SCIENTIFIC PHILOSOPHY AND PRINCIPLES IN MEDICINE

Zekâi Şen

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Scientific Philosophy and Principles in Medicine

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PREFACE

In any education system, principles of thought, science philosophy, and logical principles exclusion from the basic courses give way to mimic, rote, mechanical and non-productive graduates and career experts. With a thought, concrete and intangible information opens the door for smart inferences. Especially in medicine studies (diagnosis, treatment, healing, clinical works) and research, these topics play a fundamental role in the exploitation of linguistic and verbal information and knowledge data. One wonders if imagination, design and idea generative human thought triggering science, philosophy and logical principles are ignored, then what takes place in the social enlightenment? Throughout history, starting from ancient Greek, Hellenistic and Islamic civilizations, further enlightenment took place in the West with the renaissance dawn up today. At the roots of each civilization, contributions were philosophical and logical principles, and most of the knowledge was verbal and written in books. Among the most fundamental issues in these civilizations, first of all, the medical, philosophical and logical knowledge presented by philosophers, physicians and doctors on human health has reached today's level of development. As in many professions today, especially in medical education and professional works, productive and dynamic thinking, philosophical verbal knowledge productions, and logic rules for rational inferences are almost forgotten; instead, only mathematics, computer software, medical instrument measurements and outputs, classical algorithm, method and knowledge applications take place.

The most effective philosophical issues in the philosophy of medicine are ontology and epistemology, which is yet well developed neither in the career nor in the medicine education system. It is, therefore, essential to develop, implement and support medicine educational ventures in the philosophy of medicine with the support of logical principles. Although there are many publications on medical philosophical procedures, education in philosophy medicine lags behind. Unfortunately, there are few textbooks based on the philosophy of medicine with a few anthologies in this field. Most of the training programs concerning medicine mention about ethics, medicine history, and medical humanities. The author of this book has lectured first-year undergraduate students about science philosophical and logical principles and their usage in the medicine profession. The content of the book mostly depends on these lectures at the Istanbul Medipol University. It is the observance of the author that the students carefully listen to these principles after all explanations are verbal and logical with philosophical ingredients.

The main theme of this book is to emphasize the significance of science philosophy and logical principles in medicine education, training and professional executions. In the absence of these basic topics, physicians, doctors and medical specialists remain addicted to the classical case studies ready computer software, classical algorithms, methods and procedures. Future improvements and advancements remain obsolete without knowledge of these topics. Innovative ideas and generative intelligence gain importance through science philosophy and subsequent logical principles applications, which help minimize medicine uncertainties in almost every issue and case study. Hopefully, this book provides a forum for a harmonious integration with patients towards effective diagnoses and treatment solutions.

The author thanks the medicine department at Istanbul Medipol university for providing the opportunity to lecture to first-year medicine undergraduate students each year about the philosophy of science and medicine. I could not complete this book without the love, patience, support and assistance of my wife, Fatma Şen.

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DEDICATION

Prophet Mohammad (pbuh) famously said. “When you hear that a plague is in a land, do not go to it and if it occurs in a land that you are already in, then do not leave it”

Ibn-i Sina (Avicenna) said: Prayer is that which enables the soul to realize its divinity. Through prayer human beings worship absolute truth, and seek an eternal reward. Prayer is the foundation-stone of religion; and religion is the means by which the soul is purified of all that pollutes it. Prayer is the worship of the first cause of all things, the supreme ruler of the entire world, the source of all strength. Prayer is the adoration of the one whose being is necessary.

CHAPTER 1

Introduction

Abstract: Basic knowledge and information are acquired through the language in the family, society and education, which should be based on philosophy and logical principles. In the field of medicine, a dialog can be established between the doctor and the patient for diagnosis with linguistic (verbal, oral) information exchange rather than mathematical expressions. This chapter presents rational thinking with logical principles, preferably combining the basic principles of philosophy in medicine with the treatment of uncertainty, the results of which are presented according to the usual bivalent (crisp, two-value) logic. The necessary and effective structural steps of rational use of language are presented based on verbal knowledge and uncertainties in information production. It is emphasized that innovative ideas, procedures and methods are possible through research and development activities, if the language, philosophy, and logic principles are observed for the most reasonable cases, even with approximate decisions.

Keywords: Education, Language, Logic, Medicine, Philosophy.

Medicine and philosophy are integrated and almost similar, as Aristotle (382-323 BC) mentioned in many of his writings that the work of medical doctors and philosophers is closely similar. On the other hand, Hippocrates (460-375 BC) said:

"Medicine cannot be without medical truth, and philosophy cannot be without medical truth."

"*All traditional logic habitually assumes that precise symbols are being employed. It is, therefore, not applicable to this terrestrial life but only to an imagined celestial existence.*" (Russell, 1923).

"*So far as the law of mathematics refers to reality, they are not certain. And so far as they are certain, they do not refer to reality.* "

(Einstein, 1925).

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As the complexity of a system increases, our ability to make precise and yet significant statements about its behavior diminishes until a threshold is reached beyond which precision and significance (or relevance) become almost mutually exclusive characteristics."

(Lotfi Asker Zadeh, 1965).

1.1. GENERAL

Social, medical, cultural, economical and environmental disciplines require linguistic and verbal discussions before a numerical database treatment, through the principles of philosophical thinking and logical inference. Preliminary data between a physician and patient is verbal, in addition to simple temperature and blood pressure measurements. The basic information is sensed and learned orally by the etymologic and epistemological contents of sentences. It is not necessary that each sentence reflect reasonably causative and effective answers for information contents. The ones with unanswered questions give each person a chance to think about the issue deeply to reach a better evolution than before. If the predicate is related to the consequent part in a logical sentence, *i.e.*, proposition, the rational consequences are reachable; otherwise, one must gather more information through discussions, debates and comments for a better assessment of the predicate-consequent relationship. For example, in medical treatments after the diagnostic decisions, there is always uncertainty in terms of vagueness, bluntness, incompleteness and fuzziness, which include skepticism and doubts. These are the components of philosophical thinking for a possible solution alternative (Chapters 5 and 6).

In order to transmit and receive information, speaking, listening, writing and reading, and many actions that are linguistically more human, are parts of language, which help to communicate. Language is the essential tool for the philosophy of science and the execution of knowledge and information at times of request. The linguistical entities provide almost instantaneous graphs of the information in the forms of objects, facts and realities.

Johansson and Lynøe (2008) explained perceptions based on talking, listening, writing, and reading (linguistic acts) as intentional communication elements. They exist by inter actions among three elements; act, content and object. For example, when one reads a physician's report about his heart problem explaining the specific features, the reading is an action. In general, any reading act about the heart problem and its properties is referred to as the content in terms of assertions based on logical propositions. According to crisp (bivalent) logic, if a proposition is false, there is no logically intentional object. On the contrary, if it is completely

accurate, then there is a logically acceptable object. On the other hand, partial accuracy refers to the intentional object in the fuzzy logic domain (Chapter 8).

The three integral constituents are body (health), mind (the ability to think and make decisions) and spirit (sensitivity and responsiveness, awareness and the ability to stay alert, passionate desire to get out of the 'attractor' of egocentric thoughts and desires, compassion and love, the more subtle and spiritual reality). The simultaneous activation ('ignition') is called a consciousness resonance.

The main purpose of this book is to clarify verbal uncertain expressions by the recommendation of science, philosophical and logical principles through various intermingled chapters concerning medical issues.

1.2. LANGUAGE AND EDUCATION SYSTEM

The dynamic education system in any society should focus on scientific researches, developments, innovative improvements and productions. Instead of statically planned lessons in every branch of science, it is suggested that scientific philosophical thinking, logical principles, especially fuzzy logic, uncertainty principles, and some geometry (from sketches, shapes, Figs graphs, images) should be included among the basic foundations of education before mathematics courses.

Al-Farabi (870-950) believed in the role of language in human's social life and in conveying information, asking questions and resolving conflicts by describing distinctions and classifications similar to Aristoteles (BC 384-322), but in a more advanced way. The way to understand is through language, in which one can express ideas and discuss with other individuals, thereby distributing basic information about the topic of interest.

