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MEDICAL SCIENCE IN THE ISLAMIC WORLD: PRESERVING AND ADVANCING CLASSICAL MEDICAL KNOWLEDGE

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ABSTRACT

The preservation and advancement of classical medical knowledge in the Islamic world during the medieval period, particularly the Islamic Golden Age (8^{th}-13^{th} centuries CE), represents a pivotal chapter in the history of science. Islamic scholars systematically translated, synthesized, and expanded upon the medical traditions of antiquity- primarily from Greek (Hippocrates, Galen, Dioscorides), Persian, Indian (Ayurveda), Mesopotamian, and Roman sources- while introducing original innovations that elevated medicine to new heights. The process began under the Abbasid Caliphate, with the establishment of Baghdad as a center of learning. Caliphs such as Al-Mansur, Harun al-Rashid, and especially Al-Mamun patronized the renowned House of Wisdom (*Bait al-Hikmah*), which served as a major translation hub, library, and academy. The Islamic physicians critically engaged with these inherited texts through empirical observation, clinical experimentation, and logical synthesis. They corrected errors in Galenic anatomy and physiology, developed more precise diagnostic methods, advanced pharmacology and pioneered institutional healthcare via bimaristans- charitable hospitals with specialized wards, medical records, teaching functions, and free care.

KEYWORDS: Islamic Science, Medical Science, Muslim Scientists, Quran, Hadith.

INTRODUCTION:

In the seventh century and afterwards, the Muslims conquered all of the Arabian Peninsula from Al-Hamrah in Spain to the borders of China. The geographical expansion of Islam within its first century was accompanied by a social revolution that reconfigured the social, cultural, and intellectual climate of the old world. The same social revolution provided an

opportunity for Islamic civilization to receive a very large amount of scientific material from Greek, Persian, and Indian sources. They significantly examined, assembled, approved, and incremented the science and philosophy of the Greeks. This infusion was not a random process; rather, it was an organised and sustained effort spread over three centuries, involving thousands of scientists, scholars, translators, patrons, books, instruments, and rare manuscripts. Islam's contribution to the scientific enterprise was complex and rich, and it spanned over three continents and nearly a millennium of time.

Following this period began what is known as the Golden Age of Islam. In this age many Islamic scientists left behind hundreds and thousands of books on several branches of science more especially medical science. In the developing Muslim world, however, a Golden Age of discovery flourished from the seventh century until the fourteenth century and even later. During this period in the Muslim world, the Islamic scholars of various beliefs and cultures built and improved upon the knowledge of Greek philosophy and science, Persian literature, Indian medicine and mathematics, and certain aspects of Egyptian and Babylonian science of which even the Greeks had been unaware. During this period, there was great emphasis on the pursuit of knowledge. Muslims began to believe that Islam was not merely a set of commandments and rituals but a complete way of life, encompassing all domains of knowledge and human activity. They thought that all realms of knowledge were branches of the same tree.

Following the Islamic thought of seeking knowledge, the Islamic philosophers studied the Greek and Roman texts. The Islamic scholars found themselves in possession of the dazzling intellectual treasures of these ancient Greek and Roman civilizations. The pre-Islamic sciences came to be known as the *Ulum Al-Awa'il* (knowledge of antiquity). Indeed, the *Ulum Al-Awa'il* was a vast storehouse of intellectual treasures. It was really a challenge to assimilate these elements of secular learning into the Islamic faith, but they were taken up. The Muslims believed that they were commanded by Allah in the Holy Quran and by the Prophet Mohammad (pbuh) to study, seek knowledge, learn and benefit from others. It was this belief that inspired the Muslims to great heights in the sciences, medicine, mathematics, astronomy, chemistry, philosophy, art, and architecture.

At that time, Islam was not just a set of religious beliefs, but a set of ideas, ethics, and ideals encompassing all aspects of human life, including science, literature, and philosophy. Science entered the Islamic world during the classical Abbasid period, but a few examples could be seen even before. Muslim scholars studied nature in the context of the Quran. The Quran

depicted the relationship between nature and man, and this inspired the Muslim scholars to study natural phenomena in order to understand Allah. Moreover, the Islamic scholars borrowed knowledge from the entire world by translating Greek, Persian, Egyptian, Babylonian, and Indian works and gained a lot for the further progress of science through research and observations.

