

History of Medicine in Iran

Avicenna's Canon of Medicine: A Look at Health, Public Health, and Environmental Sanitation

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Abstract

Avicenna, a renowned Persian Muslim scientist has written numerous scientific papers and valuable medical books that are respected worldwide. For centuries his masterpiece, the "Canon of Medicine", has been used as a major medical reference. The Canon, as a prime encyclopedia on medicine is comprised of five books. In the introduction to the Canon, Avicenna has described the purpose of medicine as the preservation of health if it is already attained and its restoration when it is lost. He defines health as a trait or state, which results in the normal functioning of the human body and presumes that health is a steady state, whilst disease is more of a variable concept. Thus whenever we depart from a healthy state, we approach disease. A comparison of current views regarding definitions of health, disease and their components as defined by Avicenna could open new horizons for ancient, traditional medicine. The Canon contains numerous implications concerning the infrastructures of public health-related issues. For example the specifications of healthy water and air are well described in the "Canon of Medicine". To enable a better understanding of Avicenna's viewpoints about public health, we have briefly reviewed his perspective on the topics of health, disease, and environmental sanitation concerning water and air.

Keywords: History of medicine, Iran, public health

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Introduction

Ibn Sīnā, whose full name is Abu 'Ali al-Husayn ibn 'Abd Al-lah ibn Sina, is also known in the West as Avicenna. Avicenna was a well-known Persian and a Muslim scientist¹ who was considered to be the father of early modern medicine. Avicenna created an extensive corpus of work during Islam's Golden Age. During his time, he was regarded as a prominent physician and philosopher who influenced the world through his valuable works.^{2,3} Dante, in his epic poem "Divine Comedy", equated him with Hippocrates and Galen.⁴⁻⁶

Ibn Sina was born in 980 A.D. (Safar 370 A.H.) in a village in Afshaneh near Bukhara (in present Uzbekistan). He was born into a Persian family.^{7,8} At a young age he enthusiastically read books related to medicine, performed empirical works to treat patients, and gradually became an outstanding physician.⁹ About 1012 CE; c. 402 AH, Ibn Sina began to write his masterpiece, the "Canon of Medicine" which he finished while living in Hamadan (present day Iran).¹⁰

After considerable influence in the medical world in addition to the compilation of masterful books and papers, and doing prominent studies, Ibn Sina died of colic in 428 A.H. (1037 A.D.). He was buried in Hamadan, Iran^{9,10} where his tomb is currently a famous tourist attraction.

The "Canon of Medicine" or "Qanoun fi Tib" is considered a medical masterpiece. The Canon, which is the largest work by Ibn

Sina, was translated into Latin in the 12th century and used as a major reference in medical education from the 12th until the 17th centuries.^{6,7} The Canon includes five books and ten parts, where each book relates to one medical issue.⁶

This review discusses the concepts of health and public health in the Canon as well as Avicenna's views about public health.

Health and public health

Before embarking on a discussion of Avicenna's views it is necessary to have a clear understanding of the terms "health" and "public health". Although in existence for approximately 60 years, the World Health Organization's (WHO) definition of health is still relevant and defined as: "a state of complete physical, mental and social well-being and not merely the absence of disease".¹¹ However, this definition is limited in that it is impossibly idealistic and unobtainable for most people.¹²

In 1920 CEA Winslow, a Professor of Public Health at Yale University, defined public health as follows: "Public health is the science and art of 1) preventing disease, 2) prolonging life, and 3) promoting health and efficiency through organized community effort for a) the sanitation of the environment, b) the control of communicable infections, c) the education of the individual in personal hygiene, d) the organization of medical and nursing services for early diagnosis and preventive treatment of disease, and e) the development of social machinery to ensure that everyone is provided with a standard of living adequate for the maintenance of health. Indeed, these should be so organized as to enable every citizen to enjoy his birthright of health and longevity".¹³

In the opening section to the Canon, Avicenna has described the purpose of medicine (Tib) as the preservation of health if it is already attained and its restoration when it is lost.¹⁴ Moreover, he has argued against the assertion that there were there are three