Language consists of words and sentences, provides expressions and is the umbrella of the climate of thought (Chapter 2). The first foundation of any language is words that reflect materialist or imaginary issues existing or non-existent, as well as the essence of ideas that guide comprehension and expression. In the materialistic world, every word is the name of a subject depending on its form and geometry because the word helps to imagine the living form of the subject in the human mind. In general, each word has an etymological and epistemological background, which forms the basis of the logical and rational load for meaningful and understandable linguistic expressions that generate shape, geometry, and logical traces in the mind and memory of the individual. Depending on their thinking abilities, anyone can devise ideas in the form of

CHAPTER 2

Thought Principles and Science "It is not Possible to have Active Mind without Thought or Thought without Mind"

Abstract: Thoughts are the triggering arrogance of rational thinking to explore possible relationships among different procedures that lead to reasonably acceptable results. To this end, in this chapter, different thinking procedures are clearly explained based on the principles of proportional inference and interpretation that lead to acceptable and ultimately useful generations of knowledge, even though they may contain an element of uncertainty at the current level of scientific knowledge. The basic questions that are valid today and will be valid in the future throughout the history of science are "How?" and "Why?" A series of suggestions are given to find answers to these questions. Especially in medical sciences, the principles of mind (brain)-heart communication are explained for the production of linguistically comfortable and acceptable information. A series of suggestions are made about ways to find answers to these questions from thinkers in different cultural civilizations, which are the basic elements of the history of science. Finally, examples from the history of science are given in detail for the development of verbal knowledge developments.

Keywords: Analogy, Deduction, Induction, Positivism, Rationality, Reasoning, Thinking elements.

2.1. GENERAL

Prior to anything in this book, there is a distinction between the words thought (opinion, idea, mind, consideration, imagination, concept and proposal) and thinking (consideration, cerebration-mind activities, cogitation, drift and reasoning). The former implies all available information and knowledge ready for use in the mind and memory, whereas the latter is the dynamism of this knowledge to reach better improvements, modifications, innovations and sustainable idea generations. Everybody is conscious under the light of consciousness. Even though one is left alone away from every physical thing, the thoughts do not leave him/her alone. Human beings perceive, understand and grasp knowledge by thinking, and therefore, can manage and arrange their

thoughts for further thinking media. With inspiration from the environment and surrounding medium conditions, a human can imagine and generate different thoughts as a mind factory production. Thinking ability and process are given to humanity as gifts from Allah (God), and continue in a sustainable manner through a set of evolutions from birth to death. The triggering effects of thinking are family life, social, cultural, traditional, economic, and educational institutions through which one can arrange daily life in a sustainable manner by means of philosophical thinking and subsequent logical inferences. The term philosophy has a wide meaning, including from a "cloudy speculative" fancy to a piece of "formal logic." Philosophy and logic are the basic tools of thought sustenance and thinking activity to reach rational conclusions. They provide different perceptions, views and real and imaginary subject shapes through bodily sense organs, which provide virtue formation to minds, and afterwards they collectively help to approach reality as close as possible with additional new ideas generation.

Two important concepts concerning thoughts and thinking are information and knowledge. The former refers to the awareness (understanding) about the subject through personal experience and education; the latter is a clear form of knowledge that is helpful for understanding the core meaning. On the other hand, knowledge is the objective information that has relevance and helps reach rational conclusions. After the procession of thoughts with information and its refined form of knowledge in mind, they are transferable to other individuals with a common language, and accordingly, intellectual, almost intellectual and quite intellectual individuals start to appear in society. Verbal and numerical knowledge is converted to logical rules along cause-result (input-output) relationships leading to rational conclusions. In this manner, the knowledge that is not harmonious in the philosophical arena takes systematic and rational forms by means of logical tools. Philosophy and logic together lead to harmonious, sustainable and rational thoughts and thinking procedures in society.

Systematic forms of haphazard thought arrangements of philosophical and logical thinking started to appear about 2500 years ago before Christ (BC). Even before these years, there were preliminary pieces of philosophical and logical thinking capabilities among human beings. Starting from Thales (BC 623-545), as the first philosopher, ancient Greek philosophy opened the doors to a particular way of thinking that planted the roots for the intellectual tradition. Here, there is often an explicit preference for the life of reason and rational thought (Wrenn, 1995).

The philosopher, who first systemized philosophy and logic was the ancient Greek thinker Aristoteles (BC 384-322), and therefore, philosophy can be classified into two temporal parts as before and after him. Thinking capability and its natural result in the form of logic leading to rational inferences have developed

during various civilizations at different regions for some periods of time. For this reason, philosophy and logic fundamentals were searchable in the civilizations even before the ancient Greek period. Systematic linguistic, verbal, geometric, arithmetic, and number forms appear as archeological remnants. After the philosophical imaginations and thinking, even prehistoric pictures, animations, patterns on the cave walls and handmade gadgets such as pottery, cups, wheel and lever give the impression of many early technological activities during pre-ancient Greek civilization. Medical practices and knowledge came along different civilizations in an accumulative manner up today.

Today, the reason why the thoughts and thinking systematization is from the ancient Greek civilization is due to their rational combination of speculative thoughts by means of philosophy and logic. One can even ask, from where did the systematization of Greek thinkers take their original ideas and further develop and improve them? The answer is primarily from the ancient Egyptian and Mesopotamian civilizations (Chapter 3). Among the ancient civilizations' philosophical and logical thinking principles, there was syllogism (logical comparison), leading to practical inferences rather than irrational consequences. During the ancient Greek civilization, even in the shadows of speculative thinking, the principles took clear forms under the light of logical principles. The existence of such rules became shareable by many individuals, and hence, more intellectual societies started to appear. Initially, logic depended on propositions coupled with critical thinking that led to rational consequences (Chapter 7). During the ancient Greek civilization, importance was not given to experimentation, but the thinking path was on the way of rational and logical inferences only.

Another example of critical thinking is to benefit from thought storage for a combination of the necessary parts, similar to jigsaw puzzle games. The following points emerge from thought and critical thinking.

1. The whole is based on the use of the inductive thinking and deduction method by dividing it into small parts as explained in Section 2.5.2.
2. The number of parts is certain, but none of the parts are the same so they have randomness, or uncertainty.
3. Three different tips are used to interlock the parts. These are.
    a. Searching for the compatibility in the interlocking of the parts.
    b. Searching for meaningful matching by naked eye looking at the whole picture.
    c. In addition, investigation of texture (picture) suitability.

CHAPTER 3

Medicine History "For Countries' Political History, for Humanity, Science History has Importance"

Abstract: The history of medicine shows that medical sciences are historically intertwined with different civilizations according to advice on linguistical forms and written books. The first medical treatments were based on superstitions that had been overturned by principles of rationality for the past 2500 years. For example, several medical treatments were based on amulets, totem symbols and tattoos, originally thought to drive away evil spirits from the sick body. The history of medicine offers visions of the evolution of medical treatments. In this chapter, all civilizations and their leading medical philosophers and recommendations are coherently explained in a harmonious manner so that the reader can understand centuries of valid and invalid disease treatment procedures and better alternatives.

Keywords: Ancient Egypt, Avicenna, Civilizations, Islam, Medicine History, Mesopotamia, Old Greek.

3.1. GENERAL

Medical treatment methods, such as amulets, totem symbols and tattoos, have emerged against evil spirits that cause diseases in the body. With the discovery of the writing, medical information records were accumulated and taken under protection in the temples, which were the center of social life. Since recording (tablets) outside the temple was forbidden, medicine became a profession of the clergy, and few people knew the script except the priests (Bayat, 2016). A brief summary was given by Jackson (2014), who stated that medicine touched all of us at some point in our lives. Medical care has always-utmost importance, whether we live in a high-technology society that uses the diagnostic and therapeutic tools of modern bioscience or in an isolated rural community, where health care is less formal, intrusive and less commercial. Indeed, as modern societies increasingly struggle to cope with chronic conditions such as cancer, heart disease, arthritis, obesity and depression, we have come to rely heavily on medicine's ability to help us live our lives happily, healthily and productively.

