed to have a divine origin, and there are different versions as to how they were divinely revealed to the ancient sages. The Ayurveda is considered to be a branch of the fourth Veda, the Atharvaveda.

To explain more clearly, Ayurveda is the Vedic system of holistic medicine. It has become quite popular in the West and is continuing to gain ground and acceptance. Acharya Charaka has been called the father of medicine, known most for his work, the Charaka Samhita, which is like the encyclopedia of Ayurveda. What he covers still hold its value even after three millennium. These include human anatomy, embryology, pharmacology, circulation, and diseases, such as diabetes, tuberculosis, heart problems, etc. Ayurveda is traditionally divided into eight branches, according to Charaka, which are: 1. Sutra-sthana, general principles, 2. Nidama-sthana, pathology, 3. Vimana-sthana, diagnostics, 4. Sharana-sthana, physiology and anatomy, 5. Indriya-sthana, prognosis, 6. Chikitsa-sthana, therapeutics, 7. Kalpa-sthana, pharmacy, and 8. Siddhi-sthana, successful treatment.

Vedic texts contain references to various diseases of the eyes, ears, heart, stomach, lungs, skin, muscles, and nervous system. About 300 different parts and organs of the human body are listed. Sudden illness is considered a manifestation of the evil principle, coming either from demons, or from worms that penetrate the body. Great importance is attached to the diet, with a special place in the dietary requirements are milk, honey and rice. Later medical writings called milk a sacred drink that preserved a person's strength and mind, and protected them from diseases.

Honey has traditionally been part of prescriptions for medicines that cure many diseases. It was considered the main antidote for poisoning with mineral, plant and animal poisons. Extracts of medicinal plants were often used for the preparation of medicines. The healing properties of Indian medicines prepared on the basis of plants were known far beyond the borders of Ancient India: they were transported by sea and land trade routes to the Mediterranean, Central Asia and China, and to many other countries of the Ancient world. The best medicinal plants were brought from the Himalayas.

Sushruta was another noted physician who greatly developed the Vedic system of medicine. He had been a professor of medicine in the University of Benares nearly 3000 years ago, and wrote his Sushruta Samhita in Sanskrit, a process of diagnosis and therapy, which had been given to him by his teacher, known as Divodas Dhanvantari. Two other authorities appeared later, which were Vagbhata, who was present in Sindha about two centuries before Christ, and Madhava, who appeared in Kishkindha in Andhra in the 12 th century. There is a Sanskrit verse which explains, "Madhava is unrivaled in diagnosis, Vagbhata in principles and practice of medicine, Sushruta in surgery, and Charaka in therapeutics." It is known that the Arabs and Persians translated the knowledge of Sushruta and Charaka into their own language in the eighth century BC.

It should be understood, however, that many surgeons were known in India before Shusruta, but he was the one who compiled the knowledge which came from the teachings of Divodas Dhanvantari, who had been king of Kashi according to the Sushruta Samhita. Panini, said to have appeared around 800 BCE according to historians, mentions both Charaka and Sushruta, so they had to have appeared sometime before that. This means the dates that are generally accepted for their appearances, as previously listed, are too late and not accurate.

Medicines used by Indian medicine were prepared from products of plant, mineral and animal origin. Precious metals played an important role in the art of healing. The composition of ointments often included zinc, lead, sulfur, antimony, and ammonia, but mercury and its salts were most often used. The widespread use of mercury in ancient Indian medicine was associated with a high level of development of alchemy. The combination of mercury and sulfur was to open the way to the elixir of immortality. alchemical information was mainly contained in medical texts.

Charaka and *Sushruta* the most outstanding doctors of ancient India. The treatise "Charaka-Samhita" belongs to Charaka. Much attention in this essay is paid to the diagnosis of the disease: the doctor had to take into account the age of the patient, his physical characteristics, living conditions, habits, profession, nutrition, climate and terrain. It was necessary to carefully examine the urine and secretions of the body, to check the sensitivity to various stimuli, muscle strength, voice, memory, pulse. "Charaka-Samhita" mentions such cases when it is necessary to study a drop of blood taken from a patient, and also describes methods of active influence on the body in order to exacerbate the disease for a short time to identify its symptoms.

Medical treatises of Ancient India Surgery is a field of medical art in which India surpassed many countries of the Ancient world. Sushruta called surgery "the first and best of all medical Sciences, a precious work of heaven and a sure source of glory". He described more than 300 operations, more than 120 medical instruments, and more than 650 medicines. The anatomical knowledge of doctors in Ancient India can be judged by the fact that the works of Sushruta listed 300 bones, 500 muscles, more than 700 vessels and about 100 joints. Ancient doctors were able to restore noses, lips, and ears that had been lost or maimed in battle or by a court order. In this field, Indian surgery was ahead of European surgery until the 18-th century. European surgeons learned from the Indians the art of rhinoplasty (from Greek. "rhinos" - nose) - restoration of the lost nose. This method is described in detail in the treatise of Sushruta and went down in the history of medicine as the "Indian method": the nose was restored using a flap of skin cut from the forehead or cheek.

ANCIENT CHINEASE MEDICINE. One of the first Chinese healers, who lived about five thousand years ago, is considered to be the mythical Emperor Shen Nong, who used to treat all sorts of herbs. According to legend, he made a description of about 70 poisons and antidotes, died at the age of 140 years and became after death the deity of apothecaries. He is considered the author of one of the oldest in the world "Canon of roots and herbs", containing a description of 365 medicinal plants.

The forest dweller, the God of longevity, Shou-sin, who sends long years of life unshadowed by disease, also prepared medicines from plants. His constant companion was a stag, who conferred high rank and a large salary. For the treatment of disease is also applied to numerous substances of animal origin and minerals.

Chinese medicine is rooted in the deep past and is associated with the ancient philosophy that there is a Great Triad: "Heaven-Man-Earth". The unity of the two principles — Earth and Sky (Yin and Yang) - is the source of all things in the Universe, their combination and interaction determine the alternation of cosmic phenomena. Yin is the feminine principle, its qualities are sinking, falling, and rest. Yang is masculine, and its qualities are swimming, lifting, and moving.

The entire system of relationships between man and the Universe was taken into account by Chinese doctors when prescribing methods for treating diseases and making medicines. A large role was played by the system of magic numbers, a special place among which belongs to the number 5. The five elements corresponded to the teaching of the five categories of human character, the five temperaments. Five plants fed human strength and health: rice, millet, barley, wheat, and soybeans.

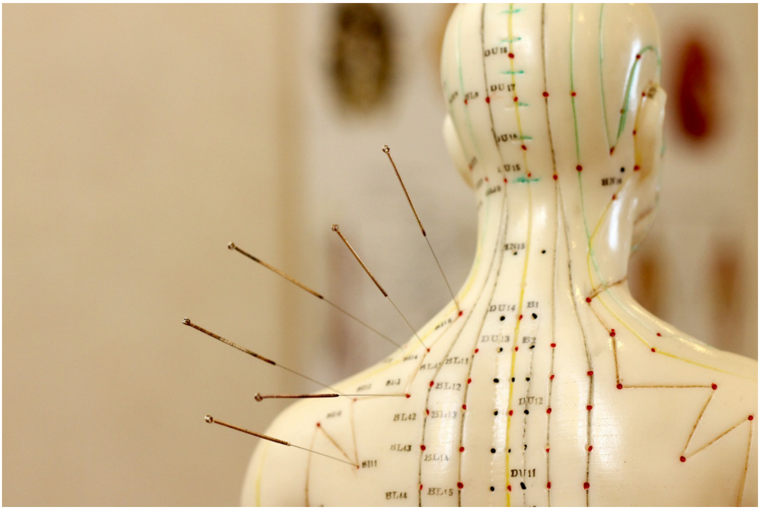
The movements of Chinese gymnastics were likened to "games of five animals" - a lion, a deer, a bear, a monkey and a bird. Recipes for medicinal plants were made in such a way that they achieved the correct combination of five flavors. Folk medicine associated the appearance of diseases with the influence of evil spirits, embodied in the images of animals. The number of them was often determined by the magic number 5.

Ancient Chinese method of diagnostic and treatment. *Acupuncture*. Tradition connects the appearance of acupuncture with the name of the famous sage Fu-si, who lived at the beginning of the third Millennium BC. Tradition attributes to him the first observation of the heavenly bodies and the invention of the doctrine of Yin and Yang — the two principles of all things in the Universe.

The first needles were made of stone. Later they began to make them from silicon or Jasper, from bone and bamboo, from metals: bronze, silver, gold, platinum, stainless steel. There were 9 forms of needles; among them were cylindrical, flat, round, triangular, lance-shaped, needles with a sharp and blunt end.

These needles were intended not only for acupuncture, they also served as surgical tools.

Moxibustion. The active points were affected not only by acupuncture, but also by moxibustion. This method is sometimes referred to in Chinese literature under such poetic names as " the wonderful needle with a thun-



Acupuncture

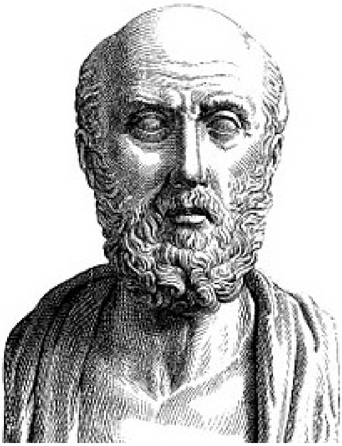
der burn “or” night hunting with torches”. In the old days, it was believed that cauterization should cause a burn. “Irritation from the outside, effect inside” - says an old Chinese proverb. Moxibustion was performed with a hot metal stick, lit sulfur powder, crushed garlic pieces. Modern doctors usually use Moxa (wormwood) for treatment, which gives only a pleasant warmth when smoldering.

Pulse diagnostic. One of the great achievements of doctors in Ancient China is the idea of the circular movement of blood. In the “Canon of the inner” it is said that the heart continuously drives blood in a circle, and the doctor can judge the movement of blood by the pulse. “The pulse is the inner essence of a hundred parts of the body and the most subtle expression of the inner spirit” Chinese doctors distinguished more than 20 types of pulse. They came to the conclusion that every organ and every process in the body has its own expression in the pulse, and by changing the pulse at several points, you can not only determine a person’s disease, but also predict its outcome. This doctrine is set forth in the” Canon of the pulse “ (III century ad).The founder of pulse diagnostics in China is the famous philosopher and doctor bian Qiao (VI century BC).

Medicine in the Ancient Greece and Rome Impair

In ancient Greek medicine illness was initially regarded as a divine punishment and healing as, quite literally, a gift from the gods. However, by the 5th century BCE, there were attempts to identify the material causes for illnesses rather than spiritual ones and this led to a move away from superstition towards scientific enquiry, although, in reality, the two would never be wholly separated. Greek medical practitioners, then, began to take a greater interest in the body itself and to explore the connection between cause and effect, the relation of symptoms to the illness itself and the success or failure of various treatments. Greek medicine was not a uniform body of knowledge and practice but rather a diverse collection of methods and beliefs which depended on such general factors as geography and time period and more specific factors such as local traditions and a patient›s gender and social class. Nevertheless, common threads running through Greek medical thought included a preoccupation with the positive and negative effects of diet and a belief that the patient could actually do something about their complaint, in contrast to a more fatalistic and spiritual mindset of earlier times. However, the distinction between the spiritual and physical worlds are often blurred in Greek medicine, for example, the god Asclepius was considered a dispenser of healing but also a highly skilled practical doctor. The god was called upon by patients at his various sanctuaries (notably Epidaurus) to give the patient advice through dreams which the site practitioners could then act upon. Grateful patients at the site often left monuments which reveal some of the problems that needed to be treated, they include blindness, worms, lameness, snakebites and aphasia. As Epidaurus illustrates, there could, then, be both a divine and a physical cause or remedy for illnesses.

Lifestyle and such factors as heat, cold and trauma were discovered to be important factors in people's health and they could alleviate or worsen the symptoms of an illness or the illness itself. It was also recognized that a person's physical constitution could also affect the severity of, or susceptibility to, an illness. There was also a growing belief that a better understanding of the causes of an illness' symptoms could help in the fight against the illness itself. With a greater knowledge of the body there also came a belief that the balance of the various fluids (humors) within



it could be a factor in causing illness. So too, the observation of symptoms and their variations became a preoccupation of the Greek doctor [2].

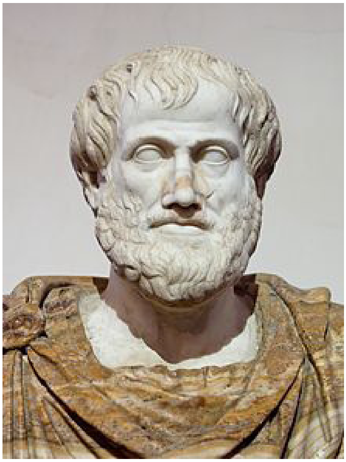
Hippocrates of Kos (c. 460 – c. 370 BC), also known as Hippocrates II , was a Greek physician, who is considered one of the most outstanding figures in the history of medicine. He is often referred to as the ”Father of Medicine”.

He became known as the founder of medicine and was regarded as the greatest physician of his time. He based his medical practice on observations and on the study of the human body. He held the belief that illness had a physical and a rational explanation.

The most famous of his supposed contributions is the Hippocratic Oath, which bears his name accordingly. It was this document that first proposed an ethical standard among doctors when doing their work. It brings up important concepts we still use today, such as doctor-patient confidentiality. Hippocrates philosophy also focused more on patient care and the “healing power of nature”. The idea was simple enough: nature, rather than the doctor, does the most healing. It is the job of the physician then, to not get in the way, but rather facilitate the recovery process with proper nutrition, cleanliness and sufficient rest.

Hippocrates held the belief that the body must be treated as a whole and not just a series of parts. He accurately described disease symptoms and was the first physician to accurately describe the symptoms of: pneumonia, epilepsy in children. He believed in the natural healing process of rest, a good diet, fresh air and cleanliness. He noted that there were individual differences in the severity of disease symptoms and that some individuals were better able to cope with their disease and illness than others. He was also the first physician that held the belief that thoughts, ideas, and feelings come from the brain and not the heart as others of his time believed.

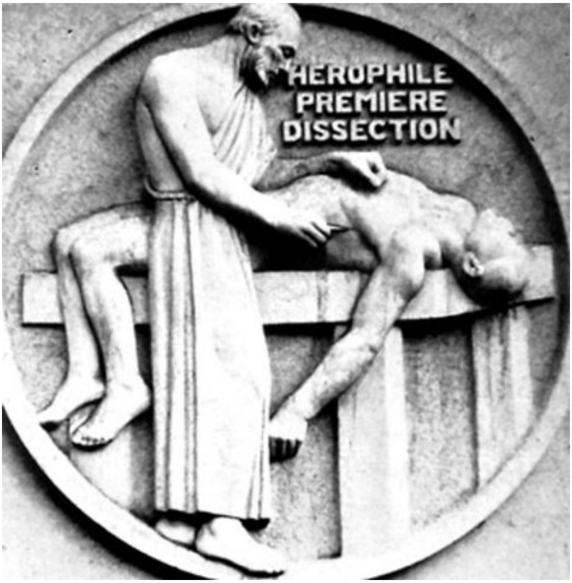
Aristotle (384–322 BC), Greek philosopher and polymath during the Classical period in Ancient Greece.



Aristotle studied almost every subject possible at the time and made significant contributions to most of them. He studied anatomy, astronomy, embryology, geography, geology, meteorology, physics and zoology. He also wrote on aesthetics, ethics, government, metaphysics, politics, economics, psychology, rhetoric and theology and studied education, foreign customs, literature and poetry. His combined works constitute a virtual encyclopedia of Greek knowledge, but his main contribution to the human mind is, no doubt, the introduction of the concept of "logic", where all natural phenomena and laws were to be based on common sense (if $A = B$ and if $B = C$, then $A = C$). The adoption of this principle in all areas of knowledge gave a strong boost to the human mind and continues to do so. Twenty-three hundred years after his death, Aristotle remains one of the most influential people who ever lived and leaves every scientist and philosopher in debt to his essential contribution to the scientific method.

Although he greatly loved medicine and probably even practiced it on occasion, Aristotle most distinguished himself in the field of biology. An avid natural historian who tirelessly studied and catalogued many species of plants and animals, Aristotle was the father of comparative anatomy and physiology, and of later theories of evolution and embryology. Aristotle›s personal philosophy and ethics center on the virtue of reason and the Golden Mean. Aristotle believed that the highest virtue that a man could have came from the proper exercise of his reason. He believed that all true happiness and morality came from adhering to the Golden Mean of moderation in all things. Aristotle›s most important contribution to the theory of Greek Medicine was his doctrine of the Four Basic Qualities: Hot, Cold, Wet, and Dry. Later philosopher-physicians would apply these qualities to characterize the Four Elements, Four Humors, and Four Temperaments. The Four Basic Qualities are the foundations for all notions of balance and homeostasis in Greek Medicine.

Herophilus, (c. 335 – c. 280 BC) the great anatomist of antiquity was a Greek physician and teacher in learning and studying of human anatomy through systematic *anatomical dissections* who made extraordinary anatomical discoveries.



He developed the theory of using the pulse as a form of diagnosis and introduced the use of experimental method to medicine.

Herophilos was a teacher, and an author of at least nine texts ranging from his book titled "On Pulses", which explored the flow of blood from the heart through the arteries, to his book titled "Midwifery", which discussed duration and phases of childbirth. In Alexandria, he practiced dissections, often publicly so that he could explain what he was doing to those who were fascinated.

Herophilus also introduced many of the scientific terms used to this day to describe anatomical phenomena. He was among the first to introduce the notion of conventional terminology, as opposed to use of “natural names”, using terms he created to describe the objects of study, naming them for the first time. A *confluence of sinuses* in the skull was originally named torcular Herophili after him. Torcular is a Latin translation of Herophilos’ label, ληνός - lenos, ‘wine vat’ or ‘wine press‘. He also named the *duodenum*, which is part of the small intestine.

Herophilus believed that physical exercises and a healthy diet were integral to the bodily health of an individual. Heroph**i**los once said that “When health is absent, wisdom cannot reveal itself, art cannot become manifest, strength cannot be exerted, wealth is useless, and reason is powerless”.

After the death of Herophilos in 280 BC, his anatomical findings lived on in the works of other important physicians, mostly **Galen**. Even though dissections were performed in the following centuries and medieval times, only a few insights were added. Dissecting with the purpose to gain knowledge about human anatomy started again in early modern times (Vesalius), more than 1600 years after Herophilos’ death.

Aelius Galenus
or Claudius Galenus
(129 AD – c. 200/c. 216)

Galen of Pergamon, was a Greek physician, surgeon and philosopher in the Roman Empire. Arguably the most accomplished of all medical researchers of antiquity, Galen influenced the development of various scientific disciplines, including anatomy, physiology, pathology, pharmacology, and neurology, as well as philosophy and logic .

Galen›s understanding of anatomy and medicine was principally influenced by the then-current theory of humorism (also known as the four humors – black bile, yellow bile, blood, and phlegm), as advanced by ancient Greek physicians such as Hippocrates. His theories dominated and influenced western medical science for more than 1,300 years. His anatomical reports, based mainly on dissection of monkeys, especially the Barbary macaque, and piggs, remained uncontested until 1543, when printed descriptions and illustrations of human dissections were published in the seminal work De humani corporis fabrica by Andreas Vesalius where Galen's physiological theory was accommodated to these new observations. Galen›s theory of the physiology of the circulatory system remained unchallenged until ca. 1242, when Ibn al-Nafis published his book Sharh tashrih al-qanun li' Ibn Sina (Commentary on Anatomy in Avicenna's Canon), in which he reported his discovery of the pulmonary circulation.

Galen saw himself as both a physician and a philosopher, as he wrote in his treatise entitled That the Best Physician Is Also a Philosopher. Galen was very interested in the debate between the rationalist and empiricist medical sects, and his use of direct observation, dissection and vivisection represents a complex middle ground between the extremes of those two viewpoints. Many of his works have been preserved and/or translated from the original Greek, although many were destroyed and some credited to him are believed to be spurious.

In his work *De motu musculorum*, Galen explained the difference between motor and sensory nerves, discussed the concept of musle tone, and explained the difference between agonists and antagonists. Galen was a skilled surgeon, operating on human patients. Many of his procedures and techniques would not be used again for centuries, such as the procedures he performed on brains and eyes. To correct cataracts in patients, Galen performed an operation similar to a modern one. Using a needle-shaped instrument, Galen attempted to remove the cataract-affected lens of the eye. His surgical experiments included legating the arteries of living animals. Although many 20th century historians have claimed that Galen believed the lens to be in the exact center of the eye, Galen actually understood that the crystalline lens is located in the anterior aspect of the human eye. At first reluctantly but then with increasing vigor, Galen promoted Hippocratic teaching, including venesection and bloodletting, then unknown in Rome. This was sharply criticised by the Eristratus, who predicted dire outcomes, believing that it was not blood but pneama that flowed in the veins. Galen, however, staunchly defended venesection in his three books on the subject and in his demonstrations and public disputations.

Medicine of Arab Caliphate. Avicenna. Canon of medicine

The Islamic Golden Age, spanning the 8^{th} to the 15^{th} Centuries, saw many great advances in science, as Islamic scholars gathered knowledge from across the known world and added their own findings. One of these important fields was Islamic medicine, which saw medical practice begin to resemble our modern systems. Certainly, this period of the history of medicine was centuries ahead of Europe, still embedded in the Dark Ages [3].

Middle Eastern medicine preserved, systematized and developed the medical knowledge of classical antiquity, including the major traditions of Hippocrates, Galen and Dioscorides [4]. During the post-classical era, Middle Eastern medicine was the most advanced in the world, integrating concepts of ancient Greek, Roman, Mesopotamian and Persian medicine as well as the ancient Indian tradition of Ayurveda, while making numerous advances and innovations. Islamic medicine, along with knowledge of classical medicine, was later adopted in the medieval medicine of Western Europe, after European physicians became familiar with Islamic medical authors during the Renaissance of the 12th century [5]. Medieval Middle Eastern physicians largely retained their authority until the rise of medicine as a part of the natural sciences, beginning with the Age of Enlightenment, nearly six hundred years after their textbooks were opened by many people. Aspects of their writings remain of interest to physicians even today [6].

Ibn Sina also known as Abu Ali Sina and often known in the West as **Avicenna** c. 980 – June 1037), was a Persian polymath who is regarded as one of the most significant physicians, astronomers, thinkers and writers of the Islamic Golden Age and the father of early modern medicine**.** Avicenna is also called "the most influential philosopher of the pre-modern era". He was a Peripatetic philosopher influenced by Aristotelian philosophy. Of the 450 works he is believed to have written, 274 have survived, including 150 on philosophy and 40 on medicine.

