THE HISTORICAL CONTRIBUTIONS OF ISLAMIC CIVILIZATION IN MEDICAL AND APPLIED SCIENCES: A SURVEY FROM THE MUSLIMS PRODUCT

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ABSTRACT

Islamic medicine is this developed during the period of Islamic civilization which, spanned for about seven or eight centuries with the rise of Islam in the Arabian Peninsula in the seventh century till the fall of the Islamic empire in the Middle East and Spain in the fourteenth century. This study will highlight a history and considerable achievements of Muslims scholars in medical and applied sciences, which commenced with a special outlook of the ‘prophetic medicine’ (Tibb Al-Nabawiy), then a significant contribution of Ibn sina (965-1045), Al haytham (965-1040), Alzahrawi (936-1013) then Al-razi (864-930) and Al-khwarizmi (780-850AD respectively. It is also the vision of this study to show the beauty of Islam and Islamic intellectualism in recounting it’s achievement in the diverse areas of medicine, pharmacy, earth sciences, mathematics and geometry. In the cause of gathering and analysing this information, the study is suitably adapted exploratory survey, and content analysis approach for the qualitative study. This paper is also envisioned to call and reorients the Muslims minds for search and research on Islamic products and its relevance to the contemporary sciences.

Key words: historical, Islamic civilization, medical, Muslim product.

1. Introduction

The Islamic golden age is traditionally dated from the mid 7th century to the mid 13th century when Muslims established the largest empires in history. During this period, artists, engineers, scholars, physicians, poets, philosophers, geographers and traders in the Islamic empires contributed to the world immensely in agriculture, economics, sciences, technology, sociology, philosophy, industry, law and literature. They preserved earlier traditions and added inventions, discoveries and innovations of their own. At that time, the Muslim world became a major intellectual centre for sciences, philosophy, medicine, and education. In Baghdad they established the “house of wisdom” (Bayt-al-Hikmah) where scholars, Muslims and non Muslims sought to gather and translate the world knowledge into Arabic. The Islamic empires were “truly universal civilization” which brought together for the first time people from diverse areas and backgrounds.

A number of important educational and scientific institutions, previously unknown in the ancient world, have their roots in the early Islamic world, the public hospital (which replaced the healings temples and sleep temples) and psychiatric hospital, the public library and lending library, the academic degree granting university and the astronomical observatory as a research institute as opposed to a private observation post as was the case in ancient times. The first university which issued diploma was the Bimaristan medical university’s hospital of the medieval Islamic world where
medical diplomas were issued to students of Islamic medicine who were qualified to be practicing doctors of medicine from the 9th century. The Guinness book of world records recognized the university of Alkarouine in Fez Morocco as the oldest degree granting university in the world with its founding in 859 C.E, this is followed by Al-azhar university founded in Cairo, Egypt in the 975 C.E which offered a variety of academic degrees including a post graduate degrees and it is often considered as a full pledged university and the origin of doctorate will also dated back to the ‘ijazat attadris wal ifti’dai’ (licence to teach and issues legal opinions).

The library of Tripoli (Libya) is said to have had as many as three million books before it was destroyed by crusaders. The number of important and original Arabic works on the mathematical sciences far exceeds the combined total of Medieval Latin and Greek works of comparable significance. The first hospital in the Islamic world was built in Damascus in 707, and soon most major Islamic cities had hospitals in which hygiene was emphasized and healing was a priority, hospitals were open 24 hours a day, and many doctors did not charge for the service. Later a central hospital was established in Baghdad by one of the Abbasid ruler, and there are thirty four hospitals throughout the Muslim world since then, and many of them with special wards for women, travelling clinics with adequate supplies of drugs and medical schools was once opened in the capital of Sassanid Persia, which became the largest in the Muslim world by the 9th century, its location in central Asia allowed it to incorporate medical practices from Greece, china, India as well as developing new technique and theories (Abdi, 2011).