One of the first few questions asked by anybody who goes to the doctor today is about past conditions of the disease, whether they have close relatives with a past

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or present disease, so the doctor tries by all means to collect preliminary information. Physicians gain more experience and expert opinion through expertise inquiry style, because of trial and error methodological approximate reasoning. In general, gained knowledge depends on bivalent logic rules.

Émile Littré (1801-1881), a French medicine historian, stated the following saying.

"*If physicians do not want to fall into a simple art degree, they must be aware of their own history with great care and importance to the inheritance of the past references.*"

There is not a concrete agreement even among all physicians throughout the history of medicine, because knowledge information has been in constant development over the centuries under critical debates and appreciation. On the other hand, the physician and philosopher Pascal (1623-1662) suggested that

"*It is necessary to respect each physician training throughout hundreds of years in his/her century as the same physician learning continuously.*"

Although some of the treatment methods in the past have been abandoned, some of them are still applied today. For example, acupuncture (needle cure), phytotherapy (herbal cure) and hydrotherapy (water cure) are some of them. Those who think old medical treatments are nonsense should remember that some of the daily treatments are treated in the same way. The history of medicine is important for physicians, who want to think philosophically and logically about medical advances over the centuries. Knowledge of past stages of medical development and awareness of today's modern medical methodologies and their possible future improvements may encourage some physicians to consider and work on improving existing medical knowledge (methods, drugs) and treatment methodologies. Over the centuries, the philosophy of medicine and its results show that medical knowledge is not static, fixed or unchanging, but is in constant improvement towards a better direction that is expected to continue in the future. Especially physicians and scientists who ponder on the future of medicine have left marks on the history of medicine, and for this reason, the author advises young physicians to read about the history of medicine and at least the biographies of a few physicians.

The vision for the history of medicine as a tool provides classical insights into past examples and their impacts on society, and this topic is essential in medical education curricula, but unfortunately, there is rarely a case in today's programs. A physician can evaluate the pros and cons of past medical developments, which provide a comprehensive view of past medical events, their effects and stages

through which types of medical treatments have passed in the light of his thinking ability, and thus strive to move towards better innovative developments in the future.

On the other hand, Chinese civilization provided the first examples of technology; Indian civilization developed the counting system; ancient Egyptian civilization provided the first techniques of measurement and geometry; Mesopotamian civilizations provided the first examples of celestial and astrological observations and related ideas. These civilizations used philosophical and logical tools and aspirations for their thought products. Starting with the Sumerian civilization about 3000 years ago, many preliminary human tools, instruments and gadgets were produced from stone, clay, bone, wood, cupper, bronze and iron materials. In ancient Greek and Hellenistic civilizations, all previous civilizations have reflections at different scales. Macedonian King Alexander the Great (BC 356-323) tried to benefit from the known world during the reign of ancient Greek civilization, Egypt, Mesopotamia and Persia, reaching almost the borders of China and India. After all, it cannot be said that the principles of philosophical and logical thinking before the ancient Greek civilization were completely arbitrary and speculative, but were not found in written documents. They were practically applicable knowledge and technologies for everyday life. The reader can find a detailed history of medicine in books by Major (1954) and Sigirist (1955).

The following sections explain the contributions of different civilizations related to medical science and its treatments according to historical chronology.

3.2. MEDICINE SCIENCE HISTORY

A first glance at the map in Fig (**3.1**) is enough to appreciate the origin of science history, including medicine. The history of medicine goes back centuries before the history of science, because before dealing with other materialistic beings, human beings first cared about their own health. From this Fig, it is obvious that early civilizations along rivers readily took advantage of the availability of fresh water. The most influential places in the history of early medicine were the Nile, Tigris-Euphrates, Indus, and Yellow River regions.

In the past, due to transportation difficulties, any development in one of these regions could not reach the other regions. Interactions remained with river beds or nearby fields. From this point of view, unfortunately, apart from papyrus and clay tablets, there is no real evidence of the history of medicine in these regions. Later, the ancient Greek and Hellenistic civilizations, based on the information and experience from these regions, transformed them into a systematic framework in written document forms. After these two civilizations, the Islamic civilization has

CHAPTER 4

Medical Terminologies "Word and Sentence Epistemology are the Key Career Expertise"

Abstract: Terminological concepts are the most important aspects of scientific research and development activities, as this book briefly provides epistemological content about the fundamentals of medicine. In scientific literature, the terminology is a combination of single or complex terms in the form of keywords that provide the first impression about an event. Medical terminology and phrases help professionals understand each other without much discussion. Information and knowledge are generally hidden in the etymological and epistemological concepts, such as words, sentences, definitions, terms, terminology and their current scientific structures. Advances in knowledge exchange and improvement processes are the results of conceptualization and terminological applications, especially as a paradigm shift in medicine. Linguistic data, which is a widely used communication tool in medical sciences, contain imprecision and ambiguity. These uncertainties can be minimized by making terminological agreements among experts.

Keywords: Approximate reasoning, Etymology, Epistemology, Diagnosis, Design, Hypothesis Terminology.

4.1. GENERAL

Information and knowledge are hidden in the etymological and epistemological concepts through words, sentences, definitions, terms, terminology and current scientific structures. The information is in the hands and minds of experts and helps establish mutual linguistic agreements between doctors and patients in concise, short, easy and meaningful ways. Any professional knowledge develops over time as more refined scientific terminology becomes available about the problems. All terms specific to nature, medicine, art or technical branches, are called scientific terminology, and their specific collections are keywords. They provide instant information about the content of the topic. The language-specific syntax provides a meaningful grammar structure for sentences. These contain basic and formal knowledge with approximate rational and meaningful validity. Rational communication helps to perceive and understand others and leads to the sharing of a common idea. Reasonable classification of relevant topics in words

leads to a more intelligible medium of communication so that treatment that is more meaningful can be defined. Terminological elements are a unique vocabulary for the foundations of scientific bases. Conceptualization and terminological practice evolve through knowledge exchange and improvement processes and a paradigm shift in disciplines. As a result, knowledge changes fundamental processes with improvements to necessary requirements and relationships between disciplines.

In this section, the framework of knowledge exchange, language development and the philosophy of science are used to examine medical terminology as knowledge growth, which is lexically-semantically through a series of transformations, such as insertion, deletion, redefinition and reorganization (Lanna and Antia, 2016). Therefore, depending on consciousness combined with basic knowledge, the scientific path found to specialization in medical research. Thus, a mutual agreement on the subject begins to form in a harmonious information community in the human mind, and thus, rational inferences and final decisions are reached. In the medical field, for example, physicians can associate specific words with objective facts through language, enabling them to reach intelligent objectivity from their lexical origins (etymology) and semantic loads (epistemology).

Knowing the origin of a language helps determine the historical background of that language. Languages are in constant evolution, scientifically and technologically adapting from local dialects on the one hand, and foreign languages on the other. Almost all the medical terminology has Latin and Greek origins with distortions in original pronunciations. For example, the most common and confusing plural forms have been defined from Greek-originated English words and some improvement methods (Kavaklı, 2016). Grammarly structured knowledge leads to mutual agreement by providing a common logical basis for better understanding.

Research is the name given to all the rational mind studies based on the curiosity and persistent desire in human nature to clarify the unknown aspects of an event in nature, medicine, *etc.* In such mind studies, imagination, philosophy, logic, scenario fiction, design (shapes), and trial and error procedures play an important role. Many functions come together from time to time in simple or complex forms to produce rational means to solve the problem. As in many education and research centers, training researches should not receive boring, mechanical, transferrable, rote and inefficient knowledge. Rather than such dogmas, research must grow constantly and sometimes in a leap over time, but in the process of continuous accumulation.

In general, there are three types of verbal data in the form of fuzzy information, as in Fig. (**4.1**) (Chapter 8). Verbal data are derived from common sense, experiences or expert views.