According to his autobiography, Avicenna had memorized the entire Quran by the age of 10. He learned Indian arithmetic from an Indian greengrocer, Mahmoud Massahi and he began to learn more from a wandering scholar who gained a livelihood by curing the sick and teaching the young. He also studied Fiqh (Islamic jurisprudence) under the Sunni Hanafi scholar Ismail al-Zahid. Avicenna was taught some extent of philosophy books such as Introduction (Isagoge)'s Porphyry (philosopher), Euclid's Elements, Ptolemy's Almagest by an unpopular philosopher, Abu Abdullah Nateli, who claimed philosophizing.

As a teenager, he was greatly troubled by the *Metaphysics* of Aristotle, which he could not understand until he read al-Farabi's commentary on the work. For the next year and a half, he studied philosophy, in which he encountered greater obstacles. In such moments of baffled inquiry, he would leave his books, perform the requisite ablutions, then go to the mosque, and continue in prayer till light broke on his difficulties. Deep into the night, he would continue his studies, and even in his dreams problems would pursue him and work out their solution. Forty times, it is said, he read through the *Metaphysics* of Aristotle, till the words were imprinted on his memory; but their meaning was hopelessly obscure to him until he purchased a brief commentary by al-Farabi from a bookstall for three dirh**a**ms (a very low price at the time). So great was his joy at the discovery, made with the help of a work from which he had expected only mystery, that he hastened to return thanks to God, and bestowed alms upon the poor.

Avicenna authored *The Book on Healing* and a medical encyclopedia *The C**a**non of Medicine* (*Al-Qanun fi›t-Tibb*). It was used as the standard medical textbook in the Islamic world and Europe up to the 18th century. The *Canon* still plays an important role in Un**a**ni medicine. The Canon of Medicine (Arabic: القانون في الطب‎ *al-Qānūn fī al-Ṭibb*; Persian: قانون در طب) is an encyclopedia of medicine in five books compiled by Avicenna (Ibn Sina) and completed in 1025. It presents an overview of the contemporary medical knowledge of the Islamic world, which had been influenced by earlier traditions including Greco-Roman medicine (particularly Galen), Persian medicine, Chinese medicine and Indian medicine.

The Canon of Medicine is divided into five books:

- Essays on basic medical and physiological principles, anatomy, regimen and general therapeutic procedures.

- List of medical substances, arranged alphabetically, following an essay on their general properties.
- Diagnosis and treatment of diseases specific to one part of the body
- Diagnosis and treatment of conditions covering multiple body parts or the entire body.
- Formulary of compound remedies.

Books 1, 3, and 4 are each further divided into parts (*fanns)*, chapters (*ta'līms),* subchapters (*jumlahs)*, sections (*faṣls*), and subsections (*bābs*).

Al-Biruni. He wrote capital work "Pharmacognosy (China as-Saydina") and made description of 107 medicines of mineral origin, 101 - animal, 950 - vegetable.

Aven-Zohar (Abu-Mervan Ibn-Zuhr believed that in practice it is necessary to be based not on authority, but on one's own experience. In an experiment on animals, Avenzoar studied tracheotomy, recommended that if necessary, a probe through the esophagus and nutritional enemas be used for artificial nutrition.

Averroes (Ibn Rushd), an outstanding mathematician, philosopher and doctor. He left a treatise of 7 books, in which he described feverish and eye diseases, he paid special attention to the retina. In his writings, he held the view of the eternity of matter and motion (because in the East and West he was considered a heretic).

Ibn al-Haysam was the first to explain the refraction of rays in the medium of the eyegave names to parts of the eye (cornea, lens, vitreous body, etc.). He made models of the lens from crystal and glass, he put forward the idea of correcting vision using biconvex lenses. Kit - kit " treatise on optics "("Kitab al-manazir") made his name famous in the countries of Eastern and Western Europe. The Arabic original of the book has not been preserved (there is a Latin translation — "opticae Thesaurus alhazeni arabis").

Ammar Ibn Ali al-Mausili a famous eye doctor in Cairo. He developed an operation to remove cataracts by sucking out the lens using a hollow needle he invented ("Ammar's operation").

Ibn an-Nafis. Anatomist and surgeon. He described the pulmonary circulation three centuries earlier than Miguel Servet and made comments on the section of anatomy in the" Canon " of Ibn Sina.

Abu'l-Qasim Khalaf Ibn ' AB-bas al-Zahrawi. Anatomist and surgeon. He found the link between ancient medicine and medicine of the European Renaissance. The criterion of truth for him was his own observations and his own surgical practice. Priorities in his practice: use of catgut in abdominal surgery and for subcutaneous sutures, seam with a snail and two needles, use of the supine position in operations on the pelvis. described what is now called a tuberculous bone lesion. He introduced cataract removal surgery (the term AZ-Zahrawi) into Western eye surgery. He was the author of new surgical instruments (more than 150) and the only author of antiquity and the early middle ages who described them and presented them in drawings.

Medieval Medicine of Western Europe

Medieval medicine in Western Europe was composed of a mixture of existing ideas from antiquity, spiritual influences and what *Claude Lévi-Strauss* identifies as the "shamanistic complex" and "social consensus". In this era, there was no tradition of scientific medicine, and observations went hand-in-hand with spiritual influences.

In the Early Middle Ages, following the fall of the Roman Empire, standard medical knowledge was based mainly upon surviving Greek and Roman texts, preserved in monasteries and elsewhere. Ideas about the origin and treatment of disease were not, however, purely secular, but were also based on a world view in which factors such as destiny, sin, and astral influences played as great a part as any physical cause. The efficacy of treatment was similarly bound in the beliefs of patient and doctor rather than empirical evidence, so that *remedia physicalia* (physical remedies) were often connected to spiritual intervention.

Medicine in the Middle Ages had its roots in *pagan* and *folk* practices. This influence was highlighted by the interaction between Christian theologians who adopted aspects of pagan and folk practices and chronicled them in their own works. The practices adopted by Christian medical practitioners around the 2nd century, and their attitudes toward pagan and folk traditions, reflected an understanding of these practices, especially *humoralism* and *herbalism*. The practice of medicine in the early Middle

Ages was emperical and pragmatic. It focused mainly on curing disease rather than discovering the cause of diseases. Often it was believed the cause of disease was supernatural. Nevertheless, secular approaches to curing diseases existed.

People in the Middle Ages understood medicine by adopting the ancient Greek medical theory of humors. Since it was clear that the fertility of the earth depended on the proper balance of the elements, it followed that the same was true for the body, within which the various humors had to be in balance. This approach greatly influenced medical theory throughout the Middle Ages.

Folk medicine of the Middle Ages dealt with the use of herbal remedies for ailments. The practice of keeping gardens teeming with various herbs with medicinal properties was influenced by the gardens of Roman antiquity. Many early medieval manuscripts have been noted for containing practical descriptions for the use of herbal remedies. These texts, such as the Pseudo-Apuleius, included illustrations of various plants that would have been easily identifiable and familiar to Europeans at the time. Monasteries later became centers of medical practice in the Middle Ages, and carried on the tradition of maintaining medicinal gardens. These gardens became specialized and capable of maintaining plants from Southern Hemisphere as well as maintaining plants during winter.

Pseudo-Apuleius Herbarius or Herbarium Apuleii Platonici.

Pseudo-Apuleius is the name given in modern scholarship to the author of a 4th-century herbal known as *Pseudo-Apuleius Herbarius* or *Herbarium Apuleii Platonici*.

Until the twelfth century it was the most influential herbal in Europe, with numerous extant copies surviving into the modern era, along with several copies of an Old English translation.

The Monastery medicine. A monastery is a building or complex of buildings comprising the domestic quarters and workplaces of monastics, monks or nuns, whether living in communities or alone (hermits). A monastery generally includes a place reserved for prayer which may be a chapel, church, or temple, and may also serve as an oratory. Monasteries developed not only as spiritual centers, but also centers of intellectual learning and medical practice. Locations of the monasteries were isolated and designed to be self-sufficient, which required the monastic inhabitants to produce their own food and also care for their sick. Prior to the development of hospitals, people from the surrounding towns looked to the monasteries for help with their sick.

A combination of both spiritual and natural healing was used to treat the sick. Herbal remedies, known as Herbals, along with prayer and other religious rituals were used in treatment by the monks and nuns of the monasteries. Herbs were seen by the monks and nuns as one of God's creations for the natural aid that contributed to the spiritual healing of the sick individual. An herbal textual tradition also developed in the medieval monasteries. Older herbal Latin texts were translated and also expanded in the monasteries. The monks and nuns reorganized older texts so that they could be utilized more efficiently, adding a table of contents for example to help find information quickly. Not only did they reorganize existing texts, but they also added or eliminated information. New herbs that were discovered to be useful or specific herbs that were known in a particular geographic area were added. Herbs that proved to be ineffective were eliminated. Drawings were also added or modified in order for the reader to effectively identify the herb. The Herbals that were being translated and modified in the monasteries were some of the first medical texts produced and used in medical practice in the Middle Ages.

Not only were herbal texts being produced, but also other medieval texts that discussed the importance of the humors. Monasteries in Medieval Europe gained access to Greek medical works by the middle of the 6th century. Monks translated these works into Latin, after which they were gradually disseminated across Europe. Monks such as *Arnald of Villanova* also translated the works of Galen and other classical Greek scholars from Arabic to Latin during the Medieval ages. By producing these texts and translating them into Latin, Christian monks both preserved classical Greek medical information and allowed for its use by European medical practitioners. By the early 1300s these translated works would become available at medieval universities and form the foundation of the universities medical teaching programs.

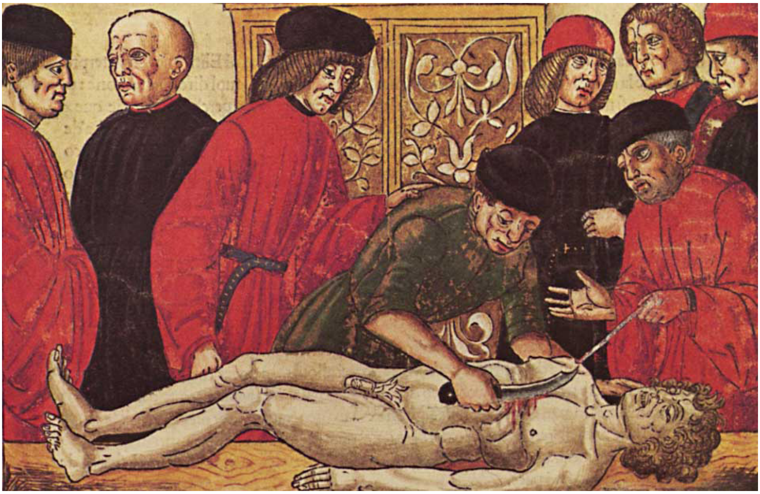
In exchanging the herbal texts among monasteries, monks became aware of herbs that could be very useful but were not found in the surrounding area. The monastic people traded with one another or used commercial means to obtain the foreign herbs. Inside most of the monastery grounds there had been a separate garden designated for the plants that were needed for the treatment of the sick. A serving plan of St.Gall depicts a separate garden to be developed for strictly medical herbals. Monks and nuns also devoted a large amount of their time in the cultivation of the herbs they felt were necessary in the care of the sick. Some plants were not native to the local area and needed special care to be kept alive. The monks used a form of science, what we would today consider botany, to cultivate these plants. Foreign herbs and plants determined to be highly valuable were grown in gardens within close proximity to the monastery in order for the monastic clergy to have access to the natural remedies.

Medicine in the monasteries was concentrated on assisting the individual to return to normal health. Being able to identify symptoms and remedies was the primary focus. In some instances identifying the symptoms led the monastic clergy to take into consideration the cause of the illness in order to implement a solution. Research and experimental processes were continuously being implemented in monasteries to be able to successfully fulfill their duties to God to take care of all God's people.

Medieval surgery arose from a foundation created from Ancient Egyptian, Greek and Arabic medicine. An example of such influence would be Galen, the most influential practitioner of surgical or anatomical practices that he performed while attending to gladiators at Pergamon. The accomplishments and the advancements in medicine made by the Arabic world were translated and made available to the Latin world. This new wealth of knowledge allowed for a greater interest in surgery.

In Paris in the late thirteenth century, it was deemed that surgical practices were extremely disorganized, and so the Parisian provost decided to enlist six of the most trustworthy and experienced surgeons who have assess the performance of other surgeons.

The emergence of universities allowed for surgery to be a discipline that should be learned and be communicated to others as a uniform practice. The University of Padua was one of the "leading Italian universities in teaching medicine, identification and treating of diseases and ailments, specializing in autopsies and workings of the body."



The most prestigious and famous part of the university is the oldest surviving anatomical theater, in which students studied anatomy by observing their teachers perform public dissections.

Surgery was formally taught in Italy even though it was initially looked down upon as a lower form of medicine. The most important figure of the formal learning of surgery was *Guy de Chauliac*. He insisted that a proper surgeon should have a specific knowledge of the human body such as anatomy, food and diet of the patient, and other ailments that may have affected the patients. Not only should surgeons have knowledge about the body but they should also be well versed in the liberal arts. In this way, surgery was no longer regarded as a lower practice, but instead began to be respected and status. During the Crusades, one of the duties of surgeons was to travel around a battlefield, assessing soldiers' wounds and declaring whether or not the soldier was deceased. Because of this task, surgeons were deft at removing arrowheads from their patients' bodies. Another class of surgeons that existed were barber surgeons. They were expected not only to be able to perform formal surgery, but also to be deft at cutting hair and trimming beards. Some of the surgical procedures they would conduct were bloodletting and treating sword and arrow wounds.

Medicine was not a formal area of study in early medieval medicine, but it grew in response to the proliferation of translated Greek and Arabic medical texts in the 11th century. Western Europe also experienced economic, population and urban growth in the 12th and 13th centuries leading to the ascent of medieval medical universities. The *University of Salerno* was considered to be a renowned provenance of medical practitioners in the 9th and 10th centuries, but was not recognized as an official medical university until 1231. The founding of the *Universities of Paris* (1150), *Bologna* (1158), *Oxford*, (1167), *Montpelier* (1181) and *Padua* (1222), extended the initial work of Salerno across Europe, and by the 13th century, medical leadership had passed to these newer institutions. Despite Salerno's important contributions to the foundation of the medical curriculum, scholars do not consider Salerno to be one of the medieval medical universities. This is because the formal establishment of a medical curriculum occurred after the decline of Salerno's grandeur of being a center for academic medicine.

In the Medieval period the term *hospital* encompassed hostels for travelers, dispensaries for poor relief, clinics and surgeries for the injured, and homes for the blind, lame, elderly, and mentally ill. Monastic hospitals developed many treatments, both therapeutic and spiritual. During the thirteenth century a huge number of hospitals were built. The Italian cities were the leaders of the movement. Milan had no fewer than a dozen hospitals and Florence before the end of the fourteenth century had some thirty hospitals. Some of these were very beautiful buildings. At Milan a portion of the general hospital was designed by Bramante and another part of it by Michelangelo. The Hospital of Sienna, built in honor of St. Catherine, has been famous ever since. Everywhere throughout Europe this hospital movement spread. Virchow, the great German pathologist, in an article on hospitals, showed that every city of Germany of five thousand inhabitants had its hospital. He traced all of this hospital movement to Pope Innocent III, and though he was least papistically inclined, Virchow did not hesitate to give extremely high praise to this pontiff for all that he had accomplished for the benefit of children and suffering people.

Scientific medicine. History of Cholera. Pandemic outbreaks. John Snow – father of epidemiology

It's unclear when, exactly, cholera first affected people. Early texts from India (by Sushruta Samhita in the 5th century B.C.) and Greece (Hippocrates in the 4th century B.C. and Aretaeus of Cappadocia in the 1st century A.D.) describe isolated cases of cholera-like illnesses. One of the first detailed accounts of a cholera epidemic comes from Gaspar Correa—Portuguese historian and author of Legendary India—who described an outbreak in the spring of 1543 of a disease in the Ganges Delta, which is located in the south Asia area of Bangladesh and India. The local people called the disease "moryxy," and it reportedly killed victims within 8 hours of developing symptoms and had a fatality rate so high that locals struggled to bury all the dead. Numerous reports of cholera manifestations along the West coast of India by Portuguese, Dutch, French and British observers followed throughout the next few centuries [7].

The first cholera pandemic emerged out of the Ganges Delta with an outbreak in Jessore, India, in 1817, stemming from contaminated rice. The disease quickly spread throughout most of India, modern-day Myanmar, and modern-day Sri Lanka by traveling along trade routes established by Europeans. By 1820, cholera had spread to Thailand, Indonesia (killing 100,000 people on the island of Java alone) and the Philippines. From Thailand and Indonesia, the disease made its way to China in 1820 and Japan in 1822 by way of infected people on ships.

It also spread beyond Asia. In 1821, British troops traveling from India to Oman brought cholera to the Persian Gulf. The disease eventually made its way to European territory, reaching modern-day Turkey, Syria and Southern Russia.The pandemic died out 6 years after it began, likely thanks to a severe winter in 1823–1824, which may have killed the bacteria living in water supplies.

The second cholera pandemic began around 1829. Like the one that came before it, the second pandemic is thought to have originated in India and spread along trade and military routes to Eastern and Central Asia and the Middle East. By autumn of 1830, cholera had made it to Moscow. The spread of the disease temporarily slowed during the winter, but picked up again in spring of 1831, reaching Finland and Poland. It then passed into Hungary and Germany. The disease subsequently spread throughout Europe, including reaching Great Britain for the first time via the port of Sunderland in late 1831 and London in spring of 1832. Britain enacted several actions to help curb the spread of the disease, including implementing quarantines and establishing local boards of health.

But the public became gripped with widespread fear of the disease and distrust of authority figures, most of all doctors. Unbalanced press reporting led people to think that more victims died in the hospital than their homes, and the public began to believe that victims taken to hospitals were killed by doctors for anatomical dissection, an outcome they referred to as "Burking." This fear resulted in several "cholera riots" in Liverpool.

In 1832, cholera had also made it to the Americas. In June of that year, Quebec saw 1,000 deaths from the disease, which quickly spread along the St. Lawrence River and its tributaries. Around the same time, cholera imported into the United States, appearing in New York and Philadelphia. Over the next couple of years, it would spread across the country. It reached Latin America, including Mexico and Cuba, in 1833. The pandemic would die out and reemerge throughout numerous countries for nearly two decades until it subsided around 1851.

Between 1852 and 1923, the world would see four more cholera pandemics. The third pandemic, stretching 1852–1859, was the deadliest. It devastated Asia, Europe, North America and Africa, killing 23,000 people in Great Britain alone in 1854, the worst single year of cholera. In that year, British physician John Snow, who's considered one of the fathers of modern epidemiology, carefully mapped cholera cases in the Soho area of London, allowing him to identify the source of the disease in the area: Contaminated water from a public well pump. He convinced officials to remove the pump handle, immediately dropping the cholera cases in the area.

The fourth and fifth cholera pandemics—occurring 1863–1875 and 1881–1896, respectively—were overall less severe than previous pandemics, but had their fair share of deadly outbreaks. Between 1872 and 1873, for example, Hungary suffered 190,000 deaths from cholera. And Hamburg lost nearly 1.5 percent of its population due to cholera in the 1892 outbreak.

John Snow, (born March 15, 1813, York, Yorkshire, England—died June 16, 1858, London), English physician known for his seminal studies of cholera and widely viewed as the father of contemporary epidemiology. His best-known studies include his investigation of London's Broad Street pump outbreak, which occurred in 1854, and his "Grand Experiment," a study comparing waterborne cholera cases in two regions of the city—one receiving sewage-contaminated water and the other receiving relatively clean water. Snow's innovative reasoning and approach to the control of this deadly disease remain valid and are considered exemplary for epidemiologists throughout the world. Snow's reputation in anesthesiology, specifically in regard to his knowledge of ether and chloroform, was considerable, such that he was asked to administer chloroform to Queen Victoria when she gave birth in 1853 to Prince Leopold and in 1857 to Princess Beatrice. Snow's achievements are considered remarkable, given his humble origin and short life; a stroke caused his death at age 45.

In 1831, when visiting coal miners, he had his first encounter with cholera, a disease that would later become the focus of his scientific endeavours. By 1836 Snow had begun his formal medical education, eventually receiving a doctor of medicine degree (1844) from the University of London. In 1849 he became a licentiate (licensed specialist) of the Royal College of Physicians of London, rising to an elite level in the medical profession. He lived, conducted research, and maintained a medical practice in the Soho neighbourhood of London.

Broad Street pump and the "Grand Experiment". Many British physicians investigated the epidemiology of cholera. The first cholera epidemic in London occurred in 1831–32, when Snow was still learning his craft. When the second cholera epidemic occurred, in 1848–49, he and others founded the London Epidemiological Society, intending to advise the government on ways to combat the disease. Snow reasoned that cholera was caused by a microbe like agent, or germ, that was spread through direct fecal contact, contaminated water, and soiled clothing. However, his theory was at odds with the then prevailing theory that cholera was spread by bad air, or miasma, arising from decayed organic matter. The two etiologic hypotheses—germ theory and miasma—were widely debated, with available clinical and population-based evidence serving as the basis for arguments from both sides. The etiologic debate raged for many years. It was not until the causative organism, Vibrio cholerae (initially discovered in 1854), was well characterized in the 1880s that the debate was decided in favor of germ theory.

Snow's respected reputation in epidemiology arose from two classic studies of the third epidemic to reach England, which began in 1853 and lasted until 1855. The first study concerned the Broad Street pump outbreak of 1854, which killed many persons in the Soho neighbourhood. He used skilled reasoning, graphs, and maps to demonstrate the impact of the contaminated water coming from the Broad Street pump. The second study was the "Grand Experiment," also of 1854, which compared London neighbourhoods receiving water from two different companies. One company relied on inlets coming from the upper River Thames, located away from urban pollution, and the other company relied on inlets in the heart of London, where the contamination of water with sewage was common. Snow showed the harmful effect of contaminated water in two nearly equivalent populations, and he suggested intervention strategies to control the epidemic. His ideas and observations, including innovative disease maps, were published in his book On the Mode of Communication of Cholera (1855). Later, in the 1930s, Snow's work was republished as a classic work in epidemiology, resulting in lasting recognition of his work [8].

In 1883, German microbiologist *Robert Koch*, the founder of modern bacteriology, studied cholera in Egypt and Calcutta. He developed a technique allowing him to grow and describe V. cholerae, and then show that the presence of the bacterium in intestines causes cholera.