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states in the health continuum: bodily health, a disease state, and the third which was neither healthy nor diseased. Instead, he emphasized only two states for the human body, healthy and diseased. He stressed that it was irrelevant to speak of the third state, which was merely an invention that described a 'decline in health' and in reality was encompassed by the diseased state.¹⁴

Avicenna further defined health as: "The beauty of the body-long hair, clear complexion, fragrance and form"¹⁴ or in other words a trait or state that resulted in normal functioning of its subject (human body).¹⁴ Since he has considered 'decline in health' to be directly opposed to health, we infer that he took into account health as being a range or sliding scale. He has presumed that health is a steady state, whilst disease is more of a variable concept (i.e., declining health). Thus when we move away from the healthy state, we approach disease. However, Avicenna did not reject others' opinions about the state of the human body, particularly with regards to the proposed third state. He has written on behalf of Galen: "The states of the human body, according to Galen, are three: Health, it is a state which helps to maintain the functions of the human body through (proper balance) of its temperament and composition in a correct and sound manner. Disease, it is that state of the human body which is contrary to the aforementioned state. Then there is a state in which, according to him (Galen), there is neither health nor disease: neither the health is perfect nor the disease is absolute such as the bodies of the old and the convalescent and of children."¹⁴

Avicenna has defined disease as an abnormal condition for the human body. As written in the Canon, "this is an abnormal unnatural state of the human body, in virtue of which injurious effects result."¹⁴ Avicenna distinguished between symptom, cause, and disease¹⁴ where he expressed the symptom as a phenomenon that followed an abnormal condition. Abnormal was considered to be something harmful to the physis (nature), such as the pain of colic, or not harmful, such as the excessive redness of the cheeks when associated with pneumonia. He exemplified the differences as follows: "Putrescence (putrefying) is an example of cause, fever is an example of disease, whilst an example of symptom is thirst and headache."¹⁴

Avicenna believed that diseases had causes. In the Canon, it is written: "The word cause in medical works, refers to that which initiates a given state of human body, or maintains a fixity of such a state."¹⁴ According to Avicenna, medical science deals with the human body in terms of health and decline in health, as knowledge of anything is acquired and completed by learning about its causes. Provided such causes exist, it is necessary to determine the causes of health and disease.¹⁴ Therefore, it would seem that Avicenna maintained an epidemiological view regarding diseases and health. Indeed, he has stated that the causes might be visible or invisible, and categorized these causes as follows: i) material comprise the substances on which health and disease depend; ii) efficient relate to those which alter or maintain the states of human body such as air, food, and sleep; iii) formal causes include temperaments, as well as faculties that follow temperaments, and compositions. Avicenna has defined temperament as a quality that results from the interaction of opposite qualities present in elements that consist of minute particles such that most particles from each of the elements may touch most of the other particles;¹⁴ and iv) final causes which are functions.¹⁴

Although Avicenna has described health and disease in two short sentences, "to preserve health if it is already attained" and "to re-

store it when it is lost", he divided medicine (Tib) into two parts. Part 1 concerns knowledge of regulating the body with the intent to maintain its health. This is often called hygiene and is also known as primary prevention. Part 2 pertains to knowledge of managing the diseased body and the methods for restoring it to health,¹⁴ which refers to knowledge of treatment, or secondary and tertiary prevention. Thus, medicine is the sum of hygiene and treatment.

Avicenna regarded medicine to be an extensive range of the following elements; temperaments; humors; simple and compound organs and their faculties; physical, vital and psychic functions; the states of the body with regards to health, disease and the intermediate state; and the means thereof, such as food, drink, air, water, countries, residence, depletion, retention, occupations, habits, physical and psychic movements, age, and sex; foreign matters that access to the body; and preservation of health and treatment of diseases by means of regimens for food and drink, choice of air, regulations of movement and rest, use of drugs and surgeries.¹⁴

Avicenna mentioned the basic goal of health as the preservation of moderation. He has written: "We may say that in the art of preserving health the basic thing is the moderation of the aforementioned general and essential causes. But of them greater attention is paid towards the moderation of seven things: moderation of temperament; selection of the articles of food and drink; depuration of superfluity; protection of the constitution (of the body); purity of the inhaled air; proper clothing; moderation of physical and psychic movements which include, in one way or another, sleep and wakefulness".¹⁴ However, he did not consider moderation as a stable concept, nor did he set limitations for health. "You have learnt from what has already been described that there is no set limit for equability of health. Nor is any temperament in perfect state of health or equability at a given time, rather it stands somewhere in the middle."¹⁴

Avicenna believed that the aim of health was to guide the human body towards attaining an advanced age, or natural span of life. In other words, a healthy man should die from old age rather than as the result of a disease.