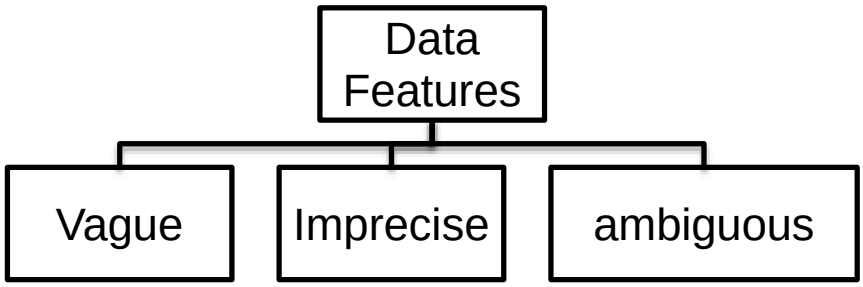

Fig. (4.1). Linguistic data types.

Meanings of words and sentences are mentioned in the following sections about the field of medical science. Furthermore, some information is presented about the topics that can be deduced from this mutual communication, especially from the conversations between the doctor and patient on medical issues.

4.2. LANGUAGE

There is a distinction between verbal and numerical knowledge, and when looking at historical knowledge development processes, verbal knowledge always takes place in the field of thought before numerical data (Chapter 9). Oral information is possible not only with mother tongue or foreign languages, but also with rhythmic movements of the hand, arms and body. Even today, texts filled with verbal expressions rather than numerical information play the most important role in books, scientific papers, projects and research studies. In this respect, each profession has a wealth of verbal expressions rather than numerical knowledge and information. Medical terminology words and phrases help professionals understand each other without much discussion. Among different fields of science, verbal knowledge is the most effective medicine, because medical specialists pre-communicate with patients for oral information retrieval. No matter how strong his expertise is, the physician tries to understand the patient's complaint by asking questions. Whoever complains about health first tells his relatives what kind of ailment he has, and even in these complaints, there is not enough explanation and information to understand the ailment, and the doctor who listens to the same complaints decides to prescribe accordingly. Thus, the physician who collects verbal information for diagnosis determines the appropriate medicine for the patient and provides the treatment.

CHAPTER 5

Philosphy Principles and Types "Does philosophy? Metaphysics? Or both? Constitute the Scientific Bases of Development?

Abstract: In this chapter, cases of free and unlimited thinking on philosophical grounds are explained more, and there is a close connection between philosophy and medicine. In addition, the philosophy of medicine and the ways of understanding the concepts of philosophy are explained with an emphasis on its possible relationship with medicine, especially bioethics. There are always unknowns about the disease and health, and it has been explained that no matter how much the philosophical principles try to come up with approximate rational solutions, they always remain in uncertainty, albeit marginally. It is stated that the philosophy of medicine is a branch of philosophy that explores issues in theory, research and practice in the field of health sciences. Before any explanation, from the very beginning, the etymological and epistemological features of "philosophy" and "science" help the reader to grasp the contents of this book. A set of recommendations are given in the form of systematic information to a thinker to provide dynamism towards more productive and generative directions.

Keywords: Academic, Design, Imagination, Knowledge, Philosophy, Productiveness.

5.1. GENERAL

Apart from the detailed thinking and its principles, herein, much more coverage of free and unlimited thinking cases is explained on philosophical foundations. In philosophical thinking, one tries to infer meaningful information and possible relationships among social, natural and medical event etymological and epistemological features. Philosophy provides a completely free-thinking system about information concerning positivistic (materialistic) existences (Günay, 2004; Kemple, 2019). Especially, individuals can dive into unlimited and uncertain worlds even in a speculative manner, whoever is eager to search and relate the subjects of interest to reach quite rational results. The initial systematic informative human works have begun in the fifth century BC (Chapter 3). Prior to this data, the only information source was speculative, partially with primitive

logical reasoning, due to the non-existence of well-established, examination and experimentation facilities. Major information concerns were medicine, social, meteorological, and astrology subjects. Philosophy kept its domination for many centuries until almost two hundred years ago. Later, the scientific way became separate from philosophy and entered into an independent disciplinary form. Unfortunately, after this separation today in the universities, philosophical subjects are not given significance. Logical principles are almost forgotten; instead, mathematics and its principles became overwhelmingly effective.

Early human beings understood their role for survival in nature. Even though the life period starts with birth and continues until death, during this period, humans could not perceive that they are a part of nature. Even today, each individual has different perceptions during life period, and nobody can appreciate philosophy's role from the first day of birth. As time passes, humans understand alive and non-alive subjects in the surrounding environment and evaluate their own situation among the subjects, and hence, life starts to get in touch with thinking abilities (Chapter 2). However, some others add spiritual dimension to life for preparation and the hereafter life. Herein, the "addition" implication is very meaningful because each individual, whether wants or not, must embrace the natural facts and compulsorily try to live with nature in peace with mutual correspondence and abidance to the physical laws.

Schramme (2017) discussed information about the philosophy of medicine and explained the ways to understand the notion of philosophy by concentrating on its possible relation with medicine and especially bioethics. Normative account of medicine does not show that the philosophy of medicine needs to aim at normative guidance like bioethics. Philosophy of medicine is a discipline, which benefits from the philosophical and medical principles through logical rules to arrive at rationally useful decisions for the benefit of patients. There is no sharp distinction between the philosophy and medicine, especiallyin verbal discussions to identify a common terminology among the medicine experts. In medical research, the conceptual models start to play a role, which can later be quantified through software for common use. Medical experts work for the goodness of the patients with verbal philosophical communication by means of diagnostic-focused questions and their assessments on the basis of philosophical and logical principles. In general, medical science is empirical, and therefore, there are always remnant uncertainties in each diagnosis.

On the other hand, Mbih and Tosam (2014) provided a different view. They argue that contrary to what some philosophers think, there is a very close link between philosophy and medicine. This is evident from ancient Greece with the works of Hippocrates (BC 470-360) until the present day, but unfortunately, the

significance of philosophical principles is rather overlooked in the present medical education systems. As already explained in Chapter 3, during the Islamic civilization's golden ages, the philosophical contents played intensive roles in the works of Al-Rhazes (865-925) and Avicenne (970-1037). During the time, the most advanced and prominent scientific-philosophical contributions appeared both in philosophy and medicine issues. The objective of the philosophy is to search for truth, whereas medicine strives for health and well-being by fighting against bacteria and viruses. The more the unknowns about the disease and health, the more the philosophical principles try to come out with approximate rational solutions, which always remain in uncertainty even though marginally. In medicine, there are no standard solutions that can be applied with firm knowledge because each patient body reaction is different from others. During consultations with patients, physicians, may come across philosophical aspects such as metaphysics, etymology, epistemology, ethics, and logic for rational decisions. Mbih and Tosam (2014) also argued that one of the weaknesses of modern Western medicine is its over-dependence on the Cartesian ontology, which considers human bodies as machines that need study using scientific logic, and the physician as a technician whose job is to repair dysfunctional bodies. This modern metaphysical outlook resulted in the neglect of the patient as a subjective being. Such a deficiency is not overcomeable without reviewing the Cartesian reductionist worldview.

The philosophy of medicine is a branch of philosophy that explores issues in theory, research, and practice within the field of health sciences (Wulff *et al*., 1986). In the late twentieth century, debates among philosophers and physicians ensued about whether or not the philosophy of medicine is considered as a field of its own, either philosophy or medicine (Arthur, 1992; Lee, 2013; Bhattacharjee, 2014).

The most important principles for systematic rational conductions turn around four ingredients, namely, critical thinking, physical existence, philosophy and logical rules. These are the steps for those who are interested in generation of nexus thoughts under the guidance of critical thinking about the virtual and actual worlds.

In this chapter, detailed information is presented about the definition and content of philosophy in the science domains including medicine prior to logical principles applications.

5.2. PHILOSOPHY DEFINITION

In general and in simple words, philosophy is defined in English as the love of knowledge and wisdom in the framework of materialism, but in Arabic, it is

CHAPTER 6

Philosophy in Medicine "Verbal Expressions in Medicine can Develop through Innovative Ideas Generation by the Philosophy"

Abstract: This chapter aims to provide a physician with the foundation and principles of philosophy in medicine for freer and independent thinking. In previous chapters, a sub-branch of the philosophy of medicine related to epistemological concepts and metaphysical implications was highlighted, including ethical and even moral principles. The philosophy of medicine is a blend of medical education and training with philosophical aspects to achieve improvements and innovative findings for public health services. The philosophy of medicine includes the contra-active interactions of diseases, health and the search for effective reciprocity. By asking questions about how medical and health professionals know what to do, and detailed information is given in terms of practical medical wisdom. How should they make the right and wise decisions in morally complex and uncertain situations? And what is the patient's role in this decision-making process? In medical practice and research, it is recommended to start problem-solving with philosophical thinking and then logical evaluations in order to reveal a better diagnosis, treatment and healing qualities for patient care.