However, Italian microbiologist *Filippo Pacini* had actually identified the cholera bacterium—naming it cholerigenic vibrios—in 1854, though this fact wasn't widely known (and was likely unbeknownst to Koch).

During the fifth pandemic, Great Britain and the United States were mostly safe thanks to improved water supplies and quarantine measures.

The sixth cholera pandemic (1899–1923) largely didn't affect western Europe and North America due to advances in public health and sanitation. But the disease still ravaged India, Russia, the Middle East and northern Africa. By 1923, cholera cases had dissipated throughout much of the world, except India—it killed more than half a million people in India in both 1918 and 1919.

Edward Jenner and vaccination. Louis Pasteur and his "Germ theory of diseases". Milestones of Smallpox eradication

For many centuries, smallpox devastated mankind. In modern times we do not have to worry about it thanks to the remarkable work of Edward Jenner and later developments from his endeavors. With the rapid pace of vaccine development in recent decades, the historic origins of immunization are often forgotten. Unfortunately, since the attack on the World Trade Center on September 11, 2001, the threat of biological warfare and bioterrorism has reemerged. Smallpox has been identified as a possible agent of bioterrorism [9]. It seems prudent to review the history of a disease known to few people in the 21st century.

Smallpox: The Origin of a Disease. *T*he origin of smallpox as a natural disease is lost in prehistory. It is believed to have appeared around 10,000 BC, at the time of the first agricultural settlements in northeastern Africa [10, 11]. It seems plausible that it spread from there to India by means of ancient Egyptian merchants. The earliest evidence of skin lesions resembling those of smallpox is found on faces of mummies from the time of the 18th and 20th Egyptian Dynasties (1570–1085 BC). The mummified head of the Egyptian pharaoh Ramses V (died 1156 BC) bears evidence of the disease [12]. At the same time, smallpox has been reported in ancient Asian cultures: smallpox was described as early as 1122 BC in China and is mentioned in ancient Sanskrit texts of India.

Smallpox was introduced to Europe sometime between the fifth and seventh centuries and was frequently epidemic during the Middle Ages. The disease greatly affected the development of Western civilization. The first stages of the decline of the Roman Empire (ad 108) coincided with a large-scale epidemic: the plague of Antonine, which accounted for the deaths of almost 7 million people. The Arab expansion, the Crusades, and the discovery of the West Indies all contributed to the spread of the disease.

Unknown in the New World, smallpox was introduced by the Spanish and Portuguese conquistadors. The disease decimated the local population and was instrumental in the fall of the empires of the Aztecs and the Incas. Similarly, on the eastern coast of North America, the disease was introduced by the early settlers and led to a decline in the native population. The devastating effects of smallpox also gave rise to one of the first examples of biological warfare [13]. During the French-Indian War (1754–1767), Sir Jeffrey Amherst, the commander of the British forces in North America, suggested the deliberate use of smallpox to diminish the American Indian population hostile to the British. Another factor contributing to smallpox in the Americas was the slave trade because many slaves came from regions in Africa where smallpox was endemic.

Smallpox affected all levels of society. In the 18th century in Europe, 400,000 people died annually of smallpox, and one third of the survivors went blind [15]. The symptoms of smallpox, or the "speckled monster" as it was known in 18th-century England, appeared suddenly and the sequelae were devastating. The case-fatality rate varied from 20% to 60% and left most survivors with disfiguring scars. The case-fatality rate in infants was even higher, approaching 80% in London and 98% in Berlin during the late 1800s.

The word *variola* was commonly used for smallpox and had been introduced by Bishop Marius of Avenches (near Lausanne, Switzerland) in ad 570. It is derived from the Latin word varius, meaning "stained," or from varus, meaning "mark on the skin." The term small pockes (pocke meaning sac) was first used in England at the end of the 15th century to distinguish the disease from syphilis, which was then known as the great pockes [14].

In Europe, where the medical profession was relatively organized, the new methods of variolation became known quickly among physicians. Since there was also a demand for protection against smallpox, physicians soon began the variolation procedure on a massive scale. Although 2% to 3% of variolated persons died from the disease, became the source of another epidemic, or suffered from diseases (e.g., tuberculosis and syphilis) transmitted by the procedure itself, variolation rapidly gained popularity among both aristocratic and common people in Europe. The case-fatality rate associated with variolation was 10 times lower than that associated with naturally occurring smallpox. In the 1750s more European princes died of smallpox, giving further impetus for the use of variolation. Among those variolated were Empress Marie-Therese of Austria and her children and grandchildren, Frederick II of Prussia, King Louis XVI of France and his children, and Catherine II of Russia and her son. King Frederick II of Prussia also inoculated all his soldiers. In fact, variolation was widely practiced in Europe until Jenner's discovery.

The regular practice of variolation reached the New World in 1721. Under the guidance of the Rev. Cotton Mather (1663–1728) and Dr. Zabdiel Boylston (1679–1766), variolation became quite popular in the colonies. Mather, a graduate of Harvard College, was always very interested in science and medicine. When a ship from the West Indies carried persons sick with smallpox into Boston in 1721, an epidemic broke out in Boston and other parts of Massachusetts. Mather wrote a cautious letter recommending immediate variolation. However, he persuaded only Dr. Boylston. With Mather's support, Boylston immediately started a variolation program and continued to inoculate many volunteers, despite many adversaries in both the public and the medical community in Boston. As the disease spread, so did the controversy around Mather and Boylston [15]. At the height of the epidemic, a bomb was thrown into Mather's house.

To make their point, Mather and Boylston used a statistical approach to compare the mortality rate of natural smallpox infection with that contracted by variolation. During the great epidemic of 1721, approximately half of Boston's 12,000 citizens contracted smallpox. The fatality rate for the naturally contracted disease was 14%, whereas Boylston and Mather reported a mortality rate of only 2% among variolated individuals [16]. This may have been the first time that comparative analysis was used to evaluate a medical procedure.

During the decades following the 1721 epidemic in Boston, variolation became more widespread in the colonies of New England. In 1766, American soldiers under George Washington were unable to take Quebec from the British troops, apparently because of a smallpox epidemic that significantly reduced the number of healthy troops. The British soldiers were all variolated. By 1777, Washington had learned his lesson: all his soldiers were variolated before beginning new military operations. The success of variolation in the New World was not without effect on Europe. In fact, the rapid adoption of variolation in Europe can be directly traced to the efforts of Cotton Mather during the Boston smallpox epidemic in 1721. Although many British physicians remained skeptical even after Mather's success, the data he had published were eventually influential. Variolation was subsequently adopted in England and spread from there throughout Western Europe.

In 1757, an 8-year-old boy was inoculated with smallpox in Gloucester; he was one of thousands of children inoculated that year in England. The procedure was effective, as the boy developed a mild case of smallpox and was subsequently immune to the disease. His name was Edward Jenner.

Edward Jenner, (17 May 1749 – 26 January 1823) was an English physician and scientist who pioneered the concept of vaccines including creating the smallpox vaccine, the world's first vaccine. The terms *vaccine* and *vaccination* are derived from *Variolae vaccinae* ('smallpox of the cow'), the term devised by Jenner to denote cowpox. He used it in 1798 in the long title of his *Inquiry into the Variolae vaccinae known as the Cow Pox*, in which he described the protective effect of cowpox against smallpox.

In the West, Jenner is often called "the father of immunology", and his work is said to have "saved more lives than the work of any other human". In Jenner's time, smallpox killed around 10% of the population, with the number as high as 20% in towns and cities where infection spread more easily. In 1821, he was appointed physician extraordinary to King George IV, and was also made mayor of Berkeley and justice of the peace. A member of the Royal Society, in the field of zoology he was the first person to describe the brood parasitism of the cuckoo. In 2002, Jenner was named in the BBC's list of the 100 Greatest Britons [17].

Louis Pasteur (December 27, 1822 – September 28, 1895)

Louis Pasteur is one of the 'greats' of science. Countless millions of people alive today owe their lives to his discoveries. Pasteur revolutionized chemistry and biology with his discovery of vaccination, with his work on fermentation, his discovery of anaerobic bacteria, and his establishment of the Germ theory of disease. The process he invented was called pasteurization and it is still in use worldwide today.

Germ theory of disease is based on the concept that many diseases are caused by infections with microorganisms, typically only visualized under high magnification. Such microorganisms can consist of bacterial, viral, fungal, or protist species. Although the growth and productive replication of microorganisms are the cause of disease, environmental and genetic factors may predispose a host or influence the severity of the infection. For example, in a host that is immunocompromised (e.g., due to AIDS or old age), an infection may result in more severe outcomes than in individuals who are fully immunocompetent.

Pasteur was the first to experimentally demonstrate that disease was caused by microorganisms in the environment rather than the air itself as proposed by the dominant theory at the time (Miasma theory) [18].

In 1967, the World Health Assembly undertook to eradicate smallpox worldwide. Priority was given to this disease, because, throughout history, it had been the most devastating of all human infections. The key elements of program execution included the World Health Organization's (WHO's) success in recruiting the global cooperation of all nations, an especially effective vaccine, a new instrument that facilitated vaccination and a unique strategy for stopping the spread of smallpox infection. The goal of the program was to eliminate smallpox throughout the world in 10 years. It missed the goal by only a few months. Smallpox Eradication was declared by the WHO in 1980 and smallpox vaccination ceased everywhere. The program, its strategies and organization provided the

Smallpox

WHO poster commemorating the eradication of smallpox in October 1979, which was later officially endorsed by the 33rd World Health Assembly on May 8, 1980. Courtesy of WHO.

impetus for a heightened global program of immunization that includes poliomyelitis, measles, diphtheria, pertussis and tetanus vaccines.

Dengue Fever. Prevention. Vaccine. Black Sickness: Kala Azar (Leishmaniasis). History of epidemiology and prevention

Dengue fever is a mosquito-borne tropical disease caused by the dengue virus. Symptoms typically begin three to fourteen days after infection. These may include a high fever, headache, vomiting, muscle and joint pains, and a characteristic skin rash.

Dengue is common in more than 120 countries. In 2013 it caused about 60 million symptomatic infections worldwide, with 18% admitted to hospital and about 13,600 deaths. The worldwide cost of dengue case is estimated US$9 billion. For the decade of the 2000s, 12 countries in Southeast Asia were estimated to have about 3 million infections and 6,000 deaths annually. In 2019 the Philippines declared a national dengue epidemic due to the deaths reaching 622 people that year. It is reported in at least 22 countries in Africa; but is likely present in all of them with 20% of the population at risk. This makes it one of the most common vector-borne diseases worldwide.

Infections are most commonly acquired in urban environments. In recent decades, the expansion of villages, towns and cities in the areas in which it is common, and the increased mobility of people has increased the number of epidemics and circulating viruses. Dengue fever, which was once confined to Southeast Asia, has now spread to southern China in East Asia, countries in the Pacific Ocean and the Americas, and might pose a threat to Europe.

Rates of dengue increased 30 fold between 1960 and 2010. This increase is believed to be due to a combination of urbanization, population growth, increased international travel, and global warming. The geographical distribution is around the equator. Of the 2.5 billion people living in areas where it is common 70% are from the WHO Southeast Asia Region and Western Pacific Region. An infection with dengue is second only to malaria as a diagnosed cause of fever among travelers returning from the developing world. It is the most common viral disease transmitted by arthropods, and has a disease burden estimated at 1,600 disability-adjusted life years per million population. The World Health Organization counts dengue as one of seventeen neglected tropical diseases.

Like most arboviruses, dengue virus is maintained in nature in cycles that involve preferred blood-sucking vectors and vertebrate hosts. The viruses are maintained in the forests of Southeast Asia and Africa by transmission from female *Aedes* mosquitos—of species other than *A. aegypti*—to their offspring and to lower primates. In towns and cities, the virus is primarily transmitted by the highly domesticated *A. aegypti*. In rural settings the virus is transmitted to humans by *A. aegypti* and other species of *Aedes* such as *A. albopictus*. Both these species had expanding ranges in the second half of the 20th century. In all settings the infected lower primates or humans greatly increase the number of circulating dengue viruses, in a process called amplification. One projection estimates that climate change, urbanization, and other factors could result in more than 6 billion people at risk of dengue infection by 2080.

The first record of a case of probable dengue fever is in a Chinese medical encyclopedia from the Jin Dynasty (266–420) which referred to a "water poison" associated with flying insects. The primary vector, *A. aegypti*, spread out of Africa in the 15th to 19th centuries due in part to increased globalization secondary to the slave trade.[25] There have been descriptions of epidemics in the 17th century, but the most plausible early reports of dengue epidemics are from 1779 and 1780, when an epidemic swept across Southeast Asia, Africa and North America. From that time until 1940, epidemics were infrequent.

In 1906, transmission by the *Aedes* mosquitos was confirmed, and in 1907 dengue was the second disease (after yellow fever) that was shown to be caused by a virus.[14] Further investigations by John Burton Cleland and Joseph Franklin Siler completed the basic understanding of dengue transmission.

The marked spread of dengue during and after the Second World War has been attributed to ecologic disruption. The same trends also led to the spread of different serotypes of the disease to new areas and the emergence of dengue hemorrhagic fever. This severe form of the disease was first reported in the Philippines in 1953; by the 1970s, it had become a major cause of child mortality and had emerged in the Pacific and the

Americas. Dengue hemorrhagic fever and dengue shock syndrome were first noted in Central and South America in 1981, as DENV-2 was contracted by people who had previously been infected with DENV-1 several years earlier [19].

The 2019–2020 dengue fever epidemic was an epidemic of the infectious disease dengue fever in several countries of Southeast Asia, including Philippines, Malaysia, Vietnamand Bangladesh, Pakistan, Thailand, Singapore, and Laos. The spread of the disease was exacerbated by falling vaccination levels in certain areas, and by a growing population of mosquitoes, which are the primary carriers of the disease, and which are able to reproduce in larger numbers where humans have littered the environment with plastic containers, which provide an ideal breeding ground for mosquitoes. Affected countries have sought to control the epidemic through increased vaccination efforts, and through efforts to control the mosquito population.

Prevention depends on control of and protection from the bites of the mosquito that transmits it. The World Health Organization recommends an Integrated Vector Control program consisting of five elements: advocacy, social mobilization and legislation to ensure that public health bodies and communities are strengthened; collaboration between the health and other sectors (public and private); an integrated approach to disease control to maximize the use of resources; evidence-based decision making to ensure any interventions are targeted appropriately; and capacity-building to ensure an adequate response to the local situation.

Vaccination. In 2016 a partially effective vaccine for dengue fever became commercially available in the Philippines and Indonesia. It has been approved for use by Mexico, Brazil, El Salvador, Costa Rica, Singapore, Paraguay, much of Europe, and the United States. The vaccine is only recommended in individuals who have had a prior dengue infection or in populations where most (>80%) of people have been infected by age 9. In those who have not had a prior infection there is evidence it may worsen subsequent infections. For this reason prescribes does not see it as suitable for wide scale immunization, even in areas were the disease is common.

The vaccine is produced by Sanofi and goes by the brand name Dengvaxia. It is based on a weakened combination of the yellow fever virus and each of the four dengue serotypes. Studies of the vaccine found it was 66% effective and prevented more than 80 to 90% of severe cases.

Kala-azar. Visceral leishmaniasis (VL), also known as kala-azar, is the most severe form of leishmaniasis and, without proper diagnosis and treatment, is associated with high fatality. Leishmaniasis is a disease caused by protozoan parasites of the genus *Leishmania*.

The parasite migrates to the internal organs such as the liver, spleen (hence "visceral"), and bone marrow, and, if left untreated, will almost always result in the death of the host. Signs and symptoms include fever, weight loss, fatigue, anemia, and substantial swelling of the liver and spleen. Of particular concern, according to the World Health Organization (WHO), is the emerging problem of HIV/VL co-infection.

Kala-azar first came to the attention of Western doctors in 1824 in Jessore, India (now Bangladesh), where it was initially thought to be a form of malaria. Assam gave kala-azar one of its common names, *Assam fever*. Another common name, *kala-azar* (Hindustani: काला आज़ार (Devanagari) رازآ الاک (Nastaleeq) *kālā āzār*), is derived from *kala* which means black in Sanskrit, as well as in the languages descended from it, including Assamese, Hindi and Urdu; the word *azar* means Fever in Persian and Hindustani; as such the disease is named for the darkening of the skin on the extremities and abdomen that is a symptom of the Indian form of the disease. The agent of the disease was also first isolated in India by Scottish doctor William Leishman (who observed the parasite in spleen smears of a soldier who died of the disease in Dumdum, Calcutta, India - hence the name *dumdum fever*) and Irish physician Charles Donovan, working independently of each other. As they published their discovery almost simultaneously, the species was named for both of them—*Leishmania donovani*.

The miracle of urea stibamine, drawn by Upendranath Brahmachari himself. The death rate is drastically declined from nearly 6300 to 750 within ten years in Assam.

Contemporary life has made itself felt even here, however—not as "progress" but in the form of the many small wars of Africa's post-colonial era. In the Sudan, where civil war has been continuous since 1983, the violence has been concentrated in the more populated south, and kala-azar was concentrated there too. But the wars have driven a steady stream of refugees out of the region, and these traveled either across the southern border or into the remoter western part of the country called the Upper Nile, where both war and the disease that went with it had not yet penetrated.

These refugees, moving at foot-speed, carried the disease with them, and when it arrived it hit the Upper Nile with a force comparable to smallpox hitting the American Indians. The isolated people of the Upper Nile had no access to medicine or education about the new disease among them. Worse, their immune systems were defenseless against this new pathogen, foreign to them though it came only from another part of their own country. One village at the center of the epidemic, Duar, was left with four survivors out of a population of a thousand, and from the late eighties to the mid-nineties a total of 100,000 succumbed to the sickness in that region alone. In the words of Jill Seaman, the doctor who led relief efforts in the Upper Nile for the French organization Médecins Sans Frontières, "Where else in the world could 50% of a population die without anyone knowing?" Due to the South Sudanese Civil War, kala-azar has spread rapidly among the population [20].

*Prevention***.** There are no vaccines or preventive drugs for visceral leishmaniasis. The most effective method to prevent infection is to protect from sand fly bites. To decrease the risk of being bitten following precautions are suggested: avoid outdoor activities, especially from dusk to dawn, when sand flies generally are the most active. When outdoors (or in unprotected quarters): minimize the amount of exposed (uncovered) skin. To the extent that is tolerable in the climate, wear long-sleeved shirts, long pants, and socks; and tuck your shirt into your pants. Apply insect repellent to exposed skin and under the ends of sleeves and pant legs. Follow the instructions on the label of the repellent. The most effective repellents generally are those that contain the chemical DEET (N.N–diethylmetatoluamide).

Indoors prevention. Stay in well-screened or air-conditioned areas, keep in mind that sand flies are much smaller than mosquitoes and therefore can get through smaller holes, spray living/sleeping areas with an insecticide to kill insects. If you are not sleeping in a well-screened or air-conditioned area, use a bed net and tuck it under your mattress. If possible, use a bed net that has been soaked in or sprayed with a pyrethroid-containing insecticide. The same treatment can be applied to screens, curtains, sheets, and clothing (clothing should be retreated after five washings)."

Upendra Nath Brahmachari

The Indian medical practitioner Upendra Nath Brahmachari was nominated for the Nobel Prize in Physiology or Medicine in 1929 for his discovery of ureastibamine (an antimonial compound for the treatment of kala-azar) and a new disease, post kala-azar dermal leishmaniasis. Brahmachari's cure for visceral leishmaniasis was the urea salt of para-amino-phenyl stibnic acid which he called Urea Stibamine.

During the nineteenth century, kala-azar was discovered near moving bodies of water in southeast Asia. Dr. Jean Dow and Dr. William McClure, are credited with finding the cure for the disease in China. Largely uncredited for her contribution, Dr. Jean Dow was one of the first to isolate the microorganism in China and conduct clinical studies on its origin. This work continued under Ernest Struthers and Lionel Napier at the School of Tropical Medicine at Calcutta to discover that kala-azar was transmitted by sandflies.

History of Diphtheria and Poliomyelitis. Discovery of vaccine. Epidemiology and prevention

Diphtheria was once one of the most dreaded diseases, with frequent large-scale outbreaks. A diphtheria epidemic in the New England colonies between 1735 and 1740 was said to have killed as many as 80 percent of the children under ten years of age in some towns. In the 1920s, there were an estimated 100,000 to 200,000 cases of diphtheria per year in the United States, with 13,000 to 15,000 deaths. Children represented the large majority of cases and fatalities.

One of the first early effective treatments was discovered in the 1880s by U.S. physician Joseph O'Dwyer (1841-1898). O'Dwyer developed tubes that could be inserted into the throat to prevent victims from suffocating from the membrane sheath that grew and obstructed the airways.

In 1883, the bacterium that causes diphtheria, *Corynebacterium diphtheriae,* was first described, by Theodor Klebs. In 1884, Friedrich Loffler isolated *C. diptheriae* and injected it into various animals, proving that it was the agent that caused diphtheria. Subsequently, the fluid in which the bacteria grew was injected, after removal of the bacteria, into various animals (guinea pigs, rabbits, dogs, horses, and cats) and exhibited the effects of the toxin released by the bacteria (Roux and Yersin 1888).

In the 1890s, the German physician Emil von Behring developed an antitoxin that, although it did not kill the bacteria, neutralized the toxic poisons that the bacteria released into the body. For this discovery and his development of a serum therapy for diphtheria, he won the first Nobel Prize in Medicine. (Americans William H. Park and Anna Wessels Williams also developed a diphtheria antitoxin in the 1890s.) Horses were utilized to produce antitoxin on a large scale.

The first successful vaccine for diphtheria was developed in 1923. (Previously, von Behring has demonstrated long lasting immunity in various animals by using the antitoxin and toxin. But widespread immunization began after a formalin-inactivated toxin was developed.) Guinea pigs were used to standardize the vaccine. However, effective vaccines were not developed until the discovery and development of sulfa drugs (sulphur-containing drugs) following World War II.

Diphtheria was also prevalent in the British royal family during the late nineteenth century. Famous cases included a daughter and granddaughter of Britain's Queen Victoria. Princess Alice of Hesse (second daughter of Queen Victoria) died of diphtheria after she contracted it from her children in December of 1878 while nursing them. One of Princess Alice's daughters, Princess Marie, also died of diphtheria in November of 1878. Sacagawea and Elisha Graves Otis also died from diphtheria [22].

History of vaccination campaigns. Immunization for diphtheria is accomplished with a toxoid (a modified version of the diphtheria toxin). Diphtheria toxoid is not given as a single injection, but rather is combined with tetanus toxoid and, often, pertussis vaccine in a preparation called Tdap, DTaP, Td, or DT.