2. Prophetic medicine (Dib Al-Nabawi)

Prophet Muhammad (Pbuh) is regarded as a leader and profounder of Islamic civilization, his medical contributions and guidelines could be considered as a starting of medical exploration during the early days of Islam. His renowned medical collection has shaped the typically Islamic uniqueness in human prevention, cure and treatment; it was summarized by Ibn Alqayyim Al-jauziyya in his compilation that: “according to prophetic medicine, the science of medicine consist of three basic rules; preserving good health, avoiding what might cause harm (i.e. establishing immunity) an eroding the body of harmful substances, there are three states that the body can be normal, abnormal and mediate(between normal and abnormal). When the state of the body is normal the body is healthy, when it is abnormal it is ill, while the third is in the middle as one extreme does not become the opposite extreme except after passing through a middle stage. Yet the type of medicine that the Prophet and his companions used to take was nothing than the chemical mixtures that are called “Agrabathay” (pharmacopoecia) rather the majority of their medicine consisted of only one ingredient, sometimes they would take another substance to assist the medicine or make it taste better. Prophetic medicine therefore has a divine element in it, this element makes comparing prophetic medicine to the medicine offered by regular doctors similar to comparing a medicine by doctors to folk medicine, the best medical authorities has agree to this fact, since the science that they excel in is a result of comparisons, experimentation, inspiration, visions and hypothesis. He (Pbuh) emphasized that “the diseases that attack the body are similar to the diseases that attack the hearts, just as Allah has sent down a cure for every disease that strikes the hearts, He has also sent down a cure for the diseases that attack the body equally. The prophet’s guidance concerning food and drinks including observing diets, refraining from excessive eating and the general guidelines that should be observed regarding eating and drinking (Al-Musnad, Imam Ahmad).
“The son of Adam never fills a vessels worse than his stomach, the son of Adam only needs a few bites that would sustain him, but if he insist, one third should be reserved for his food, another third for his drink and the last for his breathing” in this work he again described that: the physical ailment attack and harm the body and alter its normal function because of an excess amount of substance, this type also constitutes the majority of diseases and occurs, because of overeating or consuming what the body needs that which brings about little benefit or is not digested easily, or due to complex meals, i.e. when the son of Adam habitually fills his stomach with these types of foods, he will end up with various types of illness, some of which to take a long time for remedy and on the other hand, when one consumes moderate amount of food and eat sensibly, the body will get the maximum benefits from the diets as opposed to when overeats” (Abdel Qader 2003).

3. MUSLIMS CONTRIBUTIONS IN MEDICAL AND APPLIED SCIENCES

a. Ibn Sina (980-1037)

He is Abu Ali Hussein born in the Persian province of Balkh (now in Afghanistan) and moved to Bukhara a present (Uzbekistan) during childhood. He was the most brilliant, medical scholar, philosopher and educator in the world at the beginning of second millennium; he is one of the greatest and most famous physicians in the world. His works on medicine were used in European medical schools for centuries and he wrote 246 books with his renowned collections ‘kitab al-shifa’ (the book of healing), which contains a 20 volumes and the ‘Qanon fi AL- Tib’ (canon of medicine) which also serves as principal guide for medical science in the west from the twelve to seventeenth century. He is first credited with discovering the contagious nature of the diseases like tuberculosis which he correctly concluded that it could be transmitted through the air and led to the introduction of quarantine as a means of limiting the spread of such infectious disease. Ibn sina’s significant contribution to medical science was his famous book of “Al Qanon fil tib”. He made original contribution to this five volume text, the first deal with anatomy, physiology and pathology which emphasis on the importance of dissection of the human body, the second volume described the general principles of treatment and pharmacology, the third and fourth consist of diseases of all organs of the body, specials pathology of fevers signs and symptoms of known diseases, in the fifth volume also described a disease that start in one part of the body but subsequently affects the several parts of the body.