Progress of Medical Science

The progress of medical science is based on several factors. Muslims following the guidelines of the Prophet studied and searched for knowledge. The Quran is clear: "The scholar's ink is more sacred than the blood of martyrs", while the Prophet promoted medical research, preaching that "For every disease, Allah has given a cure." Moreover, communication became easier because the Muslim Empire united extensive geographic areas. Scholars travelled to teach or share ideas. Furthermore, the Arabic language became a unifying factor. Translations from Greek, Latin, Sanskrit and Chinese into Arabic were innumerable, thus removing language barriers for scholars. During the same period, Arabs learned from the Chinese how to produce paper, and books became more readily available. Libraries were established in Cairo, Aleppo, Bagdad, and urban centres in Iran, central Asia, and Spain, while bookshops with thousands of titles opened in several cities. Finally, The House of Wisdom, an academic institution serving as a university, was established in Bagdad in 1004.

In this phase of Islamic civilization, the Muslim community produced scientists such as Ibn al-Haytham (965-1039), Al-Biruni (973-1051), Umar Khayyam (1038-1123), and Nasir-ud-Din Tusi (1201-1274). The works of these scientists were the major source of research for European scientists during the Renaissance period. Roger Bacon, much to the displeasure of the Christian Church, began his experiments based on Ibn al-Haytham's treatise on optics. The Latin translation of Ibn Sina's *Canon of Medicine* was taught for centuries in Western universities.[1]

In the process of the progress in Islamic science, a school or movement Mu'tazila (Dissenters) started in the early eighth century by Wasil Ibn Ata, an ex-student of Imam Hasan al-Basri, which sought a reconciliation of faith with reason. The Mu'tazilites advanced argument based research on ethics and reason, even though they naturally supported their positions using Quranic quotations. They argued that God has given people the power to make free, unfettered choices.[2]

It spread through the courts of the nobility in the Empire, into Spain, and thence into Andalusia. Caliph Mansur encouraged it without publicly committing to it, but Mutazilism (a

liberal Muslim sect) was actually imposed as state doctrine during the reigns of Al-Mamun and Al-Mutassim. There cannot be any doubt that Al-Mamun was the greatest patron of philosophy and science in the entire history of Islam. His creation of the *Bait al-Hikmah* (House of Wisdom) was an important milestone. This immense scientific academy was an unrivalled centre for the study of humanities and sciences, where the greatest collection of worldly knowledge was accumulated and developed.[3]

In order to stock this official institute and library for research and translation, Mamun sent emissaries as far as Byzantium to seek out and purchase scientific and philosophical works. The doctrine of rationalism was preached in mosques and *madrasahs*, and became the distinguishing mark of the educated. The influential and intellectual classes of society, princes, courtiers, qazis, professors, doctors, and traders, accepted it as their creed. Phenomenal progress in the secular sciences occurred under Mutazilite rulers, and most of the great Islamic scholars and scientists either openly declared their allegiance to rationalism or were heavily influenced by it. Through the joint efforts of the rulers and intellectuals, the investigation and learning of science flourished for five centuries in Islamic civilization. The scholars tried their level best to enrich their society and curriculum with scientific learning and research.

The Muslim physicians advanced medicine in several ways: 1. Hospitals and Medical Education- They established sophisticated hospitals (bimaristans) with specialized wards, free care, and training programs. These were among the world's earliest advanced medical institutions. 2. Clinical Observation and Experimentation- Emphasis on empirical evidence, detailed case studies, and differentiating diseases through symptoms. 3. Pharmacology and Pharmacy- Developed compound drugs, emphasized hygiene in preparation, and created early formularies. 4. Surgery- Introduced advanced techniques, anesthesia, and numerous instruments still recognizable today. 5. Anatomy and Physiology- Corrected ancient errors (e.g., in blood circulation) and produced illustrated texts. 6. Other Specialized Fields- Pioneered in ophthalmology, pediatrics, psychiatry, dermatology, and public health measures like quarantine. Here are some of the most influential figures and their groundbreaking achievements:

Abu al-Hasan Ali bin Sahl Rabban al-Tabari (838-870)

Abu al-Hasan Ali bin Sahl Rabban al-Tabari was a prominent Persian Muslim scholar, physician, psychologist, and polymath active in the 9th century CE. His father, Sahl was an extremely successful physician and hailed from a respectable Jewish family. Ali embraced

Islam and classified amongst Muslim scholars. He was an accomplished Hakim and tutor of the unparalleled physician Zakariya al-Razi. Ali received his education in the disciplines of medical science and calligraphy from his able father Sahl and attained perfection in these fields. He had also mastered the Syriac and Greek languages to a high degree of proficiency.[4]

The fame acquired by Ali Bin Rabban was due to his exaltation, which is found in his world-renowned treatise *Firdous al-Hikmat* (Paradise of Wisdom). Spread over seven parts, *Firdous al-Hikmat* is the first ever medical encyclopaedia which incorporates all the branches of medical science into its folds. This work has been published in the twentieth century. Prior to this publication only five of his manuscripts were to be found scattered in libraries the world over. Dr. Mohammed Zubair Siddiqui compared and edited the manuscripts. In his preface he has provided extremely useful information regarding the book and the author and, wherever felt necessary, explanatory notes have been written to facilitate publication, of this work on modern publishing standards.[5]

Later on, this unique work was published with the cooperation of English and German institutions. The following are the details of its seven parts:[6]

1. Part one: Kulliyat-e-Tibb. This part throws light on the contemporary ideology of medical science. In that era, these principles formed the basis of medical science.

2. Part two: Elucidation of the organs of the human body, rules for keeping good health and comprehensive account of certain muscular diseases.

3. Part three: Description of the diet to be taken in conditions of health and disease.

4. Part four: All diseases right from head to toe. This part is of profound significance in the whole book and comprises twelve papers:

i) General causes relating to eruption of diseases.

ii) Diseases of the head and the brain.

iii) Diseases relating to the eye, nose, ear, mouth and the teeth.

iv) Muscular diseases (paralysis and spasm).

v) Diseases of the regions of the chest, throat and the lungs.

vi) Diseases of the abdomen.

vii) Diseases of the liver.

viii) Diseases of gallbladder and spleen.

ix) Intestinal diseases.

x) Different kinds of fever.

xi) Miscellaneous diseases- brief explanation of organs of the body.

xii) Examination of pulse and urine. This part is the largest in the book and is almost half the size of the whole book.

5. Part five: Description of flavour, taste and colour.

6. Part six: Drugs and poison.

7. Part seven: Deals with diverse topics, discusses climate and astronomy and also contains a brief mention of Indian medicine.

Abul Qasim Khalaf Ibn al-Abbas al-Zahrawi (936-1013)

Al-Zahrawi was born in the city of Azahara or Madinat al-Zahra in the northwest of Cordoba, Andalusia. In European languages, his name is written in over a dozen different ways: Abulcases, Albucasis, Bulcasis, Bulcasim, Bulcari, Alzahawi, Ezzahrawi, Zahravius, Alcarani, Alsarani, Aicaravi, Alcaravius, Alsahrawi, etc. He was the greatest surgeon of the Middle Ages, He is widely regarded as one of the greatest surgeons of the Middle Ages and often called the "father of modern surgery" or the "father of operative surgery" for his groundbreaking contributions that influenced medical practice in both the Islamic world and Europe for centuries. He became one of the most renowned surgeons of the Muslim era and was physician to King Al-Hakam-II of Spain. Al-Zahrawi's pioneering contributions to the field of surgical procedures and instruments had an enormous impact in the East and West well into the modern period, where some of his discoveries are still applied in medicine to this day.