Keywords: Education, Health, Illness, Medicine, Physician, Science, Wisdom.

6.1. GENERAL

Health has been the most important feature for human beings since time immemorial, and all worldly activities depend on a healthy body with care for shelter, dressing, feeding, physical training and disease avoidance. A productive mind exists in a healthy body. Accumulation of the preliminary knowledge and information beginning from ancient civilizations before Christ has led to classification according to diseases, and hence, philosophy and logical imprints helped the organizers, administrators, health experts and physicians in modern times. The philosophy of medicine is a branch of the general philosophy that searches for health care through various practical applications, laboratory as well as clinical experiments and theoretical generalizations. Among the philosophy of medicine, sub-branches are related to epistemological concepts, ethics and even metaphysical implications, including moral principles. The philosophy of medicine is a mixture of medical training and education with philosophical

fundamentals to reach improvements and innovative findings for social health care. The philosophy and medicine remained jointly until the 18th century and then became quite separate. The meaningful separation and content coverage of each medical word need philosophical and logical explanations for the distinction of each one from the others, such as disease, diagnosis, patient, physicist, disorder, *etc.* (Chapter 4).

In general, metaphysics is a branch of philosophy that deals with the analysis of topics, events and phenomena not only from scientific but also from spiritual, religious, imaginary and speculative perspectives. It is a transmissive transaction between reality and anti-reality, where most often, the transition is from anti-reality to reality (bivalent logic principles). Metaphysics is under the umbrella of ontology that tries to explain the existence of subjects in natural and physical events in their uncertain evolvement channels.

One of the most important issues in the philosophy of medicine is the contra-active interactions between disease and health for a mutually effective production mechanism. The search for their causes and reasons is among the subjects of philosophy of medicine. Disease and health are quite uncertain holistic concepts, but the question "what are the components of these words" leads one to philosophical thinking, where there are numerous ideas among physicists and specialists. Uncertain concepts are one of the main causes of philosophical wonders (Chapter 8). In other words, trying to put into pieces a concept with its causes is achievable through information from classical books. However, criticizing the basic definitions based on philosophical and logical rules helps to reach detailed levels of informative and productive understanding.

In the past, deductive (holistic) philosophical inferences were the main impetus for thinking, but modern times rely on more inductive (piece-wise) searches for topics and case studies (Chapter 2). For inductive approaches, there are methodologies to obtain the finest points of integrity and develop relationships between various pieces for in-depth understanding and solution possibilities. The hierarchical order of each piece provides information between the functions of the next piece, and therefore, integrity is achievable from the systematic organization of the pieces. For example, in medical research, one can start with the study of an organ that provides deductive information holistically. However, more refined information can be obtainable by continuing to the next sections for the tissues, cells, macromolecules, and then micromolecules at atomic and sub-atomic scales. Such a detailed, informative structure reveals its importance not only for physicians, but also for those working as laborants in clinics. This informative array of knowledge provides an opportunity to medicate each piece.

6.2. PHILOSOPHY AND WISDOM IN MEDICINE

Dekkers and Gordijn (2007) have asked questions about medical wisdom and health from a practical point of view as "How should they make the right or a wise decision in morally complex and uncertain situations?" and "What is the patient's role in this decision-making process?" Aristotle (BC 384-322) defines practical wisdom (prognosis) as follows:

"knowing the right thing to do in a particular circumstance through understanding the circumstance rightly, knowing what matters, and effective means-end reasoning to bring about what matters."

The word "prudence" means self-evaluation and self-interest; every object that provides a better way of life and independence is the moral value of prudence.

On the other hand, Al-Farabi (870-950) added something completely new to philosophy about wisdom, and he explained that this is the problem of the real existence and essence of existence (Mahdi, 1990). According to him.

"wisdom is knowledge and understanding of the truth"

For any given problem, there are quite different understandings among individuals, but with marginal uncertainties, they can have great inclusiveness. Patient and physician morality is one of the most effective tools for mutual rational communications. For example, patients who are aware of their illness and are calm take the given advice wisely, otherwise, a direct recommendation helps. Egonsson (2016) rationally discussed the main alternatives taking into account the consent. On the other hand, Edmondson and Pearce (2007) wrote that reasoning and judgment in healthcare require complex responses to problems, whose demands typically arise from several areas of expertise simultaneously. They further argue that current evidence or value-based models of healthcare reasoning, despite their merits, are insufficient to comprehensively explain responses to such problems.

The physician must be attentive to wisdom-based reasoning to incorporate knowledge, thought and life experience with social, emotional and ethical capacities. However, uncertainty and fuzziness are everywhere, which rational knowledge and expertise help keep to a minimum. Edmondson and Pearce (2007) exemplified the application of wisdom using cases in psychiatry, where the non-technical aspects of problems often come to the fore and require more systematic analysis than traditional approaches offer, but they also argued that this thesis is valid in the health care field.

CHAPTER 7

Logic Principles and Rules "In the Philosophy Field Logic Produces Rational Ideas that Lead to Beneficial Consequences"

Abstract: The main information in this chapter is about logic, which helps to reach more rational and productive thoughts and ideas about an event involving medical sciences. In general, after the philosophical thinking principles, the logical rules lead to inferences that are more rational, and therefore, knowledge becomes more applicable. Logical words and propositions are explained on bivalent (crisp) and fuzzy logical rule-based expressions. Logic plays a very crucial role in the medical sciences, based on sound reasoning. Mathematics based on binary logical principles is useful in science, but fuzzy logic principles and rules play a central role with extreme predominance in medical science because communication between doctor and patient takes place linguistically before laboratory analysis for some numerical data.

Keywords: Conjunctive, Inference, Logic, Mathematics, Models, Proposition, Reasoning, Rules.

7.1. GENERAL

Logic is a Greek word coming from "logos" and can mean a number of meanings, including proposition, reason, rule, rationality, comparison and inference. It is also a correct way of reasoning to determine the most rational product from a set of alternatives. All disciplines need logical interpretations, inferences and consequences. In this way, thinking is achievable with logical principles that do not require mathematical principles for inference. Aristotle (BC 384-322) established its main place in philosophy with bivalent logic based on the exclusion of the middle cases, which guide to distinguish between true and false only. Since there are two categories, the inferences from this logical system cannot suit natural and medical events exactly. The exclusion of the middle positions leads to the acceptance of certainty right from the beginning. In binary logic, truth (false) is represented by 1 (0) as the number with belonging degree characteristic values.

Zekâi Şen

Logic serves to reach more rational and productive thoughts and ideas. It is not the art of eloquence, but the art of intelligent deduction about validity, scientific objectivity, generalization, selectivity and testability. Logic is like a tool that is necessary not only in science, but also in human access to all kinds of rational interests. Scientific inferences are logical, rational and testable with facts. One tries to falsify valid scientific inferences by tests to arrive at results closer to reality. Scientific testability is possible with strict logic rule applications. Science cannot gain functionality and innovation without logical rules and principles.

In the previous chapters, rational deductions were explained as possible after philosophical thoughts with the application of logic principles. The first formal bivalent (two-value) logic played a very active role in the history of science (Aristotle, BC 384-322). In the history of science and medicine, the first multiple-logic alternative was suggested by Al-Farabi (872-950) based on the probability concepts. One interpretation of logic's probability means that there are intermediate values of the events between two opposite situations, namely, true and false. He was inspired by the Prophet Mohammad's saying.

"the best of deeds is the ones between the two extremes."

This statement implies the inclusion of the middle cases. On the other hand, Nasiruddin Hodja (1208-1284) quoted the following proposition.

"the one who complains and who is complained is right."