Since the introduction of effective immunization, starting in the 1920s, diphtheria rates have dropped dramatically in the United States and other countries that vaccinate widely. In 1974, the reach of diphtheria immunization expanded when the World Health Organization included diphtheria toxoid in its list of recommended immunizations for its Expanded Programme on Immunization for developing countries. Between 2004 and 2008, no cases of diphtheria were recorded in the United States. However, the disease continues to play a role globally. In 2007, 4,190 cases of diphtheria were reported worldwide, which is likely an underestimate of the actual number of cases [21].

The *history of polio* (poliomyelitis) infections began during prehistory. Although major polio epidemics were unknown before the 20th century, the disease has caused paralysis and death for much of human history. Over millennia, polio survived quietly as an endemic pathogen until the 1900s when major epidemics began to occur in Europe. Soon after, widespread epidemics appeared in the United States. By 1910, frequent epidemics became regular events throughout the developed world primarily in cities during the summer months. At its peak in the 1940s and 1950s, polio would paralyze or kill over half a million people worldwide every year [22].

The fear and the collective response to these epidemics would give rise to extraordinary public reaction and mobilization spurring the development of new methods to prevent and treat the disease and revolutionizing medical philanthropy. Although the development of two polio vaccines has eliminated wild poliomyelitis in all but two countries (Afghanistan and Pakistan), the legacy of poliomyelitis remains in the development of modern rehabilitation therapy and in the rise of disability rights movements worldwide [23].

Ancient Egyptian paintings and carvings depict otherwise healthy people with withered limbs, and children walking with canes at a young age. It is theorized that the Roman Emperor Claudius was stricken as a child, and this caused him to walk with a limp for the rest of his life. Perhaps the earliest recorded case of poliomyelitis is that of Sir Walter Scott. In 1773, Scott was said to have developed "a severe teething fever which deprived him of the power of his right leg". At the time, polio was not known to medicine. A retrospective diagnosis of polio is considered to be strong due to the detailed account Scott later made, and the resultant lameness of his right leg had an important effect on his life and writing.

The symptoms of poliomyelitis have been described by many names. In the early nineteenth century the disease was known variously as: Dental

Paralysis, Infantile Spinal Paralysis, Essential Paralysis of Children, Regressive Paralysis, Myelitis of the Anterior Horns, Tephromyelitis (from the Greek *tephros*, meaning "ash-gray") and Paralysis of the Morning. In 1789 the first clinical description of poliomyelitis was provided by the British physician Michael Underwood—he refers to polio as "a debility of the lower extremities". The first medical report on poliomyelitis was by Jakob Heine, in 1840; he called the disease *Lähmungszustände der unteren Extremitäten* ("Paralysis of the lower Extremities"). Karl Oskar Medin was the first to empirically study a poliomyelitis epidemic in 1890. This work, and the prior classification by Heine, led to the disease being known as *Heine-Medin disease* [26].

Major polio epidemics were unknown before the 20th century; localized paralytic polio epidemics began to appear in Europe and the United States around 1900. The first report of multiple polio cases was published in 1843 and described an 1841 outbreak in Louisiana. A fifty-year gap occurs before the next U.S. report—a cluster of 26 cases in Boston in 1893. The first recognized U.S. polio epidemic occurred the following year in Vermont with 132 total cases (18 deaths), including several cases in adults. Numerous epidemics of varying magnitude began to appear throughout the country; by 1907 approximately 2,500 cases of poliomyelitis were reported in New York City.

This cardboard placard was placed in windows of residences where patients were quarantined due to poliomyelitis. Violating the quarantine order or removing the placard was punishable by a fine of up to US$100 in 1909 (equivalent to $2,880 in 2020).

On Saturday, June 17, 1916, an official announcement of the existence of an epidemic polio infection was made in Brooklyn, New York. That year, there were over 27,000 cases and more than 6,000 deaths due to polio in the United States, with over 2,000 deaths in New York City alone. The names and addresses of individuals with confirmed polio cases were published daily in the press, their houses were identified with placards, and their families were quarantined. Dr. Hiram M. Hiller, Jr. was one of the physicians in several cities who realized what they were dealing with, but the nature of the disease remained largely a mystery. The 1916 epidemic caused widespread panic and thousands fled the city to nearby mountain resorts; movie theaters were closed, meetings were canceled, public gatherings were almost nonexistent, and children were warned not to drink from water fountains, and told to avoid amusement parks, swimming pools, and beaches. From 1916 onward, a polio epidemic appeared each summer in at least one part of the country, with the most serious occurring in the 1940s and 1950s. In the epidemic of 1949, 42,173 cases were reported in the United States and 2,720 deaths from the disease occurred. Canada and the United Kingdom were also affected.

Prior to the 20th century, polio infections were rarely seen in infants before 6 months of age, and most cases occurred in children 6 months to 4 years of age. Young children who contract polio generally suffer only mild symptoms, but as a result they become permanently immune to the disease. In developed countries during the late 19th and early 20th centuries, improvements were being made in community sanitation, including improved sewage disposal and clean water supplies. Better hygiene meant that infants and young children had fewer opportunities to encounter and develop immunity to polio. Exposure to poliovirus was therefore delayed until late childhood or adult life, when it was more likely to take the paralytic form.

In children, paralysis due to polio occurs in one in 1000 cases, while in adults, paralysis occurs in one in 75 cases. By 1950, the peak age incidence of paralytic poliomyelitis in the United States had shifted from infants to children aged 5 to 9 years; about one-third of the cases were reported in persons over 15 years of age. Accordingly, the rate of paralysis and death due to polio infection also increased during this time. In the United States, the 1952 polio epidemic was the worst outbreak in the nation›s history, and is credited with heightening parents' fears of the disease and focusing public awareness on the need for a vaccine. Of the 57,628 cases reported that year, 3,145 died and 21,269 were left with mild to disabling paralysis.

Vaccine development. In 1935 Maurice Brodie, a research assistant at New York University and William Hallock Park of the New York City Department of Health, attempted to produce a polio vaccine, procured from virus in ground up monkey spinal cords, and killed by formaldehyde. Brodie first tested the vaccine on himself and several of his assistants. He then gave the vaccine to three thousand children. Many developed allergic reactions, but none of the children developed an immunity to polio. During the late 1940s and early 1950s, a research group, headed by John Enders at the Boston Children's Hospital, successfully cultivated the poliovirus in human tissue. This significant breakthrough ultimately allowed for the development of the polio vaccines. Enders and his colleagues, Thomas H. Weller and Frederick C. Robbins, were recognized for their labors with the Nobel Prize in 1954.

Two vaccines are used throughout the world to combat polio. The first was developed by Jonas Salk, first tested in 1952 using the HeLa cell, and announced to the world by Salk on April 12, 1955. The Salk vaccine, or *inactivated poliovirus vaccine* (IPV), consists of an injected dose of killed poliovirus. In 1954, the vaccine was tested for its ability to prevent polio; its field trials grew to be the largest medical experiment in history. In 1955, it was chosen for use throughout the United States. By 1957, following mass immunizations promoted by the March of Dimes, the annual number of polio cases in the United States was reduced, from a peak of nearly 58,000 cases, to 5,600 cases.

Jonas Edward Salk
(October 28, 1914 – June 23, 1995)

An American medical researcher and virologist. He discovered and developed one of the first successful polio vaccines.

In 1960 an oral polio vaccine, developed by virologist **Albert Sabin** (1906 – 1993), came into wide use.


ALBERT SABIN, M.D.

Eight years after Salk's success, Albert Sabin developed an oral polio vaccine (OPV) using live but weakened (*attenuated*) virus. Human trials of Sabin's vaccine began in 1957 and it was licensed in 1962. Following the development of oral polio vaccine, a second wave of mass immunizations led to a further decline in the number of cases: by 1961, only 161 cases were recorded in the United States. The last cases of paralytic poliomyelitis caused by endemic transmission of poliovirus in the United States were in 1979, when an outbreak occurred among the Amish in several Midwestern states.

Hansen's disease: Leprosy. Epidemiology, prevention. History of elimination. Scurvy, history, causes and prevention.

Leprosy, also known as Hansen's disease, is a chronic infectious disease caused by *Mycobacterium leprae*. The disease mainly affects the skin, the peripheral nerves, mucosal surfaces of the upper respiratory tract and the eyes. Leprosy is known to occur at all ages ranging from early infancy to very old age. Leprosy is curable and treatment in the early stages can prevent disability. Leprosy is likely transmitted via droplets, from the nose and mouth, during close and frequent contact with untreated cases.

Although the number of new leprosy cases occurring each year is important as a measure of transmission, it is difficult to measure in leprosy due to its long incubation period, delays in diagnosis after onset of the disease and the lack of laboratory tools to detect leprosy in its very early stages. Instead, the registered prevalence is used. Registered prevalence is a useful proxy indicator of the disease burden as it reflects the number of active leprosy cases diagnosed with the disease and receiving treatment with MDT at a given point in time. The prevalence rate is defined as the number of cases registered for MDT treatment among the population in which the cases have occurred, again at a given point in time [24].

New case detection is another indicator of the disease that is usually reported by countries on an annual basis. It includes cases diagnosed with onset of disease in the year in question (true incidence) and a large proportion of cases with onset in previous years (termed a backlog prevalence of undetected cases).

Endemic countries also report the number of new cases with established disabilities at the time of detection, as an indicator of the backlog prevalence. Determination of the time of onset of the disease is generally unreliable, is very labor-intensive and is seldom done in recording these statistics.

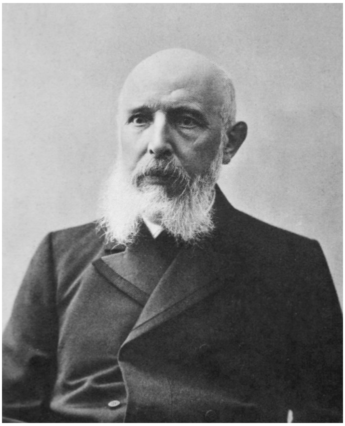
The leprosy situation in the four major countries (Brazil, Mozambique, Nepal and Tanzania) that have yet to achieve the goal of elimination at the national level. *Elimination* is defined as a prevalence of less than 1 case per 10,000 population. Madagascar reached elimination at the national level in September 2006. Nepal detection reported from mid-November 2004 to mid-November 2005. D.R. Congo officially reported to WHO in 2008 that it had reached elimination by the end of 2007 at the national level [25].

Leprosy is one of the oldest diseases in the world, and yet there are many doubts and conflicting information about the origin and description of the disease. In the old texts about the disease there is noa clear and precise description of its clinical practice, making it possible to confuse its history and evolution in different regions of the world over time.

At the turn of the third century BC in Greece, Straton, a disciple of the physician Erasistratos (c. 300–250 BC), accurately described a low-resistant leprosy, which was called elephantiasis. The word "graecorum" was added later to differentiate it from elephantiasis arabum (known as bancroftian filariasis). To deepen the confusion even further, lepra arabum was A synopsis of the history of Hansen's disease equivalent to elephantiasis graecorum, which we call leprosy nowadays. Leprosy was reliably described only by Alexandria-trained physicians, who distinguished it well from other diseases [26].

The first hospital for lepers was founded early in the fourth century in Rome, during the reign of Constantine. Some reliable medical descriptions of leprosy were recorded as early as the second century AD and issued in Latin in Western Europe during the Middle Ages. Those descriptions were written by scholars such as Aretaeus of Cappadocia (2nd to 3rd century AD), Bernardus of Gordonio (13th century), and Hieronymus Cardanus (1501–1576). There are other scholars who deserve to be mentioned as well: F. Ranchin wrote an important publication, in Lyons, in 1640: Opuscules, ou traictés divers et curieux en médicine, which describes "the nature, cause, signs, and cures of leprosy of the Israelites, Arabs and Europeans – all the problems checked and resolved." Daniel C. Danielssen and Carl W. Boeck published a relevant description of leprosy: Om spedalskhed, in Christiania, 1847 [27]. Frederic John Muat introduced into Western medicine the use of chaulmoogra oil in treating leprosy in an article printed in the Indian Annals of Medical Science in 1854.

Gerhard Henrik Armauer Hansen discovered the pathogenic leprosy bacillus in 1871. His discovery was published in Norsk Magazin for Laegevidenskaben in 1874. After 1943, sulfones replaced Chaulmoogra oil in the treatment of leprosy. It was Guy Henry Faget who described the greater effectiveness of sulfones in an important article named "The Promin treatment of Leprosy. A Progress Report" published in Public Health Report 58:1729–41, 1943 [28].



Gerhard Henrik Armauer Hansen (29 July 1841 – 12 February 1912) was a Norwegian physician, remembered for his identification of the bacterium *Mycobacterium leprae* in 1873 as the causative agent of leprosy.[1][2] His distinguished work was recognized at the International Leprosy Congress held at Bergen in 1909.

To summarize, the most important historical events in Hansen's disease were: (1) the discovery of the bacillus by Dr. Armauer Hansen of Norway in 1874; (2) the use of the sulfone drug by Dr. Guy Faget of Carville in 1941; (3) the discovery of the multiplication of the bacillus in the mouse footpad by Dr. Charles Shepard of the Center for Disease Control in 1959; and (4) the demonstration that the nine-banded armadillo is susceptible to developing disseminated Hansen's disease after inoculation with leprosy bacillus by Dr. Waldemar Kirchheimer of Carville and Dr Eleanor Storrs of the Southern Gulf Research Institute in 1968 [29].

Scurvy is a disease resulting from a lack of vitamin C (ascorbic acid). Early symptoms of deficiency include weakness, feeling tired and sore arms and legs. Without treatment, decreased red blood cells, gum disease, changes to hair, and bleeding from the skin may occur. As scurvy worsens there can be poor wound healing, personality changes, and finally death from infection or bleeding.

Some of the earliest evidence for a disorder suggesting scurvy dates to 3800–3600 BCE, captured in characteristic bone changes in the skeleton of a roughly one-year-old child in Egypt. Another early probable case of scurvy, described from the skeletal remains of a child in England, dates to 2200–1970 BCE. In addition, accounts of what was probably scurvy are found in ancient writings.

In the 13th century, the Crusaders frequently suffered from scurvy. In the 1497 expedition of Vasco da Gama, the curative effects of citrus fruit were already known and confirmed by Pedro Álvares Cabral and his crew in 1507.

The Portuguese planted fruit trees and vegetables in Saint Helena, a stopping point for homebound voyages from Asia, and left their sick, who had scurvy and other ailments, to be taken home by the next ship if they recovered.

In 1500, one of the pilots of Cabral's fleet bound for India noted that in Malindi, its king offered the expedition fresh supplies such as lambs, chickens, and ducks, along with lemons and oranges, due to which "some of our ill were cured of scurvy".

Unfortunately, these travel accounts did not stop further maritime tragedies caused by scurvy, first because of the lack of communication between travelers and those responsible for their health, and because fruits and vegetables could not be kept for long on ships.

In 1536, the French explorer Jacques Cartier, exploring the St. Lawrence River, used the local natives' knowledge to save his men who were dying of scurvy. He boiled the needles of the arbor vitae tree (eastern white cedar) to make a tea that was later shown to contain 50 mg of vitamin C per 100 grams. Such treatments were not available aboard ship, where the disease was most common. In February 1601, Captain James Lancaster, while sailing to Sumatra, landed on the northern coast of Madagascar specifically to obtain lemons and oranges for his crew to stop scurvy. Captain Lancaster conducted an experiment using four ships under his command. One ship's crew received routine doses of lemon juice while the other three ships did not receive any such treatment. As a result, members of the non-treated ships started to contract scurvy, with many dying as a result.

During the Age of Exploration (between 1500 and 1800), it has been estimated that scurvy killed at least two million sailors. Jonathan Lamb wrote: “In 1499, Vasco da Gama lost 116 of his crew of 170; In 1520, Magellan lost 208 out of 230;...all mainly to scurvy.”

In 1579, the Spanish friar and physician Agustin Farfán published a book in which he recommended oranges and lemons for scurvy, a remedy that was already known in the Spanish Navy.

In 1593, Admiral Sir Richard Hawkins advocated drinking orange and lemon juice as a means of preventing scurvy.

In 1614, John Woodall, Surgeon General of the East India Company, published *The Surgion's Mate* as a handbook for apprentice surgeons aboard the company›s ships. He repeated the experience of mariners that the cure for scurvy was fresh food or, if not available, oranges, lemons, limes, and tamarinds. He was, however, unable to explain the reason why, and his assertion had no impact on the prevailing opinion of the influential physicians of the age, that scurvy was a digestive complaint.

Apart from ocean travel, even in Europe, until the late Middle Ages, scurvy was common in late winter, when few green vegetables, fruits and root vegetables were available. This gradually improved with the introduction from the Americas of potatoes; by 1800, scurvy was virtually unheard of in Scotland, where it had previously been endemic.

James Lind FRSE FRCPE (4 October 1716 – 13 July 1794)

A Scottish doctor. He was a pioneer of naval hygiene in the Royal Navy. By conducting one of the first ever clinical trials, he developed the theory that citrus fruits cured Scurvy.

In 1753 Scottish naval surgeon James Lind showed that scurvy could be cured and prevented by ingestion of the juice of oranges and lemons. Soon citrus fruits became so common aboard ship that British sailors were referred to as "limeys."

By the early 20th century, when Robert Falcon Scott made his first expedition to the Antarctic (1901–1904), the prevailing theory was that scurvy was caused by «ptomaine poisoning», particularly in tinned meat. However, Scott discovered that a diet of fresh meat from Antarctic seals cured scurvy before any fatalities occurred.

In 1907, an animal model which would eventually help to isolate and identify the «antiscorbutic factor» was discovered. Axel Holst and Theodor Frølich, two Norwegian physicians studying shipboard beriberi contracted by ship's crews in the Norwegian Fishing Fleet, wanted a small test mammal to substitute for the pigeons then used in beriberi research. They fed guinea pigs their test diet of grains and flour, which had earlier produced beriberi in their pigeons, and were surprised when classic scurvy resulted instead. This was a serendipitous choice of animal. Until that time, scurvy had not been observed in any organism apart from humans and had been considered an exclusively human disease. Certain birds, mammals, and fish are susceptible to scurvy, but pigeons are unaffected, since they can synthesize ascorbic acid internally. Holst and Frølich found they could cure scurvy in guinea pigs with the addition of various fresh foods and extracts. This discovery of an animal experimental model for scurvy, which was made even before the essential idea of «vitamins» in foods had been put forward, has been called the single most important piece of vitamin C research.

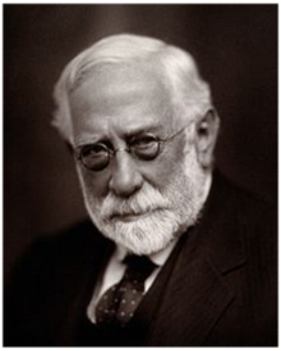
In 1915, New Zealand troops in the Gallipoli Campaign had a lack of vitamin C in their diet which caused many of the soldiers to contract scurvy. It is thought that scurvy is one of many reasons that the Allied attack on Gallipoli failed.

Vilhjalmur Stefansson, an arctic explorer who had lived among the Inuit, proved that the all-meat diet they consumed did not lead to vitamin deficiencies. He participated in a study in New York's Bellevue Hospital in February 1928, where he and a companion ate only meat for a year while under close medical observation, yet remained in good health.

In 1927, Hungarian biochemist Szent-Györgyi isolated a compound he called "hexuronic acid". Szent-Györgyi suspected hexuronic acid, which he had isolated from adrenal glands, to be the antiscorbutic agent, but he could not prove it without an animal-deficiency model. In 1932, the connection between hexuronic acid and scurvy was finally proven by American researcher Charles Glen King of the University of Pittsburgh. King's laboratory was given some hexuronic acid by Szent-Györgyi and soon established that it was the sought-after anti-scorbutic agent. Because of this, hexuronic acid was subsequently renamed *ascorbic acid* [29].

Sir Thomas Barlow

Sir Thomas Barlow (4 November 1845 – 12 January 1945) was a British royal physician, known for his research on infantile scurvy.



Prevention. Scurvy can be prevented by a diet that includes vitamin C-rich foods such as amla, bell peppers (sweet peppers), blackcurrants, broccoli, chili peppers, guava, kiwifruit, and parsley. Other sources rich in vitamin C are fruits such as lemons, limes, oranges, papaya, and strawberries. It is also found in vegetables, such as brussels sprouts, cabbage, potatoes, and spinach. Some fruits and vegetables not high in vitamin C may be pickled in lemon juice, which is high in vitamin C.

In the European North of Russia (Arkhangelsk, Murmansk and Nenets region) and in Scandinavian countries one of the most popular berry is *cloudberry* because it is one of the most rich by vitamins C.

Cloudberry

Some animal products, including liver, muktuk (whale skin), oysters, and parts of the central nervous system, including the adrenal medulla, brain, and spinal cord, contain large amounts of vitamin C, and can even be used to treat scurvy. Fresh meat from animals which make their own vitamin C (which most animals do) contains enough vitamin C to prevent scurvy, and even partly treat it. In some cases (notably French soldiers eating fresh horse meat), it was discovered that meat alone, even partly cooked meat, could alleviate scurvy.

History of Black death: Plague. Typhoid fever. Tetanus. History of outbreaks

Black Death: Plague. The Black Death was a plague pandemic which devastated medieval Europe from 1347 to 1352 CE, killing an estimated 25-30 million people. The disease originated in central Asia and was taken to the Crimea by Mongol warriors and traders. The plague then entered Europe via Italy, carried by rats on Genoese trading ships sailing from the Black Sea.

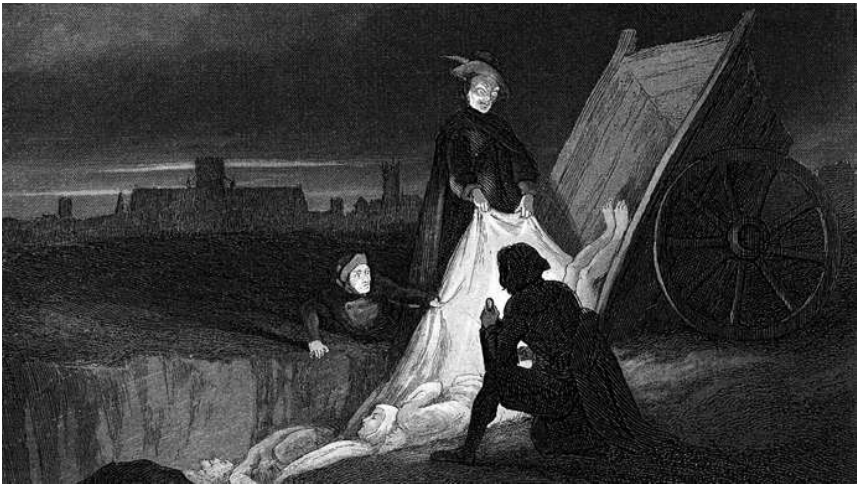
The disease was caused by a bacillus bacteria and carried by fleas on rodents. It was known as the Black Death because it could turn the skin and sores black while other symptoms included fever and joint pains. With up to two-thirds of sufferers dying from the disease, it is estimated that between 30% and 50% of the population of those places affected died from the Black Death. The death toll was so high that it had significant consequences on European medieval society as a whole, with a shortage of farmers resulting in demands for an end to serfdom, a general questioning of authority and rebellions, and the entire abandonment of many towns and villages. The worst plague in human history, it would take 200 years for the population of Europe to recover to the level seen prior to the Black Death.