Al-Zahrawi also pioneered neurosurgery and neurological diagnosis. He is known to have performed surgical treatments for head injuries, skull fractures, spinal injuries, hydrocephalus, subdural effusions, and headaches. The first clinical description of an operative procedure for hydrocephalus was given by Al-Zahrawi, who clearly describes the evacuation of superficial intracranial fluid in hydrocephalic children. Al-Zahrawi's thirty-volume medical encyclopedia, *Kitab al-Tasrif* (Book of Concessions), completed in the year 1000, covered a broad range of medical topics, including surgery, medicine, orthopedics, ophthalmology, pharmacology, nutrition, dentistry, childbirth, and pathology.[7] This book contained data that Al-Zahrawi had accumulated during a career that spanned almost 50 years of training, teaching, and practice. He apparently travelled very little but had wide experience in treating accident victims and war casualties.

Two of Al-Zahrawi's treatises deserve special mention. Firstly, his 28th treatise, known in Latin as *Liber servitoris de preparatione medicinarum simplicium*, describes chemical preparations, tablet making, filtering of extracts and related pharmaceutical techniques. This

treatise was printed in Venice in 1471 by Nicolaus Jensen. Another, and perhaps the most important treatise, is the one on surgery. This monumental work was the first in Arabic to treat surgery independently and in detail. It included many pictures of surgical instruments, most invented by Al-Zahrawi himself, and explanations of their use. Al-Zahrawi was the first medical author to provide illustrations of instruments used in surgery. There are approximately 200 such drawings, ranging from a tongue depressor and a tooth extractor to a catheter and an elaborate obstetric device.[8]

The variety of operations covered is amazing. Al-Zahrawi discussed cauterization, bloodletting, midwifery, obstetrics, and the treatment of wounds. He invented more than 200 surgical tools and devices for purposes such as inspection of the interior of the urethra and also for inspection, applying and removing foreign bodies from the throat, the ear and other body organs. These surgical tools and devices revolutionized medical science. He was also the first to illustrate the various cannulae and the first to treat a wart with an iron tube and caustic metal as a boring instrument.

Abu Ali al-Hussain Ibn Abdallah Ibn Sina (980-1037)

Ibn Sina, known as Avicenna in the West, born in Uzbekistan (Afshana near Bukhara), was a Persian Polymath and regarded as one of the most significant physicians and the father of early modern medicine. Ibn Sina was honorifically called the “Prince of Physicians” or “Al-Shaykh al-Ra’is” (the Preeminent Master or Grand Shaikh). By age 10, he had memorized all of the Quran. At 13, he started to study medicine in earnest, and after that, he studied law. Ibn Sina taught widely in medicine, philosophy, and the natural sciences. Ibn Sina gave a systematic account of medicine, and his work on medicine remained unchallenged for centuries. Ibn Sina devoted his life to the study of medicine, philosophy, and other branches of science.

While still young, he attained such a degree of expertise in medicine that his renown spread far and wide. Even as a young man, he was regularly consulted by high-ranking authorities on matters of medicine, religion, and philosophy. For example, at the age of 17, he was fortunate in curing Samani ruler Nuh Ibn Mansoor, the King of Bukhhara, of an illness in which all the well-known physicians had given up hope. The youth promptly cured the emir, who then, in gratitude, offered Avicenna the use of his vast library. Ibn Sina went to Hamadan, where he cured Amir Shamsud-Dawala of colic and was made Prime Minister.

Al-Qifti states that Ibn Sina completed 21 major and 24 minor works on philosophy, medicine, theology, geometry, astronomy and the like. Another source (Brockelmann)

attributes 99 books to Ibn Sina, comprising 16 on medicine, 68 on theology and metaphysics, 11 on astronomy, and four on verse. Another source mentions that Ibn Sina wrote some 246 books dealing with philosophy, medicine, geometry, astronomy, theology, philosophy, and art. Among his scientific works, the leading two are the *Kitab al-Shifa* (Book of Healing), a philosophical encyclopedia based upon Aristotelian traditions, and the *Al-Qanun fi al-Tibb* (The Canon of Medicine), which represents the final categorization of Greco-Arabian thoughts on Medicine.[9] In his *Kitab al-Shifa,* containing 20 volumes, he divided practical knowledge into ethics, economics, and politics, and theoretical knowledge into mathematics, physics, and metaphysics.[10]