Inferences made by bivalent rules of logic are very useful, but insufficient, especially in medical, because a mutual agreement between doctor and patient is rarely absolute certainty. Until the 20th century, almost all studies were overwhelmingly achieved according to bivariate logic only.

According to bivalent logic, in any dilemma, the mind has to choose one thing and reject the opposite (duality). Therefore, logical crispness plays an effective role in such a choice, even if it is approximate. The mind cannot transcend it; therefore, it is best to reconcile the opposite. In classical bivalent logic, vagueness, ambiguity, and incompleteness, i.e., uncertainty is not a possibility due to two alternatives as absolutely true or false. Such a mindset can trap the human mind in routines, stereotypes, prejudices, and habits and render the thinking ability incapable of authentic experience gains.

Recently fuzzy logic methodologically includes all alternatives between two-value logic extremes in a systematic manner (Zadeh, 1973). This means that in many disciplines, including medicine, there is no deterministic truth or false. In

Chapter 8, fuzzy logic developed by Lotfi Asker Zadeh (1921-2017) is explained in detail for better rational agreements and common decisions.

7.2. LOGIC DEFINITION

Since the word "logic" comes from the Greek language, it means rational reasoning, intellect, dialect, argument, and critical thinking towards valid comparative relations. More broadly, logic is the analysis and evaluation of arguments (Gensler, 2017).

Sound reasoning is the basis of logic and plays a crucial role in many fields of sciences. A wide variety of different principles are needed for sound reasoning in different fields, and "a logic" means a set of principles for some kind of sound reasoning and rational conclusions. There is no widely acceptable formal definition of logic (Mossakowski, *et al.*, 2005).

Formal or informal language is within the principles of logic as semantics to arrive at meaningful inferences that help capture, encode or simply record arguments that apply to the given language. The foundations of bivalent logic can be learned from the books Bradley and Swartz (1979) and Wogu (2010), which provide detailed logical prepositions and systems of inference.

In today's present perceptions, logic appears even in the form of ratios in sentences, discourses, rules, reasons, justifications and propositions, if they tend to make the right decisions. Rational philosophy is required before logical reasoning, followed by mathematics, probability, statistics, and engineering and computer software as supportive subjects. Rather than plain logic, critical logic plays a role in improving the current level of knowledge leading to innovative findings. The final products of logical reasoning are in grammatical form without numerical measurements. Bivalent principles of logic are systematized by ancient Greek thinker Aristotle (BC 384-322), and later on, the same logic is redefined by Muslim thinker Averroes (1126-1198) as:

"the tool for distinguishing between the true and the false"

Logic is the basis of all scientific disciplines that deal with the principles and criteria of inference validity. In short, it is the science of reasoning and is considered as the science of formal reasoning principles that investigates valid or erroneous relations.

Logic is a method for developing the reasoning ability to understand facts in a formal (systematic) and rational way to reveal the basic valid relationships

CHAPTER 8

Fuzzy Logic Interferences in Medicine ”Medical Verbal Diagnosis and Treatment Methods are Fuzzy”

Abstract: This chapter presents the principles of uncertainty, imprecision, vagueness, incomplete and random data types, treatments and diagnostics principles in medicine. For example, a disease can manifest quite differently from a patient, doctor and social perspective. It is stated that knowledge-based medical treatment decision support systems will develop further with fuzzy logic evaluation due to uncertainty involvement. This chapter offers a series of recommendations on aspects of uncertainty in the medical sciences. The comparison of fuzzy and bivalent (crisp) logic and the fuzzy logic preference in medicine are explained with evidence. Fuzzy logic inference modeling with medical vague words is presented on a sample with four inputs (temperature, blood pressure, urine quality and heart rate), for diagnosing disease as an output estimate. Finally, the use of fuzzy logic in medicine is explained by a set of diseases classifications.

Keywords: Computer, Fuzzy, Human, Linguistic, Medicine, Set, Vague, Verbal.

8.1. GENERAL

Inheritance of uncertainty in medicine includes, imprecision, vagueness, incompleteness, missing and random items that are effective in the stages of disease diagnosis, treatment and recovery. A disease can manifest itself quite differently from a patient, doctor and social perspective. In addition, chronic disease can affect patient in a variety of ways, and therefore, the definition of the disease requires greater uncertainty and imprecision in the forms of fuzziness. The most descriptive definition of a disease has varying degrees of uncertainty even among experts. Although the terms health and disease have opposite meanings, they are mutually inclusive. According to the definition made by the World Health Organization (WHO), health is a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity. On the other hand, there is confusion between words disease, illness, and sickness in medicine.

Zekâi Şen

We have fuzzy logic principles at our disposal to deal with uncertainty and imprecision. Fuzzy logic offers partial truth values between true and false (Torres-Iglesias and Nieto, 2006).

Sadegh-Zadeh (2015) stated that the concepts of health, illness, and disease can be analyzed in fuzzy theory. They are non-Aristotelian concepts that violate the basic principles of classical bivalent logic. An iterative scheme to define the controversial concept of disease supports the fuzzy concept of disease. An outline is given of prototype similarity theory of disease. Fuzzy logic necessary interpretation depends on set theory, which is the most appropriate way to express any variable in terms of finer categories at the diagnosis stage and in development of knowledge-based systems for medical tasks, including syndrome differentiations. It is stated that trials with the following systems developed by their group in Vietnam by Phuong and Kreinovich (2001) are beneficial. Fuzzy expert systems are for various medical applications such as syndromes differentiation in traditional eastern medicine, lung diseases, case based reasoning for medical diagnosis. They are also useful for the classification of western and eastern medications, and also for the diagnosis and treatment of integrated western and eastern medicine. All these systems have been developed and tested in hospitals.

Knowledge-based medical treatment decision support systems have to evolve further with fuzzy logic assessments, due to the involvement of uncertainty. Concepts and identification of interrelationships between medical domains can be achieved with fuzzy sets, association inferences, and decision-making algorithms to preserve the inherent fuzziness of medical concepts.

Chapter 7 provides detailed information about the bivalent logic rules that are crisp and exclude the middle. The first opposition to this logic came from the Muslim philosopher Al-Farabi (850-930), who criticized Aristotle (BC 384-322) in the subjects of philosophy and logic and said that the certainty principle on which the bivalent logic is based is not valid exactly especially in natural, social and medical sciences. Considering the uncertainties in the subjects of physics, geometry, mathematics and logic, which are among the natural sciences, he gathered these science branches under the umbrella of “probability”. This view has remained buried as lost history for about more than 1100 years in the history of science. His contemporaries, Muslims and Westerners considered Aristotelian (BC 384-322) bivalent logic principles, and hence, uncertainties in the science remained unnoticed. In the West, until the 18th century and the early 19th century, scientific precision became almost as believable like a religion on the basis of bivalent logic. Immediately after Einstein's (1879-1955) general and special relativity theories, which overturned Newton's (1643-1727) physics, Niels

Bohr (1886-1962) imported uncertainty in quantum physics (particle physics), which brought into consideration of Al-Farabi(850-930) suggestion as a probabilistic description of nature and science. It is now objectively understood that the innovative states of geometry are fractal geometry, non-linear mathematical differential equations are chaotic and therefore convenient for fuzzy logic assessments because of uncertainty.

Nearly 1100 years after Al-Farabi (850-930), an Azerbaijani scientist from Central Asia, who lived in the USA, Lotfi Asker Zadeh (1921-2017) was unable to reach definitive conclusions even when he solved the monstrous crisp (bivalent) logic mathematical equations. He finally thought of this very complex structure logically in terms of fuzziness, excluding the bivalent logic. His fuzzy set paper was rejected from many scientific journals, but in 1965, he managed to publish his first article in an international journal, where he was an associate editor. For several years, this fuzzy paper is not cited in the Western world. About, 10 years after its publication, its applications began to appear in Asian (Eastern) countries such as Japan, India, Malaysia and Indonesia.