Ibn Sina was the first physician to describe ‘guinea worm’ infestation and anthrax, he discussed the theory that small organism may be responsible for infectious diseases 1000 thousand years ago, and advocated the use of bread mould organism in the treatment of non responsive open wounds, he further described triggermal neuralgia and facial paralysis of central and peripheral types and writes on the interaction between the psychology and health. Ibn sina wrote a chapter on cardiac drugs for the elderly, he also discussed the treatment of anxiety, depression and melancholia. (Basheer M, 2008).Other areas of Ibn sina’s contribution is earth science, his view concerning earth science was on the origin of mountains; Ibn sina has established three origins for the formation of stones (rock) being from water (chemical) mud (detrital) or fire (igneous), presently these origins are known as sedimentary and igneous. He did not identify the third metamorphic origin (alteration from sedimentary and igneous rocks) because it was only known after the advent of microscope in Europe (Al-Rawi, 2002).

b. Abu Ali al Hassan Ibn alhaytham (965-1040 C.E)
He was born in the southern Iraq city of Basra; he held the position of chief minister was very prestigious role in the Muslim caliphate. Therefore, after some time Al-Hazen began to question the arguments of theology he encountered and wondered, in the 10th and 11th century. His speculations in medical sciences began his search for truth by finding “solace in the thought of Aristotle”, and were well versed in science as he ‘expounded the theories of Aristotle, Galen and Ptolemy’. He also devoted in philosophy, physics, medicine, optics, astronomy and mathematics. His works were as many as two hundreds, many of which eventually got lost. Although his seven volumes on optics survive and widely considered, his most important contribution was in the field of optics “Kitab Al-Manazir” and it is because of his works he was considered to this day, by many as “one of the figures in the history of optics between antiquity and the 17th century” (Gorini 2003).

Alhazen showed through experiment that light travels in straight lines and carried various experiment with lenses, mirrors, refraction and reflection. He was the first to consider the vertical and horizontal component of refracted and reflected light rays, which was an important step in understanding optics geometrically, Alhazen studied the process of sight, the structure of the eye, image formation in the eye and the visual system. He corrected a significant error of Ptolemy regarding binocular vision, Alhazen’s theory of binocular vision faced two main limits; the lack of recognition of the role of the retina and obviously the lack of an investigation of ocular tracts (ibid 2003). Therefore, Alhazen’s assistance to geometry replicated a number of theory that goes beyond the ‘Archimedean tradition’ he also operated an analytical geometry and the early stages of the link between algebra and geometry that was exemplified by “Desserts” in geometric analysis and by Newton in the calculus.

c. Abu-Bakr Muhammad Ibn Zakariyya Al-Razi (864-930)

He lived at ray in Iran; he specialized in medicine, mathematics, astronomy, chemistry, pharmacy and philosophy. His medical contribution had an everlasting influence like those of Ibn sina. His famous works were “kitab Al-Hawi Al-kabir” which known in Latin as the continents liber, and “kitab al Mansuri” that translated also in to Latin during 15th century. Al-Razi was the first in Islam to write a book based on home medical (remedial) advisor entitled ‘man la yahduruhu al-tibb’ for the general public, he dedicated it to the poor, the travellers and the ordinary citizens who could consult it for the treatment of common ailments, however he described breads, waters, dairy products, fruits, vegetables, spices, meats and fishes, he explained in detail their kinds, methods of preparation, physical properties, and therapeutic modes of action, and pointed out when they were useful and when not. He also described the disadvantages of frequent consumption of wines leading to alcoholism which often causes many serious diseases as epilepsy, paralysis, senile tremor in older people, cirrhosis, hepatitis, mental disorders, visionary distortions, obesity, debility and impotence. In his famous ‘kitab Al-Mansuri’ he devoted four out of the books total of ten treatises, to diets and drugs, medicated cosmetics, toxicology and antidotes, amelioration of laxatives and compounded remedies, all of which are of pharmaceutical interest (Sharif K, 2007).