The Qanun, or Canon of Medicine, is, of course, by far the largest, most famous, and most important of Ibn Sina's works. The work contains about one million words and, like most Arabic books, is elaborately divided and subdivided. The main division is into five books, of which the first deals with general principles; the second with simple drugs arranged alphabetically; the third with diseases of particular organs and members of the body from the head to the foot; the fourth with diseases, which though local in their inception, spread to other parts of the body, such as fevers; and the fifth with compound medicines. He also provided a list of how to prepare, dispense, and properly use more than 800 medical compounds to treat various ailments.[11]

The Canon of Medicine distinguishes mediastinitis from pleurisy and recognizes the contagious nature of phthisis (tuberculosis of the lung) and the spread of disease by water and soil. It gives a scientific diagnosis of ankylostomiasis and attributes the condition to an intestinal worm. The Qanun points out the importance of dietetics, the influence of climate and the environment on health, and the surgical use of oral anaesthetics. Ibn Sina advised surgeons to treat cancer in its earliest stages, ensuring the removal of all the diseased tissue. Avicenna offered advice on how to use anaesthetics when performing surgery. The Qanun's materia medica considers some 760 drugs, with comments on their application and effectiveness. He recommended the testing of a new drug on animals and humans prior to general use.[12]

Ibn Sina noted the close relationship between emotions and the physical condition and felt that music had a definite physical and psychological effect on patients. Of the many psychological disorders that he described in the Qanun, one is of unusual interest: love sickness! Ibn Sina is said to have identified this condition in a prince in Jurjan who was sick and whose illness had perplexed local doctors. Ibn Sina noted a fluttering in the Prince's pulse

when the address and name of his beloved were mentioned. The great doctor had a simple remedy: unite the sufferer with the beloved.[13]

The Canon of Medicine was translated into Latin in the twelfth century, and it was used in medical schools throughout Europe until the advent of modern science. The Canon of Medicine contained all Greek medical knowledge together with Arabic interpretations and contributions. Medical progress did not shake the Canon of Medicine, and there was still a professional market for the Canon during the whole of the seventeenth century. He also developed methods of treating fractured bones that doctors still adhere to today. Medical books written by these men and other scholars in Muslim civilization influenced European medicine for centuries.

He established free hospitals and developed treatments for diseases using herbs, hot baths, and even major surgery. Due to their medical and medicinal work, the Ottomans were particularly noted for their building of hospitals and for the high level of hygiene practiced in them. Every city in the Islamic world had a number of excellent hospitals, many of which were specialized for specific diseases, including mental and emotional disorders. Ibn Sina says:[14]

"If a problem was too great for me, I repaired to the mosque and prayed, invoking the Creator of all things, until the gate that had been closed to me was opened and what had been complex became simple. Always, as night fell, I returned to my house, set the lamp before me, and buried myself in reading and writing. If sleep overcame me or I felt the flesh growing weak, I had recourse to a beaker of wine, so that my energies were restored".

Ibn Sina was a fiercely independent-minded philosopher who insisted on the primacy of reason. For a time, he was a minister to the Amir of Hamedan. Here he got into a religious argument with strict believers in the army, and they soon called for his execution. Soldiers came to his house but, not finding him, plundered it and then called on the Amir to behead him. Ibn Sina was warned in time and hid at the house of his friend Abu Said Dafdaq, where he worked on his masterpiece, *Al-Qanun*. He fled persecution and the wrath of rulers several times. His book was banned and he was branded as heresy.[15]

Ibn Sina is considered by many to be the greatest thinker and polymath of the Islamic golden age, and his writings were deeply influential on the great intellects of the Islamic, Christian, and Jewish traditions. Arguably, his greatest achievement was to fuse Islamic theology with Aristotelian metaphysical thought, although in the West, it was his encyclopedic medical texts that had the most profound and visible impact on mediaeval society. Ibn Sina is still

known in the world and taught various courses of medicine. In the museum at Bukhara, there are displays showing many of his writings, surgical instruments from the period; and paintings of patients undergoing treatment. An impressive monument to the life and works of the man who became known as the 'doctor of doctors' still stands outside the Bukhara museum, and his portrait hangs in the Hall of the Faculty of Medicine at the University of Paris.