The first great plague pandemic to be reliably reported occurred during the reign of the Byzantine emperor Justinian I in the 6th century CE. According to the historian Procopius and others, the outbreak began in Egypt and moved along maritime trade routes, striking Constantinople in 542. There it killed residents by the tens of thousands, the dead falling so quickly that authorities had trouble disposing of them. Judging by descriptions of the symptoms and mode of transmission of the disease, it is likely that all forms of plague were present. Over the next half-century, the pandemic spread westward to port cities of the Mediterranean and eastward into Persia. Christian writers such as John of Ephesus ascribed the plague to the wrath of God against a sinful world, but modern researchers conclude that it was spread by domestic rats, which traveled in seagoing vessels and proliferated in the crowded, unhygienic cities of the era.

The next great plague pandemic was the dreaded Black Death of Europe in the 14th century. The number of deaths was enormous, reaching two-thirds or three-fourths of the population in various parts of Europe. It has been calculated that one-fourth to one-third of the total population of Europe, or 25 million persons, died from plague during the Black Death.

Plague victims during the Black Death, 14th century.
Courtesy of the National Library of Medicine.

For the next three centuries, outbreaks of plague occurred frequently throughout the continent and the British Isles. The Great Plague of London of 1664–66 caused between 75,000 and 100,000 deaths in a population estimated at 460,000. Plague raged in Cologne and on the Rhine from 1666 to 1670 and in the Netherlands from 1667 to 1669, but after that it seems to have subsided in western Europe. Between 1675 and 1684 a new outbreak appeared in North Africa, Turkey, Poland, Hungary, Austria, and Germany, progressing northward. Malta lost 11,000 persons in 1675, Vienna at least 76,000 in 1679, and Prague 83,000 in 1681. Many northern German cities also suffered during this time, but in 1683 plague disappeared from Germany. France saw the last of plague in 1668, until it reappeared in 1720 in the port city of Marseille, where it killed as many as 40,000 people.



Great Plague of London
The Plague Pit, a mass burial of victims during the Great Plague of London (1664–66), engraving by J. Franklin. Photos.com/Thinkstock

After those last outbreaks, plague seems to have disappeared from Europe, with the exception of an area at the Caucasus border. Various explanations have been offered: progress in sanitation, hospitalization, and cleanliness; a change in domestic housing that excluded rats from human dwellings; abandonment of old trade routes; and a natural quiescent phase in the normal rise and decline of epidemic diseases. Although some of those factors may have been at work, many of those explanations were premised on the notion that plague had become firmly established in black rat populations in Europe. But whereas the plague bacterium had disappeared from much of the continent, rats remained. Modern research has suggested that plague arrived in Europe via maritime trade routes from Central Asia—namely, those that comprised part of the Silk Road. The disease may have arrived in waves, having been reimported multiple times, as a result of climate fluctuations that affected rodent populations in Asia.

At the time of the plague outbreaks in Europe, the disease was poorly understood from a medical standpoint, as the very concept of an infectious organism was unknown. As late as 1768 the first edition of the Encyclopædia Britannica repeated the commonly held scientific notion that plague was a “pestilential fever” arising from a “poisonous miasma,” or vapour, that had been brought “from eastern countries” and was “swallowed in with the air.”

Expulsion of the poison was thought to be best accomplished by either natural rupture of the buboes or, if necessary, lancing and draining them. Other recommended means were bloodletting, sweating, induction of vomiting, and loosening of the bowels.

During the 18th and early part of the 19th century, plague continued to prevail in Turkey, North Africa, Egypt, Syria, and Greece. Once it was a maxim that plague never appeared east of the Indus River, but during the 19th century it afflicted more than one district of India: in 1815 Gujarat, in 1815 Sind, in 1823 the Himalayan foothills, and in 1836 Rajasthan. These outbreaks merely set the stage for the third great plague pandemic, which is thought to have gained momentum in Yunnan province, southwestern China, in the 1850s and finally reached Guangzhou (Canton) and Hong Kong in 1894. These port cities became plague-distribution centres, and between 1894 and 1922 the disease spread throughout the whole world, more widely than in any preceding pandemic, resulting in more than 10 million deaths. Among the many points infected were Bombay in 1896, Calcutta in 1898, Cape Town and San Francisco in 1900, Bangkok in 1904, Guayaquil (Ecuador) in 1908, Colombo (Sri Lanka) in 1914, and Pensacola (Florida) in 1922. Almost all the European ports were struck, but, of all the areas affected, India suffered the most.

The third plague pandemic was the last, for it coincided with (and in some cases motivated) a series of achievements in the scientific understanding of the disease. By the end of the 19th century, the germ theory of disease had been put on a sound empirical basis by the work of the great European scientists Louis Pasteur, Joseph Lister, and Robert Koch. In 1894, during the epidemic in Hong Kong, the organism that causes plague was isolated independently by two bacteriologists, the Frenchman Alexandre Yersin, working for the Pasteur Institute, and the Japanese Kitasato Shibasaburo, a former associate of Koch. Both men found bacteria in fluid samples taken from plague victims, then injected them into animals and observed that the animals died quickly of plague. Yersin named the new bacillus Pasteurella pestis, after his mentor, but in 1970 the bacterium was renamed Yersinia pestis, in honour of Yersin himself.

It remained to be determined how the bacillus infected humans. It had long been noticed in many epidemic areas that unusual deaths among rats preceded outbreaks of plague among humans, and this link was particularly noted in the outbreaks in India and China. The relationship was so striking that in 1897 Japanese physician Ogata Masanori described an outbreak on Formosa as "ratpest" and showed that rat fleas carried the plague bacillus. The following year Paul-Louis Simond, a French researcher sent by the Pasteur Institute to India, announced the results of experiments demonstrating that Oriental rat fleas (Xenopsylla cheopis) carried the plague bacillus between rats. It was then demonstrated definitively that rat fleas would infest humans and transmit plague through their bites. With that, massive rat-proofing measures were instituted worldwide in maritime vessels and port facilities, and insecticides were used in areas where plague had broken out. Beginning in the 1930s, sulfa drugs and then antibiotics such as streptomycin gave doctors a very effective means of attacking the plague bacillus directly.

The effectiveness of these measures is told in the declining numbers of plague deaths over the following decades. From a maximum of more than one million in 1907, deaths dropped to approximately 170,000 per year in 1919–28, 92,000 in 1929–38, 22,000 in 1939–48, and 4,600 in 1949–53. Plague is no longer an epidemic disease of port cities. It is now mainly of campestral or sylvatic (that is, open-field or woodland) origin, striking individuals and occasionally breaking out in villages and rural areas where Yersinia is kept in a constant natural reservoir by various types of rodents, including ground squirrels, voles, and field mice.

In the 21st century plague was relatively rare. From 2010 to 2015 just 3,248 cases of plague, with 584 deaths, were documented worldwide. The main regions of plague included western North America; the Andes region and Brazil in South America; a broad band across Southwest, Central, and Southeast Asia; and eastern Africa. By 2020 most cases occurred in Madagascar, Peru, and the Democratic Republic of the Congo.

With the rise of global terrorism, plague has come to be seen as a potential weapon of biological warfare. During World War II Japan is said to have spread Yersinia-infected fleas in selected areas of China, and during the Cold War the United States and the Soviet Union developed means for spreading

Yersinia directly as an aerosol—a particularly efficient way to infect people with lethal pneumonic plague. Such an attack might cause a high casualty rate in only limited areas, but it might also create panic in the general population. In response, some governments have developed plans and stockpiled medications for dealing with emergency outbreaks of plague [30].

Tetanus, also called lockjaw, acute infectious disease of humans and other animals, caused by toxins produced by the bacillus *Clostridium tetani* and characterized by rigidity and spasms of the body and face muscles. The almost constant involvement of the jaw muscles accounts for the popular name of the disease.

Tetanus was well known to ancient communities and civilisations who recognized the relationship between wounds and fatal muscle spasms. In 1884, Arthur Nicolaier isolated the strychnine-like toxin of tetanus from free-living, anaerobic soil bacteria. The etiology of the disease was further elucidated in 1884 by Antonio Carle and Giorgio Rattone, two pathologists of the University of Turin, who demonstrated the transmissibility of tetanus for the first time. They produced tetanus in rabbits by injecting pus from a person with fatal tetanus into their sciatic nerves and testing their reactions while tetanus was spreading.

Kitasato Shibasaburō (born Jan. 29, 1853, Kitanosato, Higo province [now Kumamoto prefecture], Japan–died June 13, 1931, Tokyo)

Kitasato Shibasaburō, japanese physician and bacteriologist who helped discover a method to prevent tetanus and diphtheria and, in the same year as Alexandre Yersin, discovered the infectious agent responsible for the bubonic plague.

In 1891, *C. tetani* was isolated from a human victim by Kitasato Shibasaburō, who later showed that the organism could produce disease when injected into animals, and that the toxin could be neutralized by specific antibodies. In 1897, Edmond Nocard showed that tetanus antitoxin induced passive immunity in humans, and could be used for prophylaxis and treatment. Tetanus toxoid vaccine was developed by P. Descombey in 1924, and was widely used to prevent tetanus induced by battle wounds during World War [31].

Tetanus occurs in all parts of the world but is most frequent in hot and wet climates where the soil has a high organic content. In 2015 there were about 209,000 infections and about 59,000 deaths globally [31, 32]. This is down from 356,000 deaths in 1990. In the US there are about 30 cases per year, almost all of which have not been vaccinated. An early description of the disease was made by Hippocrates in the 5th century BC [33]. The cause of the disease was determined in 1884 by Antonio Carle and Giorgio Rattone at the University of Turin.

*Typhoid fever***.** According to the World Health Organization (WHO), typhoid fever continues to affect between 11 and 20 million people each year and is responsible for between 128,000 and 161,000 deaths each year.

The pathogen that is responsible for causing typhoid fever was not established until the late 19th century, which subsequently led to the introduction of the first effective vaccination against this organism one year later. The development of a vaccine against typhoid fever had a notable effect on its incidence, particularly for highly susceptible populations, such as those serving in the military.

Early history. Some historians believe that typhoid fever was responsible for a widespread plague in Athens in 430 BC, which proved fatal for one-third of the population, including the leader at the time, Pericles. His successor, Thucydides, also contracted the same disease, although it did not prove fatal.

Jamestown, which was an English colony in Virginia, is also thought by some historians to have died out as a result of typhoid fever. In fact, the fever proved fatal for more than 6,000 settlers between 1607 and 1624, and may have been responsible for eliminating the entire colony.

Military and war environments have often been subjected to the presence of typhoid fever throughout history. In excess of 80,000 soldiers died as a result of typhoid fever or dysentery in the American Civil War. Likewise, the Spanish-American War led to infections with typhoid, both on the field and in training camps.

Mary Mallon “Typhoid Mary”. Mary Mallon, who is also commonly known as Typhoid Mary, was the most widely known carrier of typhoid fever. She was the first person in the United States to be identified as a carrier of the pathogen responsible for the disease, although she did not experience any symptoms related to the condition.

Mary Mallon worked as a cook and throughout her career and is thought to have infected 51 people, of which 3 cases proved fatal. She was forcibly isolated for quarantine purposes twice in her life, once in 1907 and again in 1915. The second time she was not released and later died in isolation at the age of 69.

Prevention and vaccine development. William Budd was an English doctor responsible for treating an outbreak of typhoid in 1838 when he noted that the poison, as he then called it, was present in the excretions of the infected and could be transmitted to healthy people through consumption of contaminated water. Upon realizing this association, Budd suggested isolating excrement to help control future outbreaks.

Karl Joseph Eberth was the first to describe the bacillus that was suspected to cause typhoid fever in 1880. Four years later, pathologist Georg Gaffky confirmed this link, naming the bacillus Eberthella typhi, which is known today as Salmonella enterica.

The first effective vaccine for typhoid was developed by Almroth Edward Wright and was introduced for military use in 1896. The development and distribution of this vaccine made a significant improvement to the health of soldiers at war, who were more likely to be killed by typhoid than in combat at that time. This vaccine was further developed over the following years in London.

Throughout the 20th century, the incidence of typhoid fever steadily declined, which was both due to the introduction of vaccinations, as well as improvements in public sanitation and hygiene. In particular, the chlorination of drinking water made a significant impact on the number of individuals affected by the disease.

Today, typhoid fever is considered a rare condition among developed countries, with an incidence rate of approximately five cases per million per year [34].

Whooping cough (Pertussis), Rubella, Measles. History, epidemiology, prevention, vaccination. WHO Measles elimination strategy

Whooping cough also known as pertussis or the 100-day cough, is a highly contagious bacterial disease. Initial symptoms are usually similar to those of the common cold with a runny nose, fever, and mild cough, but these are followed by weeks of severe coughing fits. Following a fit of coughing, a high-pitched whoop sound or gasp may occur as the person breathes in.[The coughing may last for 10 or more weeks, hence the phrase "100-day cough".

Pertussis was recognizably described as early as 1578 by Guillaume de Baillou (1538-1616), but earlier reports date back at least to the twelfth century (Versteegh et al. 2005). *B. pertussis* was isolated in pure culture in 1906 by Jules Bordet and Octave Gengou, who also developed the first serology and vaccine. The complete *B. pertussis* genome of 4,086,186 base pairs was sequenced in 2002.

There is an effective pertussis vaccine that is typically given together with diphtheria and tetanus vaccine and called DTP, with a more recent formulation called DTaP when the three vaccines are combined. Although there is generally high coverage with the DTP and DTaP vaccines, the disease remains common. While particularly common in the developing world, it is estimated that 120,000 people in the United States get whooping cough each year [39, 40]. while children under the ages of two are at the greatest risk of both getting the disease and getting the serious complications (including death), individuals of any age that do not have immunity can get the disease.

Exposure to the disease gives some, but not complete immunity to subsequent infections, but such repeat infections resemble the common cold (Rowland and Frey 2005). The vaccine, itself, is only about 70 percent effective with one shot and rises to 85 percent effective when given three times, as recommended.

History of pertussis vaccine development. Infection with pertussis induces immunity, but not lasting protective immunity, and a second attack is possible. Efforts to develop an inactivated whole-cell pertussis vaccine began soon after *B. pertussis* was grown in pure culture in 1906.

In the 1920s, Dr. Louis Sauer developed a vaccine for whooping cough at Evanston Hospital (Chicago, IL). In 1925, the Danish physician Thorvald Madsen was the first to test a whole-cell pertussis vaccine on a wide scale. He used the vaccine to control outbreaks in the Faroe Islands in the North Sea.

In 1942, the American scientist Pearl Kendrick combined the whole-cell pertussis vaccine with diphtheria and tetanus toxoids to generate the first DTP combination vaccine.

To minimize the frequent side effects caused by the pertussis component of the vaccine, the Japanese scientist Yuji Sato developed an acellular pertussis vaccine consisting of purified haemagglutinins (HAs: filamentous HA and leucocytosis-promoting-factor HA), which are secreted by *B. pertussis* into the culture medium. Sato's acellular pertussis vaccine was used in Japan since the autumn of 1981. Later versions of the acellular pertussis vaccine used in other countries consisted of additional defined components of *B. pertussis* and were often part of the DTaP combination vaccine. While DTP is composed of dead bacterial cells, the newer acellular pertussis vaccine (called DTaP when combined with diphtheria and tetanus vaccines) is made up of two to five chemical components of the *B. pertussis* bacteria [35].

Rubella, also known as German measles or three-day measles, is an infection caused by the rubella virus. This disease is often mild with half of people not realizing that they are infected. A rash may start around two weeks after exposure and last for three days. It usually starts on the face and spreads to the rest of the body. The rash is sometimes itchy and is not as bright as that of measles. Swollen lymph nodes are common and may last a few weeks. A fever, sore throat, and fatigue may also occur. In adults joint pain is common. Complications may include bleeding problems, testicular swelling, and inflammation of nerves. Infection during early pregnancy may result in a child born with congenital rubella syndrome (CRS) or miscarriage. Symptoms of CRS include problems with the eyes such as cataracts, ears such as deafness, heart, and brain. Problems are rare after the 20th week of pregnancy.

Friedrich Hoffmann made a clinical description of rubella in 1740 (Ackerknecht 1982). Later descriptions by de Bergen in 1752 and Orlow in 1758 supported the belief that this was a derivative of measles. In 1814, George de Maton first suggested that it be considered a disease distinct from both measles and scarlet fever. All these physicians were German, and the disease was known medically as Rötheln (from the German name *Röteln*), hence the common name of "German measles".

English Royal Artillery surgeon, Henry Veale, observed an outbreak in India. He coined the euphonious name "rubella" (from the Latin, meaning "little red") in 1866 (MOHNZ 2006). It was formally recognized as an individual entity in 1881, at the International Congress of Medicine in London (PAHO 1998). In 1914, Alfred Fabian Hess theorized that rubella was caused by a virus, based on work with monkeys (Hess 1914). In 1938, Hiro and Tosaka confirmed this by passing the disease to children using filtered nasal washings from acute cases.

In 1940, there was a widespread epidemic of rubella in Australia. Subsequently, opthalmologist Norman McAllister Gregg found 78 cases of congenital cataracts in infants and 68 of them were born to mothers who had caught rubella in early pregnancy (Lee and Bowden 2000; Atkinson et al. 2007). Gregg published an account, *Congenital Cataract Following German Measles in the Mother*, in 1941. He described a variety of problems now know as congenital rubella syndrome (CRS) and noticed that the earlier the mother was infected, the worse the damage was (PAHO 1998). The virus was isolated in tissue culture in 1962 by two separate groups led by physicians Parkman and Weller.

There was a pandemic of rubella between 1962 and 1965, starting in Europe and spreading to the United States (MOHNZ 2006). In the years 1964-65, the United States had an estimated 12.5 million rubella cases. This led to 11,000 miscarriages or therapeutic abortions and 20,000 cases of congenital rubella syndrome. Of these, 2,100 died as neonates, 12,000 were deaf, 3,580 were blind, and 1,800 were mentally retarded. In New York alone, CRS affected one percent of all births (PAHO 1998).

In 1969, a live attenuated virus vaccine was licensed. In the early 1970s, a triple vaccine containing attenuated measles, mumps, and rubella (MMR) viruses was introduced (MOHNZ 2006).

Measles is a highly contagious vaccine-preventable disease caused by the measles virus, a member of the genus Morbillivirus in the family paramyxoviridae. It is spread by droplets or direct contact with nasal or throat secretions of infected persons; less commonly by airborne spread or by articles freshly soiled with secretions of nose and throat.

Measles is one of the most readily transmitted communicable diseases and probably the best known and most deadly of all childhood rash/fever illnesses

Measles in history was considered to be a life event that almost all children went through. References to measles can be found as far back as the 7th century A.D.

Measles was described by Muhammad ibn Zakariya ar-Razi (860-932) or Rhazes – a Persian philosopher and physician, in the 10th century A.D. as a disease that is “more dreaded than smallpox”. Razes published a book entitled “The Book of Smallpox and Measles” (in Arabic: Kitab fi al-jadari wa-al-hasbah).

Scottish physician, Francis Home, demonstrated in 1757 that measles was caused by an infectious agent present in the blood of patients.

In 1954 the virus that causes measles was isolated in Boston, Massachusetts, by John F. Enders and Thomas C. Peebles.

The history of measles underwent a sea change in 1963 with the advent of the measles vaccine. The number of measles cases dropped by 99 percent. The vaccine was first licensed in the United States in 1963.

Before the vaccine, measles affected almost all of the population at some point in their lives. There were approximately three to four million cases, and an average of 450 deaths due to measles annually in the United States. Every two to three years there was an epidemic of the infection affecting millions. Approximately 50 percent of the population had measles by the time they were six years old, and 90 percent had the disease by the time they were 15 years old.

It was between 1985 and 1988 that researchers found that many measles cases had occurred in children who had been vaccinated with the measles vaccine. This was particularly noted in children who received only one dose. These children were not always protected from the disease. This led to the recommendation of a second dose for children between 5 and 19 years of age. The booster dose significantly increased the protection and children who did not develop immunity at the first dose developed one against measles with the second dose.

Measles outbreaks in the 1990’s. The cases of measles again soared between 1989 and 1991. For these three years 55,622 cases were reported. The cases were mostly children under five years of age and a high population of unvaccinated Hispanic and African American populations was noted among those affected.

During this time the number of measles cases for children under five years of age exceeded that of the group from 5 to 19 years old. There were 123 deaths from measles-related illnesses among the cases with 50 percent being less than 5 years of age. Ninety percent of those who lost their lives had not been vaccinated. There were 64 deaths reported in 1990; this was the largest number that had been seen in almost 20 years.

Outbreaks were reported in 1993 in populations that refused measles vaccination. This included communities in Utah and Nevada, and in Christian Scientist schools in Missouri and Illinois. This changed with increased uptake of the vaccine yet again.

It was in March 2000 that an expert panel of the Center for Disease Control and Prevention (CDC) concluded that measles is no longer endemic in the United States. Due to an aggressive measles vaccination program by the Pan American Health Organization, measles incidence is now very low in Latin America and the Caribbean [36, 37].

Discovery of X-rays by W. C. Röntgen. A. Fleming and his contribution to microbiology and pharmacology. Blood group types: Karl Landsteiner

On November 8, 1895, physicist Wilhelm Conrad Röntgen (1845-1923) becomes the first person to observe X-rays, a significant scientific advancement that would ultimately benefit a variety of fields, most of all medicine, by making the invisible visible.

Röntgen's discovery occurred accidentally in his Wurzburg, Germany, lab, where he was testing whether cathode rays could pass through glass when he noticed a glow coming from a nearby chemically coated screen. He dubbed the rays that caused this glow X-rays because of their unknown nature.