Razi is also known for having discovered “allergic asthma” and was the first physician ever to write articles on allergy and immunology, in the sense of smelling, he explains the occurrence of ‘rhinitis’ after smelling a rose during the spring, in this article he discusses seasonal ‘rhinitis’ which is the same as allergic or asthma or hay fever. Rhazes also contributed in many ways to the early practice of pharmacy by compiling texts, in which he introduces the use of mercurial ointments and
his development of apparatus such as mortars, flasks, spatulas and phials which were used in pharmacies until the early twentieth century. Other renowned works of Al-razi is; Kitab bul al-sa’ah (cure in an hour) then ‘Kitab al tibb ar ruhani’ (book of spiritual medicine) and ‘Kitab al’murshid’ (the guide) (Amr S.et, al 2007).

Touraj, (2008) states that “Razi was probably the first physician who used animal experiment to test the effect of novel treatment and if they had no untoward affects in the animal he will prescribe them for his patients. He writes that “as far as I am aware, pure mercury cannot be dangerous but causes severe abdominal pains and is excreted unchanged, I gave some mercury to a monkey that used to keep in my house, the poor animal gritted his teeth and was squeezing his abdomen with his hands... after this experiment Razi prescribed pure mercury for several of his patients with lower intestinal blockage”. Razi’s importance in the history of science is not merely that he discovered alcohol, sulphuric acid and ammonium chloride nor that he described and differentiated measles and smallpox or allergic rhinitis for the first time, but it is of greater significance that he based his scientific on a rational and empirical methodology similar to that which Francis Bacon introduced in European thought in the seventeenth century.

He however formulated the first known description of smallpox, saying that; small pox appears when blood boils and is infected resulting in vapours being expelled, thus juvenile blood (which look like wet extracts appearing on the skin) is being transformed in to richer blood, having the colour of mature wine, at this stage small shows up essentially as ‘bubbles found in wine’ (as blisters)....this disease can also occur at other times (meaning not only during childhood) the best thing to do during this first stage is to keep away from it, otherwise this disease might turn in to an epidemic’; Razi’s book: Aljudari wa-al has bah (on small pox and measles as distinct diseases, it was translated more than a dozen times in to Latin and other European languages. He added that; “the eruption of smallpox is preceded by a continued fever, pain in the back, itching in the nose and might mares during sleep, these are the more acute symptoms of its approach together with a noticeable pain in the back, accompanied by fever and an itching felt by the patient all over his body. A swelling of the face appears, which comes and goes and the notices an overall inflammatory colour noticeable as a strong redness on both cheeks and around both eyes, there is also a pain in the throat and chest and one finds it difficult to breath and caught

d. Abu AL-Qasim Khalaf Ibn Al-Abbas Al-Zahrawi (936-1013AD)

He was born and grew in Al-Zahra, a suburb of the famous city of Qurttoba (Cordova) in Andalusia (Spain). Al-zahrawi was an innovative surgeon who added many original contributions to surgery and medicine not known to his predecessors, during his life time doctors used to travel from faraway in order to learn from him. Later on in Europe during the middle ages and renaissance he remained the famous teacher of surgery through his well-known encyclopaedic work ("Al-tasreef liman ajez Aan Al-taareef") meaning (the disposal of medical knowledge to those unable to get it from other compilations) a thirty volumes medical treatise which covered surgery, medicine, orthopaedics, obstetrics and gynaecology, ophthalmology, pharmacology and nutrition. Al-zahrawi therefore was the first to stress the importance of basic medical sciences; saying that: “before practicing, one should be familiar with the science of anatomy and the functions of organs, so that he will understand them, recognize their shape, understand their connections and, know their boarders, also he should know the bones, nerves and muscles, their numbers, their origins and insertions, the
arteries and the veins, their start and end, these anatomical and physiological bases are important. *Al-zahrawi* was first to:

1. Use cotton (in surgical dressings) in the control of haemorrhage and as padding in the splinting of fractures.
2. Described in detailed the unusual disease, haemophilia.
3. Use cutlery, wax and alcohol to control bleeding from the skull during the cranial surgery and described the ligature of arteries long before Ambrose pare.
4. Teach the lithotomic position for vaginal operation; he was in this case first surgeon to described ectopic pregnancy.
5. Described the tracheotomy operation and performed it as an emergency on one of his servant. (Elgohary, 2006)

However *Al-Zahrawi* contribution on bladder stone was remarkable, as extraction of stones from the urinary bladder is one of the oldest surgical operation in history. He improved the technique of this operation and reduced its risk, he invented “Al-Mirwed” which is a metal probe or a sound to confirm the presence of the stone before proceeding with the perennial cystolithotomy operation, he was also the first to use a forceps to extract a bladder stones, which before the extraction of the stone was by an instrument similar to a small spoon that goes around the stones and scoops it out. But he introduced for that purpose a new instrument with a better grasp on the stone, *Alzahrawi* also designed a special forceps (litho trite) named “kalalib” which he used for crushing a large vesical stones through a perennial cystotomy, he was also a first to invent fine pointed instrument (a drill) to pierce impacted urethral stone. Therefore *Al-zahrawi* reigned during the Ummayads dynasty and he was considered as (the father and pioneer of modern surgery), his influence on European surgical development was deep and long lasting, also his contribution is integral to any medical practice (Abdi, Al Daffa, 2011, 1997).

e. *Abu-Abdullah Muhammad Ibn Musa Al-Khwarizmi (780-850 C.E)*

He was born in *Khwarizm* (now the Uzbeki city of Khiva). He is one of the pioneer Muslim astronomer and mathematician who worked in the ‘House of wisdom’ in Baghdad in the 9th century. He combined Babylonian and Indian numerals in to simple and feasible structures that everyone could use, he explained the use of zero and advanced the decimal system for practical reasons, both the terms “algebra” and “algorithm” owe their origin to him, *Al-khwarizmi* is the best known as “the father of Algebra”. In fact the word “Algebra” comes from the title of one of his book, it originated in an Arabic phrase meaning “the reunion of broken parts”, and therefore Algebra is used to solve problems involving unknown numbers, an example is the equation (equation: a mathematical statement in which the answer equals the statement) 7x+4=25, using algebra, we can figure out that in this equation x represent 3, Al-Khwarizmi’s important book on mathematics is used in the universities of Europe for a long centuries in the history of mathematic (Nasr, 1984). However if introducing the world to the Arabic number system were the only accomplishment that *Al-khwarizmi* would have produced in his life, this would be sufficient to rank him as one of the world greatest mathematician. His important contribution that he would be put forth, entitled “kitab al muktasar fil hisab aj-jabr wal muqabalah” (in English, the condensed book on calculation by restoring and balancing) the other mathematical operation dealt by Alkhwarizmi was ‘muqabalah’ which translated as “reduction or balancing” according to AlKhwarizmi; there are three kinds of
quantities simple numbers like 4 or 77, then the root which is the unknown x to be found in a particular problem, and the Mal (wealth) which is the square of the root in the problem, with these definitions of quantities; Alkhwarizmi classified problems in to six standard forms (a,b, and c, are all positive numbers):

1. Square equal to roots, example: ax^2=bx
2. Square equal to numbers example: ax^2=b
3. Roots equal to numbers example: ax=b
4. Squares equal to numbers example: ax^2+bx=c
5. Squares and numbers equal to roots example:ax^2+c=bx
6. Roots and numbers equal to squares example: ax^2=bx+c.