Ala-al-Din Abu al-Hasan Ali Ibn Abi al-Hazm al-Qarshi al-Damashqi al-Misri (1213-1288)

Ibn al-Nafis, was born in Damascus (hence "Al-Damashqi" or "Al-Dimashqi," referring to Damascus) during the Ayyubid era, to an Arab family. The nisba "Al-Qarshi" (or Al-Qurashi) likely indicates descent from the Quraysh tribe. Later in life, after moving to Egypt and working there extensively (hence "Al-Misri," meaning "the Egyptian"), he became a leading figure in medicine. Ibn al-Nafis studied medicine in Damascus at the famous Bimaristan al-Nuri (Noori Hospital), a major medical center of the time. After acquiring his expertise in medicine and jurisprudence, he moved to Cairo, around the age of 23, where he served as chief physician at Al-Nasiri hospital eventually becoming Principal of that hospital. Here he imparted training to a large number of medical specialists, including Ibn al-Quff al-Masihi, the famous surgeon. He also served at the Mansuri or Mansuriya Hospital in Cairo. When he died, he donated his house, library, and clinic to the Mansuriya Hospital. Apart from medicine, Ibn al-Nafis learnt jurisprudence, literature, and theology. He thus became a renowned expert on the Shafi'i School of Jurisprudence as well as a reputed physician.

His major contribution lies in medicine. His method included writing detailed commentaries on early works, critically evaluating them, and adding his own unique contribution. His major original contribution of great significance was his discovery of the circulatory system of the blood, which was re-discovered by modern science after a lapse of three centuries. He advanced a theory of blood circulation between the compartments of the heart and the lungs, and of pulmonary circulation, or less circulation. He made several important contributions to the early knowledge of the pulmonary circulation of venous blood passing into the hearts and lungs via ventricles, thus becoming oxygenated and arterial blood. He elaborated on the function of the coronary arteries as feeding the cardiac muscle. He was the first to correctly describe the constitution of the lungs and gave a description of the bronchi and the interaction between the human body's vessels for air and blood.[16]

He was the first person to believe that all the blood that reached the left ventricle passed through the lung. He stated that there is no connection between the two cavities of the heart (right and left ventricles) and that blood cannot pass through the (interventricular) septum. He also stated that there must be small communications or pores between the pulmonary artery and vein, a prediction that predated by 400 years the discovery of the pulmonary capillaries by Marcello Malpighi.[17]

The most voluminous of his books is *Al-Shamil fi al-Tibb*, which was designed to be an encyclopedia comprising 300 volumes, but it could not be completed due to his death. The manuscript is available in Damascus. His book on ophthalmology is largely an original contribution and is also extant. However, his book that became most famous was *Mujaz al-Qanun*, and a number of commentaries were written on it. His own commentaries include one on Hippocrates' book. He wrote several volumes on Ibn Sina's *Qanun* that are still extant. Likewise, he wrote a commentary on Hunayn Ibn Ishaq's book. Another famous book embodying his original contribution was on the effects of diet on health, entitled *Kitab al-Mukhtar fi al-Aghdhiya*.[18]

Ibn Al-Nafis' works integrated the then existing medical knowledge and enriched it, thus exerting a great influence on the development of medical science, both in the East and the West. However, only one of his books was translated into Latin at early stages and, therefore, a part of his work remained unknown to Europe for a long time.

Ibn abi al-Mahasin al-Halabi (1210-1267)

Al-Halabi, born in Aleppo, was an eminent writer in the field of eye surgery. He was named after Aleppo (Arabic: *Halab*), a city in the northern part of Syria, which was known for its thriving trade and wealth in the middle ages. He was considered the first ophthalmologist to use a magnet to remove metallic foreign bodies from the eye. He was aware of the concept that an instrument may be substituted by another instrument due to lack of availability. His surgical instruments represent the biomechanics field. Biomedical engineering students should know Al-Halabi for his numerous contributions in the surgical instruments field.