Fuzzy logic is based on a multiple logic schemes with intermediate values between the two extremes, (true, 1 and false, 0). If everyone thinks with fuzzy logic, he can feel how compatible this logical order is to understand the events that exist in human natural thinking. It is in accordance with the words of Prophet Mohammad:

"The best work done lies in between the extremes"

For mathematical equation derivations according to bivalent logic rules, simplifying assumptions, idealizations, and hypotheses are introduced to remove uncertainties Chapter 7). The reason for including these assumptions is due to the exclusion of the uncertain middle part. As such, it is accepted from the outset that equations in physics and other branches give approximate results, but they are falsifiable (Popper, 1959).

There is always an uncertainty, especially in medicine and social studies such as law and economy. In the bivalent logic, statements with words, idioms and sentences are treated as absolute true or false without any intermediate content. Patients explain their complaints to the physician with verbal ambiguities in words and sentences. In this respect, one of the first things that medical graduates should do is to interview patients to gain expertise by consideration of fuzzy logic rules instead of bivalent(crisp) logic.

CHAPTER 9

Numerical and Graphical Diagnosis "Numbers Help to Construct Graphics for Better Understanding"

Abstract: The main concern of this chapter is to explain the use of probabilistic and statistical numerical dataset analysis in medical sciences, leading to computer graphics, tabular classifications and representations. These treatment procedures support medical professionals to advance their linguistic knowledge of a disease with numerical and visual results. Fuzzy and bivalent logic comparisons are presented for pulse rate, heart rate, and blood pressure based on age-related tables, which are used to elicit graphical and mathematical equivalents. Probabilistic and statistical assessment methods are explained in detail with some numerical data. In such quantitative assessments and methodological applications, the importance of assumptions is recommended as a significant warning and necessary guidance. The most frequently used regression methodology to determine relationships between two or more medical variables is explained with mathematical and graphical representations. Finally, the relationship between medicine and mathematics is explained.

Keywords: Assumptions, Graphs, Mathematics, Medicine, Numbers, Probability, Regression, Statistics, Tables, Uncertainty.

9.1. GENERAL

Mathematical programming in computers, as in many fields of application, supports swift processing of numerical datasets, especially with probabilistic and statistical procedures leading to computer assessment algorithms, which help medical experts to make reliable inferences. Therefore, graphical results can be seen quickly if numerical data is available. Beck *et al*. (1996) noted that two paradigm shifts are currently taking place in medicine, first, diagnosis and therapy are increasingly based on the understanding of biochemical processes that cause the diseases, and second, diagnosis and therapy are becoming quantitative. The use of visualization techniques in medicine is related to the second phase of these developments as the emergence of quantitative medicine. It allows a physician to tailor treatments individually, generally using a computer-based planning system.

Zekâi Şen

The basic mathematical modeling of magnetic resonance (MR) is dependent on Fourier analysis. Multiplexed imaging schemes such as Fourier encoding are used in clinical magnetic resonance imaging for sensitivity enhancement (Nichol *et al*., 2013). Similarly, the simulation of some uncertain medical events is obtainable by means of suitable algorithms, such as stochastic modeling processing coupled with probability and statistical contributions. In medical applications, when the empirical input datasets are insufficient, incomplete and error-prone, the physicians find difficulties in valuation, formulization and decision-making. Even with the advancement of technological medical instruments and their output information, there are always some uncertainties, which are not avoidable completely. Medical data, apart from the simple tests, have high complexities, and therefore, even outputs from automated instruments need a review by an expert in the area. In order to command the input-output relationship, it is necessary to know the internal structure of any software as for the assumptions and hypotheses. Automatic employment of ready software may yield biased information about the concerned case.

Among the activities of philosophy, those related to medicine began with the passion for knowing nature and human health to a certain extent by interpreting some primitive observations by means of interaction with the environment. In the past, the realization of such a passion without any measuring device, was achievable only by approximate logical reasoning through useful propositions. They are taken as the basis of theories, and finally, by reaching some general provisions, valid laws were obtained for treatment procedures. Over the centuries, these developments later laid the first numerical foundations for further rational developments and inferences, but meaningful common science language with the intervention of numerical, arithmetical, and especially statistical tools. Sometimes, it was not immediately apparent that the interpretations were made only because of reason, logic, common sense and experience accumulation. Developments based on them with quite defective diagnoses slowed down information accumulation.

Especially, in the last two hundred years, developments in medical procedures, devices and instruments have made the data digital, and the development of methods has led to the evaluation and assessment of these numbers. In this way, the branch of "statistics", that is, measurement and data evaluation, became more important than mathematics. Demiray (1988) defined the statistics as

"the branch of applied mathematics, whose principles take into account methodical grouping as much as it aims to examine the phenomena derived from the theory of probabilities or the series of numerical data."

In this definition, there are ideas such as the uncertainty of events, the division of the number sequences obtained by processing to reflect the characteristics of the event and making useful interpretations to reach a conclusion. With the development of technology, novice and professional researchers, and technicians have observed that the events are not entirely clear, but have uncertain content at different scales. Such uncertainties in the field of medicine have existed since the early periods of history, and despite all kinds of science and technology developments, there is still a certain amount of verbal or numerical uncertainty. "Probability", "statistics" and more generally "stochastic" computational methods are very useful in the study of such events for uncertainty assessments, which involve the concepts of bivalent logic with precise procedures and interpretations and fuzzy logic rather than mathematics (Chapter 8). As a result, due to the increasing number of measurements from experiments in clinical laboratories, the uncertainty components in medical studies are bound to reduce, but still, there are residuals.

The principles of the successful evaluation of numerical studies are based solely on the evaluation of measurements with the probabilistic and statistical concepts that lead to rational and physical interpretations. For this reason, before the medical application of statistical formulas and methods, the internal formation structures of the examined events should be known, as mentioned in the previous chapters, verbally in order to interpret the numerical conclusions results with reason and logic (Şen, 2002).

In the field of medicine, while most of the diagnoses were based on verbal information in the past, much deeper and more precise diagnoses can be reached with supporting numerical information today. The main reasons for this are the updating of technology, engineering software and devices that enable digital data assessment. In addition to the most frequently used Magnetic Resonance (MR) devices today, there are many different devices such as X-rays offered to medical professionals for visual examinations that enable verbal and numerical data as a result of layer-by-layer human body scanning. If there are measurements, it is possible to make a diagnosis with more meaningful interpretations by converting this set of numbers into graphical forms, which provide visual inspections and enable the physician to make diagnoses that are more meaningful.

9.2. Uncertain Number of Information

As for uncertain numbers, statistical and probabilistic methodologies are at the service of medical studies as there is no absolute certainty in medical works. Although all prognostic projections are available after quantitative evaluations, it is always difficult to recommend the most appropriate treatment for any patient.

CHAPTER 10

Medicine and Engineering "Engineering is Supportive to Medical Instruments and Software"

Abstract: The main theme of this chapter is to supplement medical examinations with biomedical means, which is only possible with mutual collaboration between doctors and engineers. The principles of science and technology-based tools are explained by engineering design concepts and software possibilities, which are supportive aids for medical diagnosis. Various sections of this chapter provide a linguistic explanation of the engineering related medical issues followed by a logical explanation of mathematical expression derivations through various models based on a set of assumptions. In the explanations, bivalent and fuzzy logic principles are used according to the problem at hand. Population growth, food sharing, injection, diabetics, dialysis, epidemics, sensitive hearing intake, blood circulation, *etc*. problems are modeled using a set of convenient mathematical methodologies. Human engineering concepts are discussed from the medical point of view. Finally, a set of recommendations are given for possible future directions to arrive at better innovation.

Keywords: Diabetics, Dialysis, Engineering, Epidemics, Food, Injection, Medicine, Model, Population.

10.1. GENERAL

During the revision of medical history, one can appreciate that in the early years, there was no collaboration between medicine and engineering. The first diagnoses are sensed by routine hand touches and stethoscope listening leading to linguistic interpretations. In the medicine domain, instrumental aids started to appear based on science and technology, and hence, engineering instrumental designs and software opportunities became supportive aids for medical diagnoses. It is not easily possible to enter inside the instrument or software to make necessary changes according to time needs. In most engineering and medicine education systems, there are hardly traces of philosophical thinking and logical rules applications, and therefore, the only way is the import of some software without caring about what takes place internally. This may lead such careers to depend on classical book information by classical and traditional memorization methods without idea generative views or thoughts. It is recommended that software is

Zekâi Şen

adopted as supportive means to lead to innovative generations, and hence, the society, in general, and physician specialists and experts, in particular, gain self-reliability and thrust. Medical software is useful for patient monitoring, hospital management, medicine commercialization, store state keeping, hardware control, and administration automatically.