Avicenna stated that signs of health showed equability of temperament and evenness of structure.

He has divided the evenness of structure into three categories, i) substantial which involve some of the signs of evenness of structure and include constitution, position, quantity, and number; ii) accidental, such as beauty and comeliness; and iii) final which are those with complete functions and perfect continuance. In other words, a perfectly functioning organ is a healthy organ.¹⁴

It can be concluded that according to Avicenna functionally deficient organs are unhealthy organs.

According to Avicenna, equable temperament exists in healthy people. He has described equable temperament as the sense that quantities of opposite qualities combine in equal degrees of potency such that the temperament becomes a quality, which is exactly their mean. He states the signs of equable temperament to be: "a balanced feel of the body with respect to heat, cold, dryness, moistness, softness and hardness; a balance of color between whiteness and redness; a body grown moderate in bulkiness and leanness, but inclined to bulkiness; the blood vessels are neither too deep nor superficial, and separated from the flesh; the hair is neither profuse nor scanty and curly nor straight. The organs are healthy and the functions are perfect".¹⁴

"A person having these qualities is popular, cheerful, gay; moderate in his desire for food and drink, has good digestion of food in

his stomach, liver and vessels, which are assimilated in the body, and has normal excretion of the superfluous matter through proper passages".¹⁴

According to Avicenna there are eight different forms for an equable temperament. Moreover, he has stated that 'equable' is a term used by physicians in their discussions and does not mean a balance in weight, but rather an equitable distribution. It is a very wide term that is not confined within any limits (except those of excess and deficiency), but neither is it random.¹⁴

It is apparent from the writings of Avicenna that the definitions he has given depend on numerous conditions and a given definition will not be constant for all individuals and all conditions. Rather, the definitions offered by Avicenna should be seen as existing in a flexible format. This can be understood in the context of the WHO definition of health, which is similar to that described by Avicenna where he has written that the manner of health is unstable: "nor is any temperament in perfect state of health or equability at a given time, rather it stands somewhere in the middle".¹⁴

Avicenna has defined compatibility as an individual's perception of a complete, intact and moderate temperament. In other words, a person perceives himself/herself as moderate in temperament and whole health. Likewise, a person who feels that they have lost his/her temperament and therefore does not have a natural temperament should be called incompatible.¹⁴ Thus the perception of health can be interpreted as an improvement in temperament.

This definition closely approximated with the WHO definition of quality of life. WHO defines quality of life as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns".¹⁵ Both definitions emphasize an individual's perception.

The following section focuses on another aspect mentioned in the Canon, namely public health and environmental sanitation.

Water

Avicenna was aware of the importance of water hygiene. He understood that water was a substance with different properties, and therefore classified water according its qualities. Avicenna has also stated that water is a part of all foods and drinks; however, he did not consider it to be nutritious. He has argued that a nutritious thing is that which is potentially blood and has the remote ability of becoming a part of an organ of the human body.¹⁴

"Water is of different kinds, not because of its aquosity but purely watery substance, and because of what is mixed with it and the conditions which dominate it. The best water is that of springs not all springs but springs on pure earth which is not dominated by any condition or polluted by extraneous elements, or springs which are on rocky ground and thus they do not putrefy as easily as those on pure earth".¹⁴

According to Avicenna springs provide the best water for health. He has defined healthy water as water that is not dominated by any condition or polluted by extraneous elements and is not putrefied.¹⁴ This definition closely approximates the WHO's current definition of safe drinking water, in that it "should not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages".¹⁶ According to Avicenna, running spring water should be exposed to the sun and wind. He believed these elements imparted purity to spring water. It has been said that microorganisms decay at a faster rate at higher

temperatures, which may further be mediated by the lethal effects of UV radiation in sunlight that act near the surface of spring water. This further confirms Avicenna's recommendation.