X-rays are electromagnetic energy waves that act similarly to light rays, but at wavelengths approximately 1,000 times shorter than those of light. Röntgen holed up in his lab and conducted a series of experiments to better understand his discovery. He learned that X-rays penetrate human flesh but not higher-density substances such as bone or lead and that they can be photographed.

Röntgen's discovery was labeled a medical miracle and X-rays soon became an important diagnostic tool in medicine, allowing doctors to see inside the human body for the first time without surgery. In 1897, X-rays were first used on a military battlefield, during the Balkan War, to find bullets and broken bones inside patients.

Scientists were quick to realize the benefits of X-rays, but slower to comprehend the harmful effects of radiation. Initially, it was believed X-rays passed through flesh as harmlessly as light. However, within several years, researchers began to report cases of burns and skin damage after exposure to X-rays, and in 1904, Thomas Edison's assistant, Clarence Dally, who had worked extensively with X-rays, died of skin cancer. Dally's death caused some scientists to begin taking the risks of radiation more seriously, but they still weren't fully understood.

On the evening of November 8, 1895, he found that, if the discharge tube is enclosed in a sealed, thick black carton to exclude all light, and if he worked in a dark room, a paper plate covered on one side with barium platinocyanide placed in the path of the rays became fluorescent even when it was as far as two metres from the discharge tube. During subsequent experiments he found that objects of different thicknesses interposed in the path of the rays showed variable transparency to them when recorded on a photographic plate. When he immobilised for some moments the hand of his wife in the path of the rays over a photographic plate, he observed after development of the plate an image of his wife's hand which showed the shadows thrown by the bones of her hand and that of a ring she was wearing, surrounded by the penumbra of the flesh, which was more permeable to the rays and therefore threw a fainter shadow. This was the first "röntgenogram" ever taken.

Wilhelm Conrad Röntgen, Röntgen (born March 27, 1845, Lennep, Prussia [now Germany]—died February 10, 1923, Germany)

Rontgen wife's hand picture

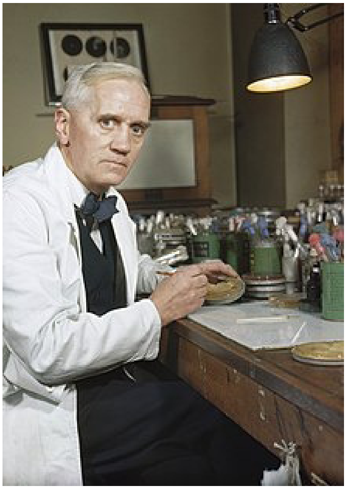
Rontgen's acceptance of the honorary title in Medicine indicated not only his loyalty to his University but also his clear understanding of the significance of his contribution to the improvement of medical science. He published a total of three papers on X-rays between 1895 and 1897. None of his conclusions have yet been proven false. Today, Röntgen is considered the Father of Diagnostic Radiology, the medical specialty that uses imaging to diagnose injury and disease.

In 1901, Röntgen was awarded the very first Nobel Prize in Physics. The award was officially, *"in recognition of the extraordinary services he has rendered by the discovery of the remarkable rays subsequently named after him"*.

In 1932 German bacteriologist Gerhard Domagk announced that Prontosil is active against streptococcal infections in mice and humans. Soon afterward French workers showed that its active antibacterial agent is sulfanilamide.

In 1936 English physician Leonard Colebrook and colleagues provided overwhelming evidence of the efficacy of both Prontosil and sulfanilamide in streptococcal septicemia (bloodstream infection), thereby ushering in the sulfonamide era. New sulfonamides, which appeared with astonishing rapidity, had greater potency, wider antibacterial range, or lower toxicity. Some stood the test of time. Others, such as the original sulfanilamide and its immediate successor, sulfapyridine, were replaced by safer and more powerful agents.

A dramatic episode in medical history occurred in 1928, when Alexander Fleming noticed the inhibitory action of a stray mold on a plate culture of staphylococcus bacteria in his laboratory at St. Mary's Hospital, London. Many other bacteriologists must have made the observation, but none had realized the possible implications. The mold was a strain of *Penicillium—P. notatum*—which gave its name to the now-famous drug penicillin. In spite of his conviction that penicillin was a potent antibacterial agent, Fleming was unable to carry his work to fruition, mainly because the techniques to enable its isolation in sufficient quantities or in a sufficiently pure form to allow its use on patients had not been developed.



Scottish physician, microbiologist and pharmacologist Alexander Fleming (6 August 1881 – 11 March 1955).

His best-known discoveries are the enzyme lysozyme in 1923 and the world's first antibiotic substance benzylpenicillin (Penicillin G) from the mould *Penicillium notatum* in 1928, for which he shared the Nobel Prize in Physiology or Medicine in 1945 with Howard Florey and Ernst Boris Chain. He wrote many articles on bacteriology, immunology, and chemotherapy.

While penicillin was the most useful and the safest antibiotic, it suffered from certain disadvantages. The most important of these was that it was not active against *Mycobacterium tuberculosis*, the bacillus of tuberculosis. However, in 1944 Selman Waksman, Albert Schatz, and Elizabeth Bugie announced the discovery of streptomycin from cultures of a soil organism, *Streptomyces griseus*, and stated that it was active against *M. tuberculosis*. Subsequent clinical trials amply confirmed this claim. Streptomycin, however, suffers from the great disadvantage that the tubercle bacillus tends to become resistant to it. Fortunately, other drugs became available to supplement it, the two most important being para-aminosalicylic acid (PAS) and isoniazid. With a combination of two or more of these preparations, the outlook in tuberculosis improved immeasurably. The disease was not conquered, but it was brought well under control.

Penicillin is not effective over the entire field of microorganisms pathogenic to humans. During the 1950s the search for antibiotics to fill this gap resulted in a steady stream of them, some with a much wider antibacterial range than penicillin (the so-called broad-spectrum antibiotics) and some capable of coping with those microorganisms that are inherently resistant to penicillin or that have developed resistance through exposure to penicillin.

This tendency of microorganisms to develop resistance to penicillin at one time threatened to become almost as serious a problem as the development of resistance to streptomycin by the bacillus of tuberculosis. Fortunately, early appreciation of the problem by clinicians resulted in more discriminate use of penicillin. Scientists continued to look for means of obtaining new varieties of penicillin, and their researches produced the so-called semisynthetic antibiotics, some of which are active when taken by mouth and some of which are effective against microorganisms that have developed resistance to the earlier form of penicillin [38].

Discovery Blood group types by Karl Landsteiner. In 1900 Karl Landsteiner found out that the blood of two people under contact agglutinates, and in 1901 he found that this effect was due to contact of blood with blood serum. As a result, he succeeded in identifying the three blood groups A, B and O, which he labelled C, of human blood. Landsteiner also found out that blood transfusion between persons with the same blood group did not lead to the destruction of blood cells, whereas this occurred between persons of different blood groups. Based on his findings, the first successful blood transfusion was performed by Reuben Ottenberg at Mount Sinai Hospital in New York in 1907.

Today it is well known that persons with blood group AB can accept donations of the other blood groups, and that persons with blood group O-negative can donate to all other groups. Individuals with blood group AB are referred to as *universal recipients* and those with blood group O-negative are known as *universal donors*. These donor-recipient relationships arise due to the fact that type O-negative blood possesses neither antigens of blood group A nor of blood group B. Therefore, the immune systems of persons with blood group A, B or AB do not refuse the donation. Further, because persons with blood group AB do not form antibodies against either the antigens of blood group A or B, they can accept blood from persons with these blood groups, as well as from persons with blood group O-negative.

In today's blood transfusions only concentrates of red blood cells without serum are transmitted, which is of great importance in surgical practice. In 1930 Landsteiner was awarded the Nobel Prize in Physiology or Medicine in recognition of these achievements. For his pioneering work, he is recognized as the father of transfusion medicine.

Karl Landsteiner, (born June 14, 1868, Vienna, Austrian Empire [Austria]—died June 26, 1943, New York, N.Y., U.S.), Austrian American immunologist and pathologist who received the 1930 Nobel Prize for Physiology or Medicine for his discovery of the major blood groups and the development of the ABO system of blood typing that has made blood transfusion a routine medical practice.

Karl Landsteiner received the Aronson Prize in 1926. In 1930, he received the Nobel Prize in Physiology or Medicine. He was elected to the National Academy of Sciences in 1932 and awarded the Cameron Prize for Therapeutics of the University of Edinburgh in 1937 and he was elected a Foreign Member of the Royal Society (ForMemRS) in 1941. In 1946, he was posthumously awarded the Lasker-DeBakey Clinical Medical Research Award.

In 1937 Karl Landsteiner identified, with Alexander S. Wiener, the Rhesus factor, thus enabling physicians to transfuse blood without endangering the patient's life.

The history of the HIV and AIDS. It is widely believed that HIV originated in Kinshasa, in the Democratic Republic of Congo around 1920 when HIV crossed species from chimpanzees to humans. Up until the 1980s, we do not know how many people were infected with HIV or developed AIDS. HIV was unknown and transmission was not accompanied by noticeable signs or symptoms.

While sporadic cases of AIDS were documented prior to 1970, available data suggests that the current epidemic started in the mid- to late 1970s. By 1980, HIV may have already spread to five continents (North America, South America, Europe, Africa and Australia). In this period, between 100,000 and 300,000 people could have already been infected.

In 1981, cases of a rare lung infection called Pneumocystis carinii pneumonia (PCP) were found in five young, previously healthy gay men in Los Angeles. At the same time, there were reports of a group of men in New York and California with an unusually aggressive cancer named Kaposi's Sarcoma.

In December 1981, the first cases of PCP were reported in people who inject drugs. By the end of the year, there were 270 reported cases of severe immune deficiency among gay men - 121 of them had died. In June 1982, a group of cases among gay men in Southern California suggested that the cause of the immune deficiency was sexual and the syndrome was initially called gay-related immune deficiency (or GRID). Later that month, the disease was reported in haemophiliacs and Haitians leading many to believe it had originated in Haiti. In September, the CDC used the term 'AIDS' (acquired immune deficiency syndrome) for the first time, describing it as "a disease at least moderately predictive of a defect in cell mediated immunity, occurring in a person with no known case for diminished resistance to that disease".

AIDS cases were also being reported in a number of European countries. In Uganda, doctors reported cases of a new, fatal wasting disease locally known as 'slim'. By this point, a number of AIDS-specific organisations had been set up including the San Francisco AIDS Foundation (SFAF) in the USA and the Terrence Higgins Trust in the UK.

In January 1983, AIDS was reported among the female partners of men who had the disease suggesting it could be passed on via heterosexual sex. In May 1983, doctors at the Pasteur Institute in France reported the discovery of a new retrovirus called Lymphadenopathy-Associated Virus (or LAV) that could be the cause of AIDS. In June 1983, the first reports of AIDS in children hinted that it could be passed via casual contact but this was later ruled out and it was concluded that they had probably directly acquired AIDS from their mothers before, during or shortly after birth. By September 1983, the CDC identified all major routes of transmission and ruled out transmission by casual contact, food, water, air or surfaces.

The CDC also published their first set of recommended precautions for healthcare workers and allied health professionals to prevent «AIDS transmission». In November, 1983 the World Health Organization (WHO) held its first meeting to assess the global AIDS situation and began international surveillance.

In April 1984, the National Cancer Institute announced they had found the cause of AIDS, the retrovirus HTLV-III. In a joint conference with the Pasteur Institute they announced that LAV and HTLV-III are identical and the likely cause of AIDS. A blood test was created to screen for the virus with the hope that a vaccine would be developed in two years. In July 1984, the CDC state that avoiding injecting drug use and sharing needles “should also be effective in preventing transmission of the virus.” In October 1984, bath houses and private sex clubs in San Francisco were closed due to high-risk sexual activity. New York and Los Angeles followed suit within a year. By the end of 1984, there had been 7,699 AIDS cases and 3,665 AIDS deaths in the USA with 762 cases reported in Europe. In Amsterdam, the Netherlands, the first needle and syringe programme was set up with growing concerns about HTLV-III/LAV.

In March 1985, the U.S Food and Drug Administration (FDA) licensed the first commercial blood test, ELISA, to detect antibodies to the virus. Blood banks began to screen the USA blood supply.

In May 1986, the International Committee on the Taxonomy of Viruses said that the virus that causes AIDS will officially be called HIV (human immunodeficiency virus) instead of HTLV-III/LAV. By the end of the year, 85 countries had reported 38,401 cases of AIDS to the World Health Organization. By region these were; Africa 2,323, Americas 31,741, Asia 84, Europe 3,858, and Oceania 395.

In February 1987, the WHO launched The Global Program on AIDS to raise awareness; generate evidence-based policies; provide technical and financial support to countries; conduct research; promote participation by NGOs; and promote the rights of people living with HIV. In 1988, the WHO declared 1st December as the first World AIDS Day.

In 1999, the WHO announced that AIDS was the fourth biggest cause of death worldwide and number one killer in Africa. An estimated 33 million people were living with HIV and 14 million people had died from AIDS since the start of the epidemic. In November 2002, the FDA approved the first rapid HIV test with 99.6% accuracy and a result in 20 minutes.

In January 2010, the travel ban preventing HIV-positive people from entering the USA was lifted. In July 2010, the CAPRISA 004 microbicide trial was hailed a success after results showed that the microbicide gel reduces the risk of HIV infection in women by 40%. Results from the iPrEx trial showed a reduction in HIV acquisition of 44% among men who have sex with men who took pre-exposure prophylaxis (PrEP).

In 2011, results from the HPTN 052 trial showed that early initiation of antiretroviral treatment reduced the risk of HIV transmission by 96% among serodiscordant couples. In August 2011, the FDA approved Complera, the second all-in-one fixed dose combination tablet, expanding the treatment options available for people living with HIV.

In July 2012, the FDA approved PrEP for HIV-negative people to prevent the sexual transmission of HIV. For the first time, the majority of people eligible for treatment were receiving it (54%).

In 2013, UNAIDS reported that AIDS-related deaths had fallen 30% since their peak in 2005. An estimated 35 million people were living with HIV. In September 2014, new UNAIDS "Fast Track" targets called for the dramatic scaling-up of HIV prevention and treatment programmes to avert 28 million new infections and end the epidemic as a public health issue by 2030. UNAIDS also launched the ambitious 90-90-90 targets which aim for 90% of people living with HIV to be diagnosed, 90% of those diagnosed to be accessing antiretroviral treatment and 90% of those accessing treatment to achieve viral suppression by 2020.

In July 2015, UNAIDS announced that the Millennium Development Goal (MDG) relating to HIV and AIDS had been reached six months ahead of schedule.

The target of MDG 6 – halting and reversing the spread of HIV – saw 15 million people receive treatment. In September 2015, the WHO launched new treatment guidelines recommending that all people living with HIV should receive antiretroviral treatment, regardless of their CD4 count, and as soon as possible after their diagnosis. In October 2015, UNAIDS released their 2016-2021 strategy in line with the new Sustainable Development Goals (SDGs), that called for an acceleration in the global HIV response to reach critical HIV prevention and treatment targets and achieve zero discrimination. The number of people in Russia living with HIV reached one million. Newly released figures also showed 64% of all new HIV diagnoses in Europe occurred in Russia.

UNAIDS announced that 18.2 million people were on ART, including 910 000 children, double the number five years earlier. However, achieving increased ART access means a greater risk of drug resistance and the WHO released a report on dealing with this growing issue.

AVERT marked its 30th anniversary - having provided HIV and AIDS information from the start of the epidemic we continue our work to empower people through knowledge to avert HIV.

For the first time ever, more than half of the global population living with HIV are receiving antiretroviral treatment, a record of 19.5 million people.

Organisations around the world endorse "Undetectable = Untransmittable"(U=U). This anti-stigma slogan launched by the Prevention Access Campaign is based on robust scientific evidence that people who have adhered to treatment and achieved an undetectable viral load cannot pass the virus on. In 2017 'U=U' becomes a defining message of the HIV response in many well-resourced countries, but fails to have the same impact in lower resource settings, where viral-load monitoring is more difficult.

New infections have fallen by a third in East and Southern Africa over the last six years, with particular decreases among young women and girls. It is thought that this is partly due to the success of the DREAMS initiative, which aimed to reduce HIV infections among women and girls in sub-Saharan Africa by providing them with economic opportunities as well as better HIV services and education.

Since 2016, WHO has recommended that all people living with HIV be provided with lifelong ART, including children, adolescents, adults and pregnant and breastfeeding women, regardless of clinical status or CD4 cell count.

By June 2021, 187 countries had already adopted this recommendation, covering 99% of all people living with HIV globally. In addition to the treat all strategy, WHO recommends a rapid ART initiation to all people living with HIV, including offering ART on the same day as diagnosis among those who are ready to start treatment. By June 2020, 82 low- and middle-income countries reported that they have adopted this policy, and approximately half of them reported country-wide implementation.

Globally, 27.5 million [26.5–27.7 million] people living with HIV were receiving ART in 2020. This equates to a global ART coverage rate of 73% [56–88%]. However, more efforts are needed to scale up treatment, particularly for children and adolescents. Only 54% [37–69%] of children (0–14 years old) were receiving ART at the end of 2020 [39, 40, 41, 42].

History of Tuberculosis. Scientists have found that the disease appeared in Africa about 70 thousand years ago and since then “follows” humanity. Archaeologists have found human remains Dating back 3 thousand years BC, with well-recognized signs of tuberculous bone damage.

Long before the discovery of the nature of infectious diseases, people already assumed that tuberculosis was a contagious disease. For example, the Babylonian Code of Hammurabi established the right to divorce a sick wife who had signs of pulmonary tuberculosis. In the middle ages, tuberculosis of the lungs was called consumption (from the word to wither). And in Ancient India (laws of Manu) it was forbidden to marry such a woman. Information about tuberculosis has also been found in ancient Chinese manuscripts.

At a later time, the Greek physician Hippocrates (460-377 BC) described the General signs of pulmonary tuberculosis. However, he did not understand the cause and pathogenesis of tuberculosis correctly — he reduced everything to mixing mucus in the brain, which gets into the lungs and becomes inflamed. Hippocrates mistakenly believed that tuberculosis was a hereditary disease.

An important role was played by the work of Avicenna (980-1037), who attached great importance to the influence of the environment on the development and course of tuberculosis, and also pointed to the connection of pleurisy (inflammation of the serous lining of the lungs) with pulmonary tuberculosis. He considered tuberculosis a contagious disease and believed in the possibility of healing patients.

In ancient Russian Chronicles, tuberculosis of the lymph nodes is repeatedly mentioned, which at that time was treated by surgery and cauterization. This is how the Grand Duke of Kiev Svyatoslav Yaroslavich was treated in 1076.

Only in the second half of the XVII century, the science of tuberculosis began to develop rapidly. So, Because of Willisii (1621-1675) at autopsy deaths from tuberculosis have detected characteristic changes in their bodies. In the XVII century, F. Sylvius first associated ulcers found during autopsy with signs of consumption.

And in 1822, the English doctor James Carlson expressed the idea and made the first, but unsuccessful, attempt to treat tuberculosis with an artificial pneumothorax. Six decades later, in 1882, the Italian Carlo Forlanini managed to introduce this method into practice.

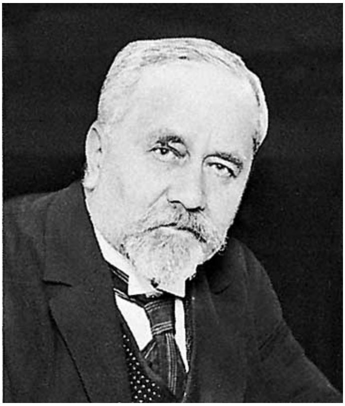
In 1865, a French naval doctor, Jean-Antoine Villemain, observed the spread of tuberculosis on a ship from one sick sailor to the others. As proof of the contagious nature of the disease, the doctor collected the sputum of patients and soaked it in the litter for Guinea pigs. The pigs contracted tuberculosis and died. Thus, the researcher proved that tuberculosis is a contagious disease.

In 1882, in Germany, Robert Koch discovered the causative agent of tuberculosis, which was called Koch's Bacillus. He discovered the pathogen by microscopic examination of the patient's sputum.Unlike other microbes, the tuberculosis bacterium was extremely tenacious: it feels great in the ground and in the snow, resistant to alcohol, acid and alkali. It can only die under prolonged exposure to direct sunlight, high temperatures and chlorine-containing substances.

For his research on tuberculosis, R. Koch received the Nobel Prize in Physiology or Medicine in 1905

BCG vaccine, vaccine against tuberculosis. The BCG vaccine is prepared from a weakened strain of *Mycobacte-*

rium bovis, a bacteria closely related to *M. tuberculosis*, which causes the disease. The vaccine was developed over a period of 13 years, from 1908 to 1921, by French bacteriologists Albert Calmette and Camille Guérin, who named the product *Bacillus Calmette-Guérin*, or BCG. The vaccine is administered shortly after birth only in infants at high risk of tuberculosis. BCG vaccine produces an immune response that partly protects infants and young children from serious forms of tuberculosis. Because of the risk of infection and variability in protection associated with the vaccine, it is used only in countries where the prevalence of tuberculosis is high.



Albert Calmette, in full Albert Léon Charles Calmette, (born July 12, 1863, Nice, France—died Oct. 29, 1933, Paris), French bacteriologist, pupil of Louis Pasteur, and codeveloper with Camille Guérin of the tuberculosis vaccine Bacillus Calmette-Guérin (BCG). He also described a diagnostic test for tuberculosis, known as Calmette's reaction.

Camille Guérin, (born Dec. 22, 1872, Poitiers, Fr.—died June 9, 1961, Paris), French co-developer, with Albert Calmette, of Bacillus Calmette-Guérin, or BCG, a vaccine that was widely used in Europe and America in combatting tuberculosis.

Global efforts to combat tuberculosis (TB) have saved an estimated 53 million lives since 2000 and reduced the TB mortality rate by 37%, according to the "Global TB Report 2017" released by the World Health Organization (WHO) today. Despite these achievements, the latest picture is grim. TB remains the top infectious killer in 2016. TB is also the main cause of deaths related to antimicrobial resistance and the leading killer of people with HIV. Progress in most countries is stalling and is not fast enough to reach global targets or close persistent gaps in TB care and prevention.

Malaria. Yellow fever. History of epidemiology and prevention. WHO programs against malaria and yellow fever

Malaria history. The history of malaria stretches from its prehistoric origin as a zoonotic disease in the primates of Africa through to the 21st century. A widespread and potentially lethal human infectious disease, at its peak malaria infested every continent, except Antarctica. Its prevention and treatment have been targeted in science and medicine for hundreds of years. Since the discovery of the Plasmodium parasites which cause it, research attention has focused on their biology, as well as that of the mosquitoes which transmit the parasites.