In his work "*Kitab al-Kafifi al-Kuhl"* (The Book of Sufficient Knowledge in Ophthalmology), he mentions eighteen major ophthalmologic texts. Al-Halabi's book was the first book to give a remarkable illustration of the anatomy of the brain, the eyes, and the visual pathway among them. In his work, he also describes and gives drawings of various surgical instruments, including 36 instruments for eye surgery. He was an intriguing ophthalmologist who invented many surgical instruments for the treatment of various eye

diseases.[19] He included in his book a magnificent illustration of the anatomical structure of the eye. The book reflects Al-Halabi's medical practice and teaching, and shows a number of advanced medical techniques and tools. His invaluable comments reflect his deep experimental observations in the field of ophthalmology. His work was very practical, too, with very good descriptions of cataract operations and the instruments used, and also the steps to be taken after the operation.

The Chapters in his treatise deals with eye diseases, their definitions, descriptions, varieties, causes, symptoms, treatments, medicines, and cures for them. Surgery for the removal of the cataract is described in good detail, including the author's own experience. Al-Halabi has given in his book the details of cataract operations representing twelve sorts of cataract. He dedicated a chapter of his book to the procedures for removing the cataract. He described cataract operations, the required instruments, and the steps to be taken after the operation. Al-Halabi's anatomy of the eye mentions: definition; colour of the eye; tunics of the eye; the fluids of the eye; visual power and its nerves; motive nerves; muscles of the eye, eyelids and eyelashes; hygiene of the eye; things which are useful and things which are harmful; how to open the eye and introduce drugs into it; the best kind of probe and its use; tools for the handling of ophthalmology; best garments for the eye doctor.[20]

In his work there are synoptic tables relative to the diseases of the eyes and eyelids, giving for each disease the definition, description, varieties, causes, symptoms, treatments, drugs, including narcotics; and other tables relative to surgical cases. Finally, there is a list of drugs. The most remarkable synoptic table is the one related to instruments; each table contains 18 such instruments, with their names and their usage. The instruments are in colour and perfectly drawn; some instruments are for the operations on cataracts, others for eye infections which do not affect the senses. The author himself is so confident in his own talents as an eye surgeon that he did not fear to operate the cataract of a one eyed man.

Serafeddin Sabuncuoglu (1385–1468)

Serafeddin Sabuncuoglu was born in Amasya (a key cultural and intellectual center in northern Anatolia during the early Ottoman period). Sabuncuoglu came from a family of physicians. His grandfather (Hacı Ilyas Celebi) and father (Ali Celebi) had also served as chief physicians at the Amasya Darussifa (hospital/medical school). He received his early medical training there under mentors like Burhanettin Ahmet and became a prominent Ottoman Turkish physician, surgeon, and medical author. He began practicing at a young age

of 17. He is widely regarded as one of the most innovative figures in medieval Islamic and Ottoman medicine.

He served as a clinician, teacher, and researcher at the Amasya Darussifa for many years, including a noted 14-year period as chief physician. Serafeddin Sabuncuoglu was the author of the *Cerrahiyyetu'l-Haniyye* (Imperial Surgery), the first illustrated Turkish-written medical textbook. Sabuncuoglu's *Imperial Surgery* was the first surgical atlas and the last major medical encyclopaedia from the Islamic world. Female surgeons were also illustrated for the first time in *Imperial Surgery*. One of the surgical techniques, described by Sabuncuoglu, was the legating of the temporal artery for migraine.[21]

These include three chapters that incorporate 134 surgical interventions and 156 surgical instruments. These three chapters discussed cauterization treatments, surgical procedures, fractures and dislocations, and cancer-related issues. Serafeddin Sabuncuoglu was one of the first to describe hydrocephalic drainage techniques in children. Hydrocephalus is a medical condition in which fluid builds up in the brain. Sabuncuoglu was also the first to use an axial traction technique for spinal surgery. An important observation that Serafeddin Sabuncuoglu made in *Imperial Surgery* was that a fast delivery of a baby can occur if the patient holds their breath and exerts a strong force.[22]