Avicenna also wrote of the qualities of water from higher mountainous regions where he believed that this water was fresh and considered sweet. Such water is light in weight. It is quick to cool down and warm up because it is rarefied, and it is cold in winter and warm in summer with no taste or odor. This water is quickly passed through the epigastrium and easy to cook with.¹⁴

Avicenna has proposed a method for water quality evaluation based on its weight and added that light water is better in most cases. According to Avicenna, there were two ways to clarify water's weight, namely with the aid of a measure or simply by taking two pieces of linen or cotton wool of equal weight and soaking them into two different kinds of water. The pieces of linen/wool were then to be thoroughly dried and weighed. The water from the lighter of the two linen/cotton-wool samples was considered the better in terms of quality.¹⁴

Avicenna introduced distillation, filtration, and boiling to purify hard water. This was noteworthy since physicians at that time thought that when water was boiled, its attenuated part was evaporated and the dense part was left behind. They believed there was no point in boiling water because it would only become harder. However, despite criticism from other physicians, Avicenna believed boiled water was beneficial, for example it was less flatulent and more easily ingested.¹⁴

Avicenna was also aware that temporary hardness could be removed by boiling. He wrote: "Boiling first removes the hardness produced by cold. Then the particles of water become well rarefied till it becomes thin in consistency. Thus it is possible for the heavy earthy particles mixed in water to be separated from it. They sink down in water and are thus separated from it in the form of sediment. There remains only water which is nearer to the simple water."¹⁴

Today it is accepted that temporary hardness when caused by hydrogen carbonate (or bicarbonate) ions can be removed by boiling. For example calcium bicarbonae, which is often present in temporary hard water may be boiled to remove hardness. In this process, a scale forms on the inside of the container in a process known as "furring". This scale is composed of calcium carbonate and the reaction for dissociation is as follows: $\text{Ca}(\text{HCO}_3)_2 \rightarrow \text{CaCO}_3 + \text{CO}_2 + \text{H}_2\text{O}$. Also, according to WHO guidelines, boiling water serves as an effective means to reduce microbial contamination, something that could easily threaten public health.¹⁶

Air

Avicenna considered air to be an element, in fact even a light element. He believed that elements were simple bodies which were also primary substances of human and non-human bodies alike. He advised physicians to learn about the various types of elements, including fire, air, earth and water.¹⁴

Clean air is considered to be a basic requirement for human health and well-being. Poor air quality principally affects the respiratory and cardiovascular systems. Therefore individuals who spend a lot of time outside when the air quality is poor increase their exposure to air pollutants and increase their risk of illness or disease.

Avicenna has devoted an entire section in the Canon to the effects of air on the human body, believing air is one of the factors that affects human health and promote disease. He states that inhala-

tion of fresh or good air is one of the principles of health. He has considered some of the qualities of good air to be that with which foreign matter (i.e., vapors and smoke) is not mixed, is open to the sky, and not closed by walls and roofs. Good air is fresh and pure, not mixed with vapors that rise from lakes, ponds, ditches, damp land, fields of vegetables [particularly those in which cabbage and rocket seed (Jirjir) are grown], dense forests, yew trees, walnut trees, fig trees, and not mixed with putrid air. Clean air is not troublesome for breathing and not suffocating.¹⁴

Avicenna also considered air pollution and classified abnormal changes in air in two ways: i) a change in the substance of air where the substance becomes morbid, but not in such a way that any of its quality has grown in intensity or decreased and ii) a change in air quality.

He named polluted air as morbid air and has believed that putrefaction of air occurs in the same way as the putrefaction of foul, stagnant water. Intelligently, he could differentiate between pure simple air and that which surrounds us, defining pure simple air that air which could not be putrified. In contrast, contaminated air is a mass that is spread out in the atmosphere and comprises elemental air, watery vapor, terrestrial particles which ascend through smoke and dust, and fiery particles. Such air is prone to putrefaction as its many substances may become corrupted.¹⁴

Avicenna has observed that the putrefaction of air coincided with the appearance of diseases, in particular epidemics. This was in itself not so unusual, as for some time, it had been widely held that air caused specific diseases such as cholera. It was not until much later that Dr. Snow, in the 1850's, demonstrated that cholera entered a body only by means of water, not by air.¹⁷

An ancient idea regarding the causation and spread of diseases considered that air did not act as a medium for the spread of disease; rather air itself contained miasma or pollution.¹⁸ This view supported and rationalized the divine origins of disease.

Herodian, an ancient author, believed that a medical disaster which happened in army camps was caused by poor diet and the inability of the troops to adjust to a new climate and its hot, stifling air.¹⁹ Yet, modern epidemiologists attribute this problem to some forms of disease transmission, such as shigellosis or another type of bacillary dysentery.

However, Avicenna did not believe that air caused specific diseases such as cholera. Instead, he believed that epidemics and putrefaction of air mostly occurred towards the end of the summer and during the autumn. Thus, he has stated that changes in air quality, as an intolerable excess of heat or cold, would most likely result in the destruction of crops and animal life. Avicenna considered changes in the properties of air to exert a negative effect on the human body, placing them in a state of "disorder". He believed that disorder occurred when the body humors became putrid, and that the putrefaction of the humors was a direct effect of putrid air. Thus Avicenna has concluded that abnormal warm and cold airs are not good for healthy persons.¹⁴

In the following section, we compare Avicenna's views with other authors regarding public health.

As mentioned, Avicenna has declared that water has certain properties and he classified waters according to its qualities. Yet, Pedanius Dioscorides believed that water analysis was difficult. He has proposed qualifications for optimal water: purity, sincerely sweet, lacking in other qualities, does not remain in the digestive system for very long, and is not inflative nor spoiled.²⁰

Despite that Pedanius Dioscorides mentioned valuable properties

for healthy water, he neglected to explain which qualities may negatively affect water.²⁰ In contrast to Dioscorides, Avicenna's definition of healthy water closely approximates the current definition of safe drinking water mentioned earlier.¹⁶ Moreover, Avicenna has believed that the traveler is more exposed to illness from the diversity of drinking water rather than the foods consumed. Thus he has recommended that travelers should filter water repeatedly, and boil and percolate it.¹⁴ These are current recommendations by international health organizations. For example the Center for Disease Control and Prevention (CDC), in a brochure designed to travelers, recommends that if boiling water is not possible, combined filtration and chemical disinfection could be the most effective pathogen reduction method for safe drinking water when travelling.²¹

Avicenna described air quality in greater detail. He devoted numerous pages in the Canon to air believed that inhalation of clear air was an effective factor for health. He proposed that some particles which cause diseases could be airborne. Until that time, airborne diseases had not been recognized. Thus he opened a new window in epidemiology by his works. In other words he has provided a major base for the diagnosis and treatment of many communicable diseases, including tuberculosis and influenza.

Today we know that the air plays an important role in developing respiratory diseases, which is not solely related to particles transferred by air, but also air quality. For example, air temperature is an influential factor in the emergence or severity of diseases. In asthma, it is believed that cold air causes more severe conditions.²² This issue has been observed by Avicenna over one millennium before the statement that fresh air should be of a normal temperature.

Another important point from Avicenna regarding air is that pollutants are the major causes of air putrefaction and have a considerable role in disease occurrence. Although Avicenna has supported the miasma theory, however, he knew that external factors such as vapors, particles or smoke lead to the development of miasma.

This perspective is now strengthened by the status of air pollution particularly in industrial and populous cities, as the rate of disease in areas is not comparable to villages and less polluted areas.²³

Avicenna's productive life had many positive impacts for present medical progressions. By reviewing his valuable medical works it can be concluded that Avicenna was ahead of his time. Up to the 17th century, many of his compilations have been taught in universities worldwide. He has devoted a part of his famous book, the "Canon of Medicine", to public health and provided highly systematic knowledge on the definition of health, disease, and their features which are comparable to today's knowledge. By his exact description of air and water specifications and qualities we note his scholastic and precise viewpoint on scientific affairs with regards to public health and sanitation, an insight needed by today's researchers and scientists.

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