The human species has suffered from malaria for thousands of years. In ancient Egypt malaria probably occurred in lowland areas; the enlarged spleens of some Egyptian mummies are surviving traces of its presence. Tutankhamen, who reigned as king of ancient Egypt from 1333 to 1323 BCE, may have been afflicted by the disease; in 2010 scientists recovered traces of malaria parasites from the mummified remains of his blood.

In ancient Greece malaria appeared annually as an autumnal fever and was described by Hippocrates and others. Some scholars have surmised that malaria occurring in Greece in those times was probably caused by P. vivax and P. malariae. By the later classical period of the Roman Empire, however, malaria was a much more serious disease than it had previously been in the lands along the north shore of the Mediterranean Sea, and the association of malaria with the Pontine Marshes of the Roman Campagna was well established. Modern malariologists have attributed this increase in the severity of malaria to ecological changes associated with deforestation that had accompanied intensified agricultural activities—changes that allowed new species of mosquitoes from North Africa to be introduced and successfully established in southern Europe. Two of the introduced species were better transmitters of P. falciparum than any of the native European insects.

Alexander the Great, whose death on the banks of the Euphrates River in June 323 BCE was attributed to malaria, shared that fate with numerous illustrious victims. In the Italian peninsula, malaria killed Pope Innocent III as he was preparing to lead a Crusade to the Holy Land in 1216, the poet Dante Alighieri in 1321, and Pope Leo X in 1521. The artist Raphael, who painted a famous portrait of Leo X, also died of malaria (in 1520). Thirty-eight years later the former Holy Roman emperor Charles V reportedly succumbed to the disease in Spain.

Malarial fevers were associated with swamps and marshes as early as classical Greece, but the role of mosquitoes in transmitting the infection was completely unknown. Many of the early Greeks thought the disease was contracted by drinking swamp water; later, because the Romans attributed it to breathing "miasmas," or vapours, arising from bodies of stagnant water, the disease came to be called mal aria, or "bad air." Since early Greek times, attempts were made to control malaria by draining swamps and stagnant marshes, but a specific treatment for the disease did not become available in Europe until the 1630s, when bark of the cinchona tree was introduced into Spain from Peru. The skillful use of "Peruvian bark" by the great English physician Thomas Sydenham helped to separate malaria from other fevers and served as one of the first practices of specific drug therapy. The lifesaving drug became much more widely available by the mid-19th century, after the active ingredient of cinchona, quinine, was successfully isolated and the Dutch began to cultivate the cinchona tree in plantations on the island of Java.

Following the introduction of cinchona bark, no comparably significant advance in the understanding of malaria or its control came until after the 1870s, when pioneering studies by Louis Pasteur in France and Robert Koch in Germany laid the foundations of modern microbiology. In November 1880 Alphonse Laveran, a French military physician working in Algeria, showed that the elements seen in red blood cells of certain patients were parasites responsible for their hosts' malaria. Laveran won a Nobel Prize in 1907 in part for this discovery. In August 1897, in India, British bacteriologist Ronald Ross discovered parasites of a malaria of birds in the stomach of a *Culex* mosquito, and in 1898, in Rome, Giovanni Grassi and his colleagues discovered a parasite of human malaria in an Anopheles mosquito. A bitter controversy that ensued between Ross and Grassi and their respective partisans over priority of discovery was one of the most vitriolic public quarrels in modern science. (Ross was awarded a Nobel Prize in 1902.)

Immediately following the discovery that mosquitoes were the vectors for transmitting malaria to humans, William C. Gorgas, an American army surgeon, led two campaigns of mosquito reduction using sanitary measures (drainage and larviciding) in Cuba and Panama. Gorgas's campaign made the U.S. construction of the Panama Canal possible. It also made the killing of mosquito larvae by spreading oil on their breeding sites another widely accepted means of controlling the disease. In 1939–40 Fred Soper of the Rockefeller Foundation led a vigorous effort in Brazil that eradicated the *Anopheles gambiae* mosquito, using a dust larvicide (Paris green) against the larvae and a newly discovered insecticide (pyrethrum) against the adult insects. The entire antimalarial effort was given an enormous boost in 1939 when the Swiss chemist Paul Müller discovered the insecticidal properties of DDT. (Müller received a Nobel Prize in 1948 for his work.) After a six-year campaign (1946–51) of spraying DDT in Sardinia, malaria virtually disappeared from that Mediterranean island. Similar success was achieved in Greece, and with that, public health officials began to contemplate the possible eradication of malaria from the globe.

Even as these multiple methods of attacking the mosquito vector were being improved, direct means of attacking the parasite itself were also refined. Chloroquine, the mainstay of modern antimalarial drugs, was first synthesized in Germany in 1934, and pyrimethamine was synthesized in the United States during World War II (1939–45) by a team that included future Nobel laureates George H. Hitchings and Gertrude B. Elion. The value of the synthetic antimalarials was heightened for the wartime Allies after Japan seized Java, where the Dutch cinchona plantations were the main source of quinine. Because the synthetics were cheaper, more plentiful, and caused fewer side effects than the natural products from bark, they too raised hopes after the war of winning a global campaign against malaria.

In 1955 the World Health Organization (WHO) inaugurated its Global Malaria Eradication Campaign, to be based mainly on the spraying of insecticide in designated “malarious areas” of the world. The program resulted in the elimination of endemic malaria from Europe, Australia, and other developed areas and in a radical reduction of cases in less-developed countries such as India. However, by 1969 WHO was forced to abandon its dream of complete eradication. Species of Anopheles mosquitoes had quickly developed resistance to DDT, and the insecticide itself fell out of favour owing to its cost and ecological effects. More disturbing was the appearance of drug-resistant strains of Plasmodium. The first chloroquine-resistant parasites emerged in the late 1950s and early 1960s in Asia and Latin America, and soon almost no country with endemic malaria was without drug-resistant parasites. In the late 1990s and early 2000s partnership-based aid programs, such as the Multilateral Initiative on Malaria and the Malaria Vaccine Initiative, were established to support the fight against malaria. Some of these programs aim to fund a broad range of malaria research, whereas others aim to fund ongoing malaria control efforts in endemic areas. These control efforts, which are the focus of antimalarial strategies established by the WHO, include the dissemination of insecticide-treated netting, the provision of prophylactic drugs to pregnant women, and earlier and more effective treatment of clinical cases, preferably through the use of multidrug “combination therapy” in order to attack drug-resistant parasites.

In the early 21st century, declining numbers of malaria cases and deaths suggested that efforts to control the disease were working. In 2011 officials estimated that, if control efforts were sustained, malaria could be eliminated from one-third of all affected countries within a decade. By mid-2021, 40 countries worldwide had been declared malaria-free by WHO.

For thousands of years, traditional herbal remedies have been used to treat malaria. The first effective treatment for malaria came from the bark of the cinchona tree, which contains quinine. After the link to mosquitos and their parasites was identified in the early twentieth century, mosquito control measures such as widespread use of the insecticide DDT, swamp drainage, covering or oiling the surface of open water sources, indoor residual spraying and use of insecticide treated nets was initiated. Prophylactic quinine was prescribed in malaria endemic areas, and new therapeutic drugs, including chloroquine and artemisinins, were used to resist the scourge. Today, artemisinin is present in every remedy applied in treatment of malaria. After introducing artemisinin as a cure administered together with other remedies, malaria mortality in Africa went down by half, though it later partially rebounded.

Malaria researchers have won multiple Nobel Prizes for their achievements, although the disease continues to afflict some 200 million patients each year, killing more than 600,000.

Malaria was the most important health hazard encountered by U.S. troops in the South Pacific during World War II, where about 500,000 men were infected.[6] According to Joseph Patrick Byrne, “Sixty thousand American soldiers died of malaria during the African and South Pacific campaigns.”

At the close of the 20th century, malaria remained endemic in more than 100 countries throughout the tropical and subtropical zones, including large areas of Central and South America, Hispaniola (Haiti and the Dominican Republic), Africa, the Middle East, the Indian subcontinent, Southeast Asia, and Oceania. Resistance of Plasmodium to anti-malaria drugs, as well as resistance of mosquitos to insecticides and the discovery of zoonotic species of the parasite have complicated control measures [43].

Globally, the elimination net is widening, with more countries moving towards the goal of zero malaria. In 2018, 27 countries reported fewer than 100 indigenous cases of the disease, up from 17 countries in 2010. Countries that have achieved at least 3 consecutive years of 0 indigenous cases of malaria are eligible to apply for the WHO certification of malaria elimination. Over the last decade, 10 countries have been certified by the WHO Director-General as malaria-free: Morocco (2010), Turkmenistan (2010), Armenia (2011), Maldives (2015), Sri Lanka (2016), Kyrgyzstan (2016), Paraguay (2018), Uzbekistan (2018), Algeria (2019) and Argentina (2018). The WHO *Framework for Malaria Elimination* (2017) provides a detailed set of tools and strategies for achieving and maintaining elimination.

RAT’S Is the first and, to date, the only vaccine to show that it can significantly reduce malaria, and life-threatening severe malaria, in young African children. It acts against *P. falciparum*, the deadliest malaria parasite globally and the most prevalent in Africa. Among children who received 4 doses in large-scale clinical trials, the vaccine prevented approximately 4 in 10 cases of malaria over a 4-year period. In view of its public health potential, WHO's top advisory bodies for malaria and immunization have jointly recommended phased introduction of the vaccine in selected areas of sub-Saharan Africa. Three countries – Ghana, Kenya and Malawi – began introducing the vaccine in selected areas of moderate and high malaria transmission in 2019. Vaccinations are being provided through each country's routine immunization program.

The pilot program will address several outstanding questions related to the public health use of the vaccine. It will be critical for understanding how best to deliver the recommended 4 doses of RTS; the vaccine's potential role in reducing childhood deaths; and its safety in the context of routine use. This WHO-coordinated program is a collaborative effort with Ministries of Health in Ghana, Kenya and Malawi and a range of in-country and international partners, including PATH, a non-profit organization, and the vaccine developer and manufacturer. Financing for the vaccine program has been mobilized through a collaboration between 3 major global health funding bodies: Gavi, the Vaccine Alliance, the Global Fund to Fight AIDS, Tuberculosis and Malaria, and UniAID.

The WHO *Global technical strategy for malaria 2016-2030* – adopted by the World Health Assembly in May 2015 – provides a technical framework for all malaria-endemic countries. It is intended to guide and support regional and country programmes as they work towards malaria control and elimination.

Yellow fever history. Yellow fever is an epidemic-prone mosquito-borne vaccine preventable disease that is transmitted to humans by the bites of infected mosquitoes. Yellow fever is caused by an arbovirus (a virus transmitted by vectors such mosquitoes, ticks or other arthropods) transmitted to humans by the bites of infected *Aedes* and *Haemagogus* mosquitoes. These day-biting mosquitoes breed around houses (domestic), in forests or jungles (wild), or in both habitats (semi-domestic). Yellow fever is a high-impact high-threat disease, with risk of international spread, which represents a potential threat to global health security.

There are 3 types of transmission cycles. The first is sylvatic (or jungle) yellow fever in which monkeys, which are the primary reservoir of yellow fever, are bitten by wild mosquitoes that pass the virus on to other monkeys and occasionally humans. The second is intermediate yellow fever in which semi-domestic mosquitoes infect both monkeys and people. This is the most common type of outbreak in Africa. The third is urban yellow fever of which large epidemics occur when infected people introduce the virus into heavily populated areas with high mosquito density and where people have little immunity. In these conditions, infected mosquitoes transmit the virus from person to person.

Strong case-based surveillance for yellow-fever can help detect outbreaks early as well as spread to new areas. Occasionally, infected travelers have exported cases to countries that are free of yellow fever. However, the disease can only spread easily if the country it is imported to has mosquito species able to transmit it, specific climatic conditions and the animal reservoir needed to maintain it. To prevent international spread, it is essential that the International Health Regulations (2005) are applied and that travelers to high risk areas present yellow fever vaccination certificates – these certificates are valid for life.

The first of the viral vaccines to result from these advances was for yellow fever, developed by the microbiologist Max Theiler in the late 1930s. South African American virologist and physician. He was awarded the Nobel Prize in Physiology or Medicine in 1951 for developing a vaccine against yellow fever in 1937, becoming the first African-born Nobel laureate.

Max Theiler (30 January 1899 – 11 August 1972)

The global *Eliminate yellow fever epidemics (EYE) strategy* has been developed by a coalition of partners (Gavi, UNICEF and WHO) to face yellow fever's changing epidemiology, resurgence of mosquitoes, and the increased risk of urban outbreaks and international spread. This global, comprehensive long-term strategy (2017-2026) targets the most vulnerable countries, while addressing global risk, by building resilience in urban centers, and preparedness in areas with potential for outbreaks and ensuring reliable vaccine supply.

World History and Development of Public Health

Among the various areas of medical specialties, public health and healthcare have traditionally been given a special place, this is due to its universal, interdisciplinary, synergistic approach to the tasks being solved.

Public health and healthcare are considered from the point of view of the academic discipline, scientific specialty and practical activity, its main concept is the organization of preventive work among the population.

Public health has deep history. In different periods of history, both domestic and foreign scientists and physicians gave different definitions of it. This was because of to the peculiarities of the historical periods in the development of the countries, the actuality of the problems to be solved, the professional and political ideas of the authors, and other current situations. At the same time, the peculiarities of history and national traditions were important. This science in English-speaking countries is more often called “public health”, in French-speaking countries - “social medicine”, in the United States earlier than in other countries, it began to be referred to as “ medical sociology”.

Public health has early roots in antiquity. From the beginnings of human civilization, it was recognized that polluted water and lack of proper waste disposal spread communicable diseases (theory of miasma). Early religions attempted to regulate behavior that specifically related to health, from types of food eaten, to regulating certain indulgent behaviors, such as drinking alcohol or sexual relations. Leaders were responsible for the health of their subjects to ensure social stability, prosperity, and maintain order.

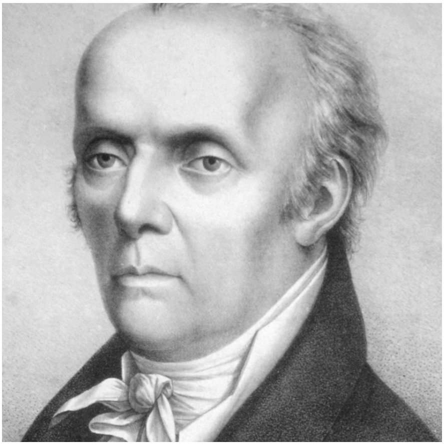
By Roman times, it was well understood that proper diversion of human waste was a necessary tenet of public health in urban areas. The ancient Chinese medical doctors developed the practice of variolation following a smallpox epidemic around 1000 BC. An individual without the disease could gain some measure of immunity against it by inhaling the dried crusts that formed around lesions of infected individuals. Also, children were protected by inoculating a scratch on their forearms with the pus from a lesion.

The 18th century saw rapid growth in voluntary hospitals in England. The latter part of the century brought the establishment of the basic pattern of improvements in public health over the next two centuries: a social evil was identified, private philanthropists brought attention to it, and changing public opinion led to government action.

The practice of vaccination became prevalent in the 1800s, following the pioneering work of Edward Jenner in treating smallpox. James Lind's discovery of the causes of scurvy amongst sailors and its mitigation via the introduction of fruit on lengthy voyages was published in 1754 and led to the adoption of this idea by the Royal Navy. Efforts were also made to promulgate health matters to the broader public; in 1752 the British physician Sir John Pringle published *Observations on the Diseases of the Army in Camp and Garrison*, in which he advocated for the importance of adequate ventilation in the military barracks and the provision of latrines for the soldier.

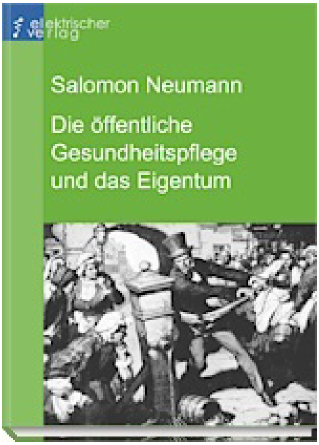
The first systematic guide to social hygiene was Frank's multi-volume work "System einer vollstandingen medizinischen Polizei", written between 1779 and 1819. The socialist-utopian doctors who held leadership positions during the revolutions of 1848 and 1871 in France tried to scientifically justify public health measures, considering social medicine to be the key to improving society.

The bourgeois revolution of 1848 was important for the development of social medicine in Germany. One of the social-hygienists of that



Johann Peter Frank (German: Johann Peter Frank; (1745-1821) time was Rudolf Virchow. He emphasized the close connection between medicine and politics. His work «Mitteilungen uber Oberschlesien herrschende Typhus-Epidemie» is considered one of the classics in German social hygiene. Virchow was known as a democratically minded physician and researcher.

A contemporary of Virchow, Solomon Neumann, introduced the concept of “social medicine” into German literature. In the work “Die offentliche Gesundshitspflege und das Eigentum” published in 1847, he convincingly proved the role of social factors in the development of public health.

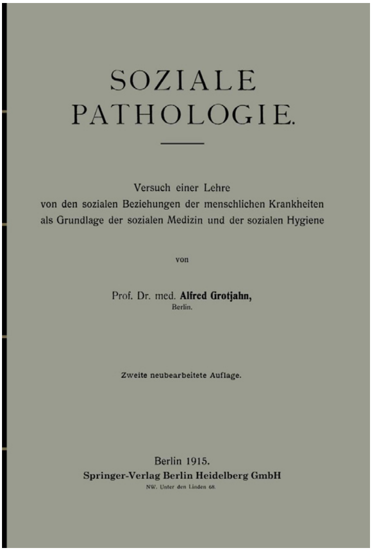


Neumann, Solomon-German physician and writer;
b. in Piritz (Pomerania) in 1819, the author of a number of medical works.

From today’s point of view, most of Neumann’s demands seem perfectly natural, but at the time they seemed utopian: a state commitment to organizing public health, improving medical care for the poor, thanks to which even the poor could enjoy adequate medical care, the creation of medical departments, the creation of medical statistics on the causes and effects of diseases. In addition, Neumann demanded an improvement in the scientific training of doctors, their self-organization, and generally a Democratic restructuring of the state.

Development of Public Health in Russia and abroad in the 20-th century

The founder of social hygiene as a science in Germany was outstanding physician and scientist A. Grotian. In 1904, Grotian wrote: “Hygiene should study in detail the effects of social relations, and the social environment in which people are born, live, work, enjoy, continue their kind, and finally die. So it becomes social hygiene, which stands next to physical and biological hygiene as its complement.” According to A. Grotian, the subject of social and hygienic science is the analysis of the conditions in which the relationship between man and the environment is carried out. As a result of such studies, A. Grotian approached the second side of the subject of public health, that is, the development of norms that regulate the relationship between a person and the public environment so that they strengthen his health and benefit him.


SOZIALE
PATHOLOGIE.

Versuch einer Lehre
von den sozialen Beziehungen der menschlichen Krankheiten
als Grundlage der sozialen Medizin und der sozialen Hygiene

von

Prof. Dr. med. **Alfred Grotjahn,**
Berlin.

Zweite neubearbeitete Auflage.

Berlin 1915.
Springer-Verlag Berlin Heidelberg GmbH
NW. Unter den Linden 68.

Alfred Grotjahn (1869-1931), German physician, one of the founders of social hygiene. Works on alcoholism, sexually transmitted diseases, birth control, etc. Fundamental works: «Dictionary of social hygiene» (vol. 1-2, 1912; together with I. Kaup), «Social Pathology» (1912; Russian translation 1925-26).

In 1913, in Berlin, a manual for doctors, economists, management and social reform figures by Alphonse Fischer “Fundamentals of Social Hygiene”was published. In the opinion of G. F. Frenkel, this publication on social hygiene, which appeared in German literature, is the best of the manuals available at that time, a well-defined science, with a rich factual material, well-founded statements and conclusions.

Monograph of Alphonse Fischer “Fundamentals of social hygiene”, translated from German by N. A. Zimilova. Moscow: State Medical Publishing House, 1929. - 568 p.

Alphonse Fischer has the merit of building a strictly consistent scientific system of research and presentation that make up the content of social hygiene. The system program of social hygiene developed by Fischer consists of four sections. The first section is called the “General Part”, which describes the field and problems of social hygiene, research methods and scientific institutions of social hygiene, and the history of social hygiene. The second section is called “The main and constituent parts of social hygiene”, which include - the composition and movement of the population, working life conditions in connection with professional and social stratification, the height of earnings and lifestyle, food business (food consumption by the entire population and its individual layers, social measures aimed at improving public nutrition), housing conditions (their impact on health, their current state and activities to improve them), clothing, skin care (folk baths), recreation, physical culture, procreation (heredity, the fight against low birth rates, measures for the birth of healthy persons). The third section "Socio-hygienic describes the state of individual population groups" describes the socio-hygienic characteristics and health protection of age and professional groups: mothers, infants, young children, school-age children, young people, workers of various professions, employees. The last fourth section is entitled "The influence of the cultural environment on certain types of diseases", it examines the relationship of individual disease forms with social and economic conditions. Among the diseases identified are infectious diseases, tuberculosis, sexual diseases, alcoholism, nervous and suffocating diseases, injuries (disabled people). The fourth section ends with state measures of cultural hygiene [44].

In England, in the XIX century, there were prominant figures of public health, but the first department of social medicine was established in England only in 1943 by J. Ryle at Oxford University. Before the II World War, the situation in England was very complicated and scientists and physicians were talking about the need to found a new modern discipline — social medicine.

The Johns Hopkins University School of Hygiene and Public Health was the first school of public health to open during the 1918 flu epidemic.

The Institute of Social Medicine, University of Oxford (United Kingdom).

Later, representatives of the Rockefeller Foundation agreed to fund additional schools of public health, including those at Harvard and Toronto. These early schools were well-funded by private universities that attracted faculty with medical degrees, and the universities had curricula more focused on fighting infectious diseases. Since the Rockefeller Foundation provided scholarships to medical graduates from all countries, the schools generally had an international contingent. By 1930, the first schools produced a limited number of specialists with appropriate education, which did not cover the need for the necessary number of specialists in the field of public health.

In 1936, 10 schools taught public health programs in USA requiring at least one year of study, namely Johns Hopkins University, Harvard University, Columbia University, the University of Michigan, the University of California (Berkeley), the Massachusetts Institute of Technology, the University of Minnesota, the University of Pennsylvania, Wayne State University, and Yale University. By 1938, more than 4,000 people (1,000 of whom were doctors) had received appropriate public health training with funds provided to the states by the federal Government. Increased funding and the increasing need for public health graduates have led many colleges and universities to open public health departments and create programs offering training courses lasting several months or even weeks. Federal training funds were allocated to the State of California, the State of Michigan, Minnesota, and North Carolina to develop short courses for rapid training of public health professionals.