In physical researches, there are basic scientific principles, which are the mass, energy and momentum conservations and, on the other hand, physical laws, such as Ohm, Newton, Fourier, Hubble, *etc*. (Fig **10.1**). The conservation principle depends on the philosophical assumption that "Matter cannot be created or destroyed".

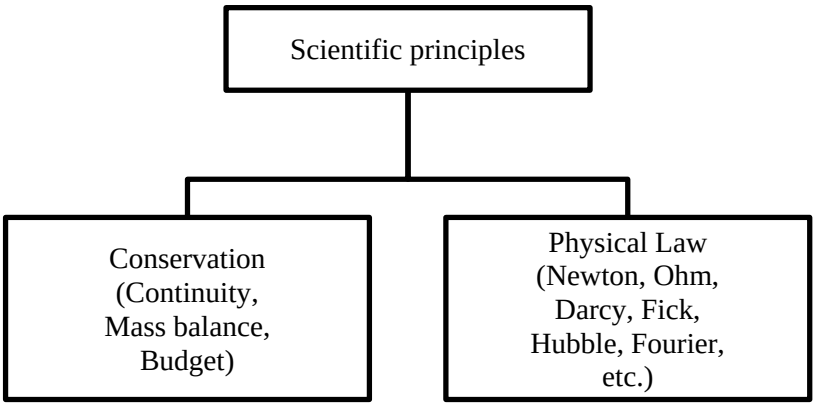

Fig. (10.1). Scientific principles.

In human health researches crisp mathematical expressions are not valid precisely, because human health itself is fuzzy, *i.e*. has different forms, actions and reactions from one individual to another (Chapter 8). However, medical instruments work according to the aforementioned scientific methodologies based on the logical principles leading to mathematical equations for their operation.

This chapter presents some of the commonly achieved methodologies and possibility of further cooperation between engineering workers and physicians. Especially, in the medicine domain, some fundamental mathematical bases are explained by convenient mathematical formulation derivations.

10.2. KNOWLEDGE GAIN

The sprout of knowledge ripens through critical thinking activities in the real and imaginary worlds. Thereof even hidden facts trigger unripe knowledge treasures in our minds and then express them logically through language (Chapter 1). An informed society can raise individuals, who can think, criticize and produce new knowledge for benefit of humanity. Since the first stage of human history, knowledge about human health has accumulated until today. The main goal is not only to accumulate information in order to understand the accumulation of knowledge from practical, rational and scientific points of view but also to use the knowledge accumulation. The interpretation of the modern world depends on a good understanding of uncertain and at times, complex events.

About 600 years ago, science began as a systematic system of thought, including the ancient Greek period, in order to reach rational knowledge with philosophical thought and logical principles. Before this period, there were many civilizations where different thinking, inventions, discoveries and tools were the pioneers of technological developments. These civilizations had thinking abilities based on a rational-irrational mixture. Their activities and discoveries could not be classified as philosophy, arithmetic, numbers and medicine, due to the lack of universally effective systematic explanations, and therefore, remained only in the circle of that civilization. Pioneering technological inventions for daily needs and convenience took place. These preliminary techniques were later developed further, and thus, the first seeds of rational thinking emerged.

In daily life, every person encounters uncertain and deterministic impressions; however, the assumptions, simplifications, idealizations and hypotheses underlying the deterministic knowledge imply that even uncertain knowledge is given synthetic determinism by clipping off the uncertainty components. In order to make numerical predictions with a systematic approach under the principles of bivalent logic or mathematical, symbolic logic, some simplification means are needed, such as assumptions. For centuries, scientific results have been based on various hypotheses, assumptions and concepts to arrive at rational, plausible and scientific conclusions. It is well known that procedures for thinking on large scales (deduction) and small scales (induction) begin from a world of uncertainty brought to the level of perception of the researcher by a set of assumptions to reduce complexity (Chapter 2).

The real world is complex, fuzzy, and, therefore, uncertain (Chapter 8). Many social, medical, economic and technical subjects are intertwined with verbal uncertainties due to human incomplete perception and understanding because a complete perceptual grasp of real events is not fully possible. Whoever tries to

CHAPTER 11

Conclusion

Philosophy and medicine have been twin sisters since the dawn of human history, in order to generate logically rational treatment alternatives that support human health after careful diagnostic studies. Although medicine originally started with suggestions to deal with superstitious ideas, medical content took the principles of philosophical, logical and rational thoughts during the ancient Greek period, reflecting the accumulated rational information and knowledge including ancient civilizations, written in books. Galen was the most famous thinker during this period, combining medical aspects with philosophical and logical components. Philosophically, the fraternity with medicine continued almost until the 18th century. In this period, philosophers and thinkers of the Islamic period also focused on medicine with philosophical and logical rules supported by experiments. The most respected medical expert to emerge in this period is Ibn-i Sina (Avicenna), whose "Canon of Medicine", book in English "Law of Medicine" provided pre-modern fundamentals of medical science.

The first two chapters of this book are concerned with philosophical, logical and rational thoughts concerning past and modern times. Chapter 2 discusses the basic principles of reflective thinking and presents possible relationships between different thinking procedures. In the first sections, different stages of thinking are emphasized and after the propositional inferences, the final knowledge generations are determined. The main purpose of such an approach is to finally arrive at rational knowledge through critical thinking arguments, propositions, and inferences and also bring them into widely acceptable forms. Chapter three details the history of medical science related to early civilizations, including those along the Nile, Tigris and Euphrates rivers before the study of ancient Greece, Islamic, and modern Western medicine. The sections in this chapter include the contributions of different civilizations to medical science and its treatments, in historical chronology.

Although linguistic communication between physicians and patients is important, it is emphasized that medical terminological contents provide expert communication between medical professionals. Detailed information is provided in Chapter 4 about these aspects. Etymologic and epistemological concepts of informative knowledge are hidden in concepts, words, sentences, definitions, terms, terminologies and existing scientific structures. The available knowledge is in the hands and minds of experts and is useful for establishing mutual linguistic agreements between patients and physicians in concise, short, easy and

meaningful ways. Any professional knowledge evolves over time, including more refined scientific terminologies that are significantly related to the subject.

Before the applications of logical principles, a separate chapter is devoted to the definition of knowledge in the light of philosophy in the field of medicine. It deals with general philosophy, ontology, epistemology, metaphysics, ethics and aesthetics. However, the philosophy of science, which includes medical research, takes more into account epistemology, ethics and aesthetics. Chapter 5 presents the distinguishing features of medicine from other science subjects.

The close relationship between philosophy and medicine is revealed in Chapter 6 with more refined information, continuing with discussion on tissues, cells, macro-molecules, and micro-molecules at atomic and sub-atomic scales. Such a detailed informative structure reveals its relevance not only to specialist physicians, but also to those working as laboratory workers in clinics. The informative array of knowledge provides an opportunity to mediate each piece. Some preliminary explanations of the uncertainties are presented in this chapter as a preparation for the detailed explanations in Chapter 8.

In Chapter 7, it is mentioned that logical rules and principles are necessary to define rational prescriptions from the general ocean of philosophy and transform ideas into more scientifically acceptable forms. The main information in this chapter is about logic, which helps to reach more rational and productive thoughts and ideas about an event involving medical sciences. In general, after the philosophical thinking principles explained in the previous few chapters, the logical rule filtering of the rational reductions of the philosophically obtained information is refined and becomes more applicable after the logical rules are loaded. Logical words and sentence propositions are explained based on both crisp (two-value) and fuzzy logical rule-based expressions. Logic plays a very important role in medical sciences, based on sound reasoning. It is recommended that fuzzy logic principles and rules play a central role in medical sciences, as mathematics is based on exact crisp logical principles, and communication between