Another book of Serafeddin Sabuncuoglu was the *Mucerrebname* (The book of tried medications). It was the manual on drugs and their preparation. This was the last of three medical treatises he composed. He explains, following common phrasing we see in many medical treatises, that he wrote the work as an answer to a plea from colleagues that he put on paper his fourteen-year medical experiences in a hospital. The contents and structure of this short manual- with regard to types of drugs, their ingredients, and methods of preparation- repeat earlier Arab-Islamic examples of learned written pharmacopeia. At the same time he refers frequently to his techniques in preparing drugs and discusses efficacy based on experiments upon himself and animals.[23]

CONCLUSION: Islamic scholars translated and preserved vast bodies of classical knowledge, preventing its disappearance amid the decline of the Roman and Byzantine world. This transmission was crucial, as these texts later reached Europe through Latin translations from Arabic, influencing the Renaissance and early modern medicine. Beyond preservation, they advanced the field through original contributions: empirical observation, clinical experimentation, refined pharmacology, surgical techniques, differentiation of diseases, holistic approaches integrating psychology and diet, establishment of hospitals

(bimaristans) with specialized wards and medical education, and ethical and professional standards. Islamic innovations laid groundwork for scientific methodology in medicine, influenced public health (e.g., quarantine, hygiene emphasis), and ensured continuity of knowledge that shaped global healthcare. The Islamic medicine preserved classical heritage while pushing boundaries through observation, integration of diverse traditions, and innovation. This period highlights how intellectual curiosity, patronage, and cultural openness can drive profound scientific advancement.

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9. Wan Hazmy, *op. cit*. p. 69; see also Faruqi, Yasmeen Mahnaz, *Contributions of Islamic scholars to the scientific enterprise*, International Education Journal, 2006, 7(4), 391-399.
10. Faruqi, *op. cit*. 391-399. (The first true medical schools of the Middle Ages were founded in Salerno, Italy; there, starting in the 9th century, ancient traditions of Greek and Latin healing were taught according to a well-organized curriculum, and medical treatises from the North African and Muslim worlds were incorporated from an early date. But it was when Avicenna's Canon of Medicine arrived in the 12th century that medicine as a subject began to be codified and standardized throughout the mediaeval world. Eventually, medical schools opened in Bologna, Padua, Paris, Oxford, and other European cities. And in all of them, Avicenna's Canon of Medicine was the basis of education. Dorsey Armstrong, *op. cit*. p. 45.)
11. Wan Hazmy, *op. cit*. p. 70; see also Dorsey Armstrong (2014). *Great Minds of the Mediaeval World*, Virginia, p. 46.

12. *Ibid.* see also Hunt Janin (2005). *The Pursuit of learning in the Islamic World 610-2003*, McFarland & Co Inc. USA, p. 80.
13. *Ibid.* p. 71.
14. Hoodbhoy, *op. cit*. p. 112.
15. *Ibid*. (For Avicenna, God knows nothing about human history. God understands the world of which He is the first cause, but He does not (nor should He) know about individuals or particulars. Avicenna argues that even evil things are "accidental" consequences of what are ultimately good things. This position caused consternation for later Muslim scholars, who saw it as a heretical denial of God's intervention in and knowledge of the world he had created. Dorsey Armstrong *op. cit*. p. 50.)
16. Wan Hazmy, pp. 122-23.
17. John B. West, *Ibn al-Nafis, the pulmonary circulation, and the Islamic Golden Age*, J Appl Physiol (1985). 2008 Dec; 105(6): 1877-1880.
18. Wan Hazmy, *op. cit*. p. 123.
19. *https://muslimheritage.com/al-mahassin-al-urdi-al-lubudi-al-halabi/* and *https://www.researchgate.net/publication/331272985_Halabi*.
20. *Ibid.*
21. Miri Shefer-Mossensohn (2015). *Science among the Ottomans: The Cultural Creation and Exchange of Knowledge*, Austin, pp. 31-32.
22. *Ibid.*