His approach to geometrical proofs and paradigms were heavily represents simple numbers and roots as length of line segments, the multiplication of roots and numbers represented particular rectangles where the roots and numbers corresponded to the side lengths of the rectangles and their products represented the area of the rectangle. A common term like ‘completing the square’ or ‘squaring a polynomial’ originally came from Alkhwarizmi with geometrical and algebraic expressions, for example: Alkhwarizmi solves x^2+10x=39, by completing the square, the following is the geometric representation of the solution:

In this example, Alkhwarizmi begins by constructing a square with side length x and area x^2 (picture 1) he then construct four rectangles with side length x and 5/2 and area 5x/2 (picture 2) this polygon represents the x^2+10x part of the equation, Alkhwarizmi then complete the large squares by adding four smaller squares with side lengths 5/2 and area 25/4 (picture 3) the total area of the four smaller squares is 25 on this equation, Alkhwarizmi adds 25 to both sides. Therefore the equation x^2+10x=39 become x^2+10x+25=39+25, simplifying the expression yields (x+5)^2=64, which implies that x+5=8 and therefore x=3, this examples clearly indicates why Alkhwarizmi had difficulties accepting negative roots and coefficients, because his numbers represented concrete quantities, such as length or area, it would be impossible to create a negative area or length (Al-Daffa, 1997).

4. Conclusion
Islam has significantly achieved to the world of general sciences, its remarkable achievement in the multi disciplinary medical aspects could also never be forgotten. The earlier rise Bimaristan medical institution in the 9th century was marked the first practice of learning and teaching medical sciences throughout the history of Islamic civilization, thereby owing the development of the first recognized degree granting university in human history (the University of Alkarouine in Fez, morocco) in 859, the rise and development of Tripoli (Libya) were said to have had about three million books before it was destroyed by crusades, then the development of first hospital and its practices in Damascus by 707 were all shape the earlier medical practices. A distinguishing contribution of “prophetic medicine” which technically stated that: “the medicine was first consisted of preserving good health, avoiding what might cause harm i.e. (establishing immunity) and eroding the body from harmful substances, it also categorised the three states of human body, from the state of normalcy, abnormal and the middle stage, its then explained the chemical mixture of Islamic medicine, the types of diseases and various nature of its attacks as well as Islamic medical compositions. 

However Ibn Sina’s contribution on contagious diseases, his development of quarantine system, his original theories in guinea warm, infestation, anthrax and their modes of treatment, his theory on the relationship between the psychology and health were all added values to the medical science in human history. Therefore Alhazen’s important works on optics is still benefiting the modern ophthalmology as he was first to consider the vertical and horizontal component of refracted and reflected light rays which was an important step in understanding optics, he gave the clear process of sight, the structure of the eye, image formation in the eye and the visual system. Alhazen’s important collection “kitab Al manazir” ranked him as a pioneer in the history of optics. Meanwhile Al-razi was credited with the early discovery of “allergic asthma” he contributed immensely in the field of pharmacy where he introduces the mercurial ointments, pharmaceutical apparatus such as mortars, flask, spatulas, and phials which were used in pharmacies until twentieth century and he is the first to describe the measles and small pox.

It is also note that, Alzahrawi important contribution in medicine and surgery led to the introduction of fundamental basics for the practice of medicine, where he stressed that: “one should be familiar with the science of anatomy and the functions of organs, so that he will understand them, recognize their shape, understand their connections, and know their boarders, also he should know the bones, nerves, and muscles, their numbers, origins and insertions, the arteries and the veins, their start and ends. And he improved the technique of bladder surgery where he invented so many surgical instruments for that course. Therefore, “kitab al muktasar fil- hisab aj-jabr wal muqabalah” (the condense book on calculation by restoring and balancing) was attributed to Alkhwarizmi, he also developed three kinds of quantities with simple numbers like 4, 77 and the geometrical contribution of completing the square using diagram. However, the contemporary Muslim scientist and the practicing doctors can be reawaken and redeveloped the mention techniques, inventions and medical theories from these noble men during the pinnacle of Islamic civilization, Muslim are therefore to understand the Islamic dynamism and general tolerance to all periods, nations, race and intellects. An indefinite search for the knowledge of Islamic sciences and the rigorous research for the composition of drugs from the natural chemical mixtures, employing Islamic ethics in the medical and health related practices which in turn will signify the uniqueness of Islam in health care and human development.
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