Harvard School of Public Health

Harvard School of Public Health has its roots to public health activity at the beginning of the last century, a time of energetic social reform. The School began as the Harvard School of Health Officers, founded in 1913 as the first professional public health training program in the United States. The partnership offered courses in preventive medicine at Harvard Medical School, sanitary engineering at Harvard University and allied subjects at Massachusetts Institute of Technology.

Public Health Education in NSMU

Department of public health in the NSMU was established in 1936. That means the Department of Public Health, Health Care and Social Work is celebrating 85 Anniversary this year. The main objects of research at the Department were health of children, structure of causes mortality of the population in the North, organizational approaches to outpatient care organization. Later, in 1940s - questions of sanitary statistics, physical development and demographic consequences of the Great Patriotic wars in the North, problems of medical prevention, follow-up patients with chronic disease by primary care physicians were in the focus of Department's research.

Professor R.V. Bannikova was a head of the Department in 1957 – 1996. Actually, she was a founded the scientific School of Social Hygienists and Health Organizers in the North-West of Russia. The results of her community-demographic expedition to Nenets National District made a basis of research activities at the Department and were implemented into the study process. From the beginning of the 90s. Russia went into a period of deep socio-economic crisis. Thus, research of the department included health problems of refugees, internally displaced persons, unemployed, persons, prisoners, disabled and convicted persons.

Department's research in the first two decades of the XXI century investigate the health of newborns, children and adolescents living in the northern regions of the country. These data are used to justify measures aimed at strengthening interdisciplinary cooperation aimed to solve this problem. Another direction of scientific work the staff of the department is an assessment medico-social and demographic consequences of alcohol abuse.

Russia has been one of the world “leaders” in frequency artifactual pregnancy terminations. The incidence of abortions in the Arkhangelsk region is even higher than average in the country. The unique longitudinal research conducted at the department (in 1986, 1996, 2005, 2014) made it possible to study main reasons for so high prevalence of induced abortions in the region; to justify the necessary measures for their prevention.

New era in public health education in NSMU has been started in 2007: Master program in public health has been established at the University. The Arkhangelsk International School of Public Health (ISPHA) was found in the NSMU to organize the program within the framework of an international project. Six universities of Northern Europe took part in the project: Institute of Community Medicine, University of Tromsø (Norway), Nordic School of Public Health (Sweden), Umeå University International School of Public Health (Sweden), University of Middle Sweden (Sweden), Tampere University School of Public Health (Finland), National Institute of Public Health (Norway). The foundation of the Master’s program became possible with the financial support of the program of cooperation in the field of health and related social issues in the Barents Euro-Arctic Region.

In 2007 ISPHA was the first place in Russia, there international Master’s program in public health was conducted. In October 2007, ISPHA became the first and is currently it is only Russian school of public health accepted as a member of the Association of Schools of Public Health in the European Region (ASPHER).

In December 2007, ISPHA was featured in the bulletin of the World Health Organization as one of the first educational institutions in Russia offering education in the field of public health in accordance with international standards.

In 2009, the field of training “Public health” was included in the Russian state list of educational programs, and the federal state educational standard of higher professional education in this area was approved in 2010. NSMU became the first university in Russia to be licensed in this specialty on April 19, 2011.

ISPHA is currently offering a Master of Public Health (MPH) two-year Master of Public Health (MPH) program in line with international standards. When developing the program, the recommendations on the creation of a unified pan-European system of higher education, referred to as the Bologna Declaration of 1999, were considered. The basic educational program and curriculum of the Master's program implemented in the ISPHA are developed in accordance with the Federal State Educational Standard of Higher Professional Education in the direction of preparation 32.04.01 "Public Health".

In the process of training, ISPHA is closely collaborates with medical and research organizations of Arkhangelsk region students undergo a number of practices at the Medical Information and Analytical Center, Arkhangelsk Regional Center for Public Health and Medical Prevention, the Central Research Laboratory of the NSMU, the Corporation for the Development of the Arkhangelsk Region, the Federal Research Center for the Arctic Research, there they carry out research work, the result of which considered to be a basis of master's thesis.

The master's thesis is a research work devoted to solving an urgent problem that has theoretical or practical significance for modern science, containing a set of new scientific results and provisions.

Since 2012, a doctoral program has been implemented at the ISPHA together with the Arctic University of Norway (University of Tromsø) and The Norwegian University of Science and Technology (Trondheim), within the framework of which 7 PhD theses have been successfully defended, 3 doctoral students are currently implementing their research projects, most of the program participants are graduates of the master's degree in public health.

The directors of ISPHA at various times were: Yuri Alexandrovich Sumarokov (2007 - 2009), Andrey Mechislavovich Grjibovsky (2009 - 2015). In 2015, Vitaly Aleksandrovich Postoev was appointed the head of the ISPHA. A great contribution to the development of the magistracy and the Arkhangelsk International School of Public Health in general was made by the executive director of ISPHA and teacher of the modules Epidemiological methods in public health, Injuries prevention and safety promotion Alexander Valerievich Kudryavtsev and Director of the Institute of Public Health, Health and Social Work, Doctor of Medical Sciences, Professor Alexander Mikhailovich Vyazmin.

The general management of the scientific content of the Master's program in 2015 - 2019 was carried out by the Professor of the department Olga Albertovna Tsyganova, since 2019 the head of the scientific content of the program in the profile “Research activities, disease prevention and public health protection” is Doctor of Medical Sciences, Professor Anatoly Leonidovich Sannikov.

More 70 specialists graduated from ISPHA from 2007, 43 of them received diplomas from the Arctic University of Norway, others - Russian state diplomas. Most of the graduates are medical doctors, psychologists, teachers, and researchers of NSMU (including teachers of the Department of Public Health, Healthcare and Social Work). Among the graduates - the chief specialist-expert of Rospotrebnadzor in Arkhangelsk region, the coordinator of a major project of the World Health Care Organization, chief specialist of the health of the Russian American oil company the protection of “Northern Lights”, current teachers and PhD students at different universities in Western Europe.

ISPHA has already established as one of leaders in public health research both in Russia and abroad. Research conducted is ISPHA are presented at a high international level. Students, alumni and teachers of Master program are regular participants in international conferences on public health problems, such as the European Conference on Public Health (2008-2015), the World Congress on Public Health (2009, 2012, 2020), the European Congress on Epidemiology (2009, 2011, 2015), World Congress of Epidemiology (2008, 2011, 2014).

ISPHA students and alumni are the authors of more than 200 publications in Russian and international journals, including such highly cited ones as the International Journal of Epidemiology, BMC Public Health, BMC Cancer, BMC Psychiatry.

History of International cooperation in the field of medicine. World Health Organization. International Committee of the Red Cross (ICRC) and other international organizations

World Health Organization. Currently, there are more than 200 international organizations and associations in the world, whose activities are related to health care, including: United Nations, International labor organization, International children’s Fund, United Nations scientific and cultural organization, International food organization, etc.

The largest and most important among them is the World Health Organization (WHO), which cooperates with 180 international medical organizations, agencies, associations of the world.

World Health Organization is an organization of 194 Member States. The Member States elect the Director-General, who leads the organization in achieving its global health goals.

WHO's emblem was chosen by the First World Health Assembly in 1948. The emblem consists of the United Nations symbol surmounted by a staff with a snake coiling round it.

The staff with the snake has long been a symbol of medicine and the medical profession. It originates from the story of Asclepius, who was revered by the ancient Greeks as a god of healing and whose cult involved the use of snakes. Asclepius, incidentally, was so successful at saving lives that, the legend goes, Hades the god of the underworld complained about him to the supreme god Zeus who, fearing that the healer might make humans immortal, killed Asclepius with a thunderbolt.

The WHO logo consists of the WHO emblem and the words "World Health Organization" or "WHO". The use of the WHO logo is restricted to institutions that have an official collaborating status with WHO and only in conjunction with the work that they are undertaking for WHO. In addition to being an identifier of the Organization, the WHO emblem or logo implies endorsement by WHO of the material it is used in conjunction with. The use of the WHO emblem and logo is governed by a resolution of the First World Health Assembly (resolution WHA1.133), which states that «appropriate measures should be taken to prevent the use, without authorization by the Director-General, and in particular for commercial purposes by means of trade-marks or commercial labels, of the emblem, the official seal and the name of the World Health Organization, and of abbreviations of that name through the use of its initial letters». WHO's rules accepted by its 194 Member States do not allow the Organization's name, emblem or logo to be used to promote specific companies, products or ideologies. In most Member States of WHO, legislation has subsequently been introduced to protect the emblem, logo and name of the Organization. The WHO emblem, logo, name and abbreviation are also protected from being registered as trademarks under Article 6 of the Paris Convention for the Protection of Industrial Property.

The history of international organizations in health care before WHO began with the convening in 1851in Paris, the International conference to fight epidemics. International sanitary conference in Rome in 1907 established the 1-st international medical organization – the International Bureau of public hygiene (IBOH), which was located in Paris and worked until 1946. 55 States, including Russia (in 1926), joined the Convention on the organization of the IBO. Soon after the creation of the League of Nations, in 1923, the so-called League of Nations health (hygiene) Organization was established. It included questions similar to the task IBOH; in addition, it assisted in health care training, research, programs, disease, etc. This organization has attracted well-known experts, consultants, publish information and other materials on topical issues of medicine etc.

At the 1-st UN General Assembly in February 1946 in Philadelphia (USA), it was decided to create a new international health organization with the transfer of its functions to the League of Nations. With 19 June on 11 July 1946 in new York, the international conference with delegates from 51 countries discussed and adopted the Constitution of the world health organization (WHO). In 1948. 26 States members of the United Nations, the founders who ratified the Charter In honor of this event, April 7 is celebrated as the *International Health Day* each year.

World Health Day is one of 11 official global health campaigns marked by WHO, along with World Tuberculosis Day (March 24), World Immunization Week (last week of April), World Malaria Day (April 25), World No Tobacco Day (May 31), World AIDS Day (December 1), World Blood Donor Day (June 14), World Chagas Disease Day (April 14), World Patient Safety Day (September 17), and World Hepatitis Day (July 28).

“*Health is a state of complete physical, mental (mental) and social well-being, not merely the absence of disease and infirmity*”. This definition is given in the Preamble to the Constitution of the world health organization, adopted by the International health conference, new York, June 19-22, 1946, signed on July 22, 1946 by representatives of 61 countries (Official documents of the world health organization, Nº 2, p.100) and entered into force on April 7, 1948.

At the 17-th world health Assembly in May 2017, WHO member States elected Dr. Tedros Adhanom Gebreyesus as Director-General of who for a five-year term. Dr. Tedros was the first to be elected by the World health Assembly from among several candidates and the first representative of the African region. Previously Minister of health of Ethiopia, Minister of foreign Affairs of Ethiopia

World Health Assembly of WHO

The *World Health Assembly* is the highest decision-making body of WHO. Its annual sessions, attended by delegations from all 194 WHO member States, are usually held in may in Geneva. The primary function of the health Assembly is to determine the overall policy direction of the Organization. The Health Assembly appoints the Director-General, monitors the financial policy of the Organization, and reviews and approves the draft programme budget. The Health Assembly reviews the reports of the Executive Board and identifies areas for further research.

The Executive Committee consists of 34 members technically qualified in the field of health. The members of the Committee are elected for a term of three years.

WHO's activities are supported by a regular budget consisting of member States ' contributions. More than 2/3 of the total budget, which for 2 years of activity planning reaches almost 900 million dollars from the USA (25% of the total regular budget), Russia, Germany, the UK, Canada, etc.

The number of who member States is over 190 (194 in 2017). The WHO Secretariat has a decentralized structure: headquarters in the health Palace in Geneva; 6 regional offices for Europe in Copenhagen (Denmark), for the Americas in Washington (USA), for the Eastern Mediterranean basin in Alexandria (Egypt), for South – East Asia in New Delhi (India), for the Western Pacific in Manila (Philippines), for sub – Saharan Africa in Brazzaville (Congo). In total, more than 4.5 thousand people work in the headquarters and regional offices on a permanent.

WHO attracts more than a thousand well-known experts for discussion and consultation, holds meetings of expert committees and councils. WHO has published more than 20 publications, statistical publications, documents, committees and meetings, reports of the assemblies, the magazines who, "Bulletin of the who, international health forum," the popular magazine "Health world", monographs and technical reports. WHO's official languages are English and French. WHO initiated a global campaign to eliminate smallpox in the world (the last case reported in 1981). Excellent results have been achieved in the campaign against malaria, the prevalence of which has decreased by at least 2 times; immunization program against 6 infectious diseases ; detection and control of HIV; organization of PHC services, etc. More than 4.5 thousand people work on a permanent basis.

The main directions for the running program of the WHO. Development of health systems in the countries in accordance with the basic principles of national health (state responsibility, prevention, public participation, the use of science, etc.); development of PHC, the Declaration of which was adopted at the who Alma-ATA conference in 1978; training and improvement of medical personnel; protection and strengthening of health of different population groups; environmental protection; control of infectious and parasitic diseases, immunization and vaccination against epidemic diseases; mental health protection and promotion; provision of public health information; expanded program of scientific medical research, current directions of advisory and technical assistance to countries.

The WHO's Constitution states that its objective "is the attainment by all people of the highest possible level of health". The WHO fulfills this objective through its functions as defined in its Constitution: (a) to act as the directing and coordinating authority on international health work; (b) to establish and maintain effective collaboration with the United Nations, specialized agencies, governmental health administrations, professional groups and such other organizations as may be deemed appropriate; (c) to assist Governments, upon request, in strengthening health services; (d) to furnish appropriate technical assistance and, in emergencies, necessary aid upon the request or acceptance of Governments; (e) to provide or assist in providing, upon the request of the United Nations, health services and facilities to special groups, such as the peoples of trust territories; (f) to establish and maintain such administrative and technical services as may be required, including epidemiological and statistical services; (g) to stimulate and advance work to eradicate epidemic, endemic and other diseases; (h) to promote, in co-operation with other specialized agencies where necessary, the prevention of accidental injuries; (i) to promote, in co-operation with other specialized agencies where necessary, the improvement of nutrition, housing, sanitation, recreation, economic or working conditions and other aspects of environmental hygiene; (j) to promote co-operation among scientific and professional groups which contribute to the advancement of health; (k) to propose conventions, agreements and regulations, and make recommendations with respect to international health matters.

The International Committee of the Red Cross (ICRC). The International Committee of the Red Cross (ICRC) is a humanitarian institution based in Geneva, Switzerland, and a three-time Nobel Prize Laureate. State parties (signatories) to the four Geneva Conventions of 1949 and their Additional Protocols of 1977 (Protocol I, Protocol II) and 2005 have given the ICRC a mandate to protect victims of international and internal armed conflicts. Such victims include war wounded, prisoners, refugees, civilians, and other non-combatants.

The ICRC is part of the International Red Cross and Red Crescent Movement along with the International Federation of Red Cross and Red Crescent Societies (IFRC) and 190 National Societies. It is the oldest and most honored organization within the movement and one of the most widely recognized organizations in the world, having won three Nobel Peace Prizes in 1917, 1944, and 1963

The official mission statement says that: “The International Committee of the Red Cross (ICRC) is an impartial, neutral, and independent organization whose independently humanitarian mission is to protect the lives and dignity of victims of war and internal violence and to provide them with assistance.” It also conducts and coordinates international relief and works to promote and strengthen international humanitarian law and universal humanitarian principles. The core tasks of the Committee, which are derived from the Geneva Conventions and its own statutes are: to monitor compliance of warring parties with the Geneva Conventions; to organize nursing and care for those who are wounded on the battlefield; to supervise the treatment of prisoners of war and make confidential interventions with detaining authorities; to help with the search for missing persons in an armed conflict (tracing service); to organize protection and care for civil populations; to act as a neutral intermediary between warring parties.

The ICRC drew up seven fundamental principles in 1965 that were adopted by the entire Red Cross Movement. They are humanity, impartiality, neutrality, independence, volunteerism, unity, and universality.

The ICRC›s operations are generally based on international humanitarian law, primarily comprising the 4 Geneva Conventions of 1949, their two Additional Protocols of 1977 and Additional Protocol III of 2005, the Statutes of the International Red Cross and Red Crescent Movement, and the resolutions of the International Conferences of the Red Cross and Red Crescent.

International humanitarian law is founded upon the Geneva conventions, the first of which was signed in 1864 by 16 countries. The First Geneva Convention of 1949 covers the protection for the wounded and sick of armed conflict on land. The Second Geneva Convention asks for the protection and care for the wounded, sick and shipwrecked of armed conflict at sea. The Third Geneva Convention concerns the treatment of prisoners of war. The Fourth Geneva Convention concerns the protection of civilians in time of war. In addition, there are many more customary international laws that come into effect when necessary.

The 2015 budget of the ICRC amounts to about 1250 million Swiss francs. All payments to the ICRC are voluntary and are received as donations based on two types of appeals issued by the Committee: an annual *Headquarters Appeal* to cover its internal costs and *Emergency Appeals* for its individual missions. The total budget for 2019 consists of about 996.9 million Swiss Francs (85% of the total) for field work and 168.6 million Swiss Francs (15%) for internal costs. In 2019, the budget for field work increased by 6.9% and the internal budget by 4.4% compared to 2009, primarily due to above-average increases in the number and scope of its missions in Africa.

Most of the ICRC›s funding comes from Switzerland and the United States, with other European states and the EU close behind. Together with Australia, Canada, Japan, and New Zealand, they contribute about 80–85% of the ICRC›s budget. About 3% comes from private gifts, and the rest comes from national Red Cross societies.

The ICRC is headquartered in the Swiss city of Geneva and has external offices called Delegations in about eighty countries. Each delegation is under the responsibility of a Head of delegation who is the official representative of the ICRC in the country. Of its 2,000 professional employees, roughly 800 work in its Geneva headquarters and 1,200 expatriates work in the field. About half of the field workers serve as delegates managing ICRC operations, while the other half are specialists such as doctors, agronomists, engineers, or interpreters. In the delegations, the international staff are assisted by some 13,000 national employees, bringing the total staff under the authority of the ICRC to roughly 15,000. Delegations also often work closely with the National Red Cross Societies of the countries where they are based, and thus can call on the volunteers of the National Red Cross to assist in some of the ICRC›s operations.

The organizational structure of the ICRC is not well understood by outsiders. This is partly because of organizational secrecy, but also because the structure itself has been prone to frequent change. The Assembly and Presidency are two long-standing institutions, but the Assembly Council and Directorate were created only in the latter part of the twentieth century. Decisions are often made in a collective way, so authority and power relationships are not set in stone. Today, the leading organs are the Directorate and the Assembly.

The ICRC operates in over 80 countries with a total number of 11,000 employed people worldwide. The extensive network of missions and delegations of the ICRC can relieve nations that are affected by armed conflicts and other sources of violence. In 2013 the ten largest operations worldwide are Pakistan, Mali/Niger, Afghanistan, Yemen, Iraq, Colombia, Israel, Somalia, Democratic Republic of the Congo and Sudan.

In 2011, with support from the Red Cross Society of the DRC, the ICRC returned to their families in the RDC 838 unaccompanied children including over 390 former child soldiers, 34 of whom had been in neighboring countries.

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Appendix 1.

Examples of tests.

1. Ayurveda System of Medicine means:
(a) 'science of health'
(b) 'science of life'
(c) 'science of spirit'
(d) 'science of prevention'

2. Sushruta Samhita was translated by:
(a) Galen
(b) Celsus
(c) Harnel
(d) Charak
(e) Hessler

3. Father of Indian Surgery is:
(a) Dhanvantari
(b) Charaka
(c) Sushruta
(d) Atreya

4. **Siddha System of Medicine** means:
(a) Health
(b) Result
(b) Achievement
(c) Success

5. Unani System of Medicine
(a) Originated from Rome impair
(b) Based on the Avicenna ideas
(c) Based on the teachings of the Greek physicians Hippocrates and Galen
(d) Originated from Middle East

6. Sushruta wrote:
(a) Sushruta Samhita

(b) ‘Airs, Waters and Places’ book
(c) The Book on Healing
(d) Canon of Medicine

7. Ayurvedic Text Nidana wrote:
(a) Sushruta
(b) Charaka
(c) Madhav
(d) Dhanvantari

8. Who is known as ‘Father of Plastic Surgery and Cosmetic Surgery’:
(a) Dhanvantari
(b) Charaka
(c) Sushruta
(d) Atreya

9. The most common method of treatment in Ancient China:
(a) ritual dances
(b) treatment for the opposite
(c) conspiracies
(d) surgery

10. The peak of the art of diagnostics in Ancient China was the teaching
(a) about breathing
(b) about pneuma
(c) about pulse
(d) «Yin-Yang»

11. What method of treatment was used in Ancient China for smallpox:
(a) vaccination
(b) variolation
(c) surgery
(d) bloodletting

12. In India medicine was trained in:
(a) in temples
(b) in special schools such as universities
(c) in medical schools
(d) at home with healers

13. Pulse diagnostic and needle therapy were created in:
(a) Ancient Egypt
(b) Ancient China
(c) Ancient India
(d) Greece

14. Doctors of Ancient India:
(a) Sushruta
(b) Imhotep
(c) Bian-quo
4) Hammurabi

15. European surgeons learned from the Indians the art of:
(a) amputations
(b) bloodletting
(c) needle therapy
d) rhinoplasty

16. Who is known as 'First True Epidemiologist' in the history of medicine?
(a) John Snow
(b) Hippocrates
(c) James Lind
(d) Joseph Lister

17. Who is known as 'Father of Medicine' in the history of medicine?
(a) Susruta
(b) Hippocrates
(c) Charaka
(d) Avicenna.

18. Which theory Aristotle found:
(a) Four Temperaments
(b) Four Basic Qualities
(c) Four Elements
(d) Four Humors

19. What, according to the ancient Greeks, was the best healer?
Medicine
Nature
Prevention
Praying

20. In the Hippocratic Oath, ancient Greek doctors promised...
(a) To heal the sick
(b) Not to do the harm
(c) To tell truth, the whole truth, nothing but the truth.

Answers:

1	2	3	4	5	6	7	8	9	10
b	**e**	**c**	**b**	**c**	**a**	**c**	**c**	**b**	**c**

11	12	13	14	15	16	17	18	19	20
b	**b**	**b**	**a**	**d**	**b**	**b**	**b**	**b**	**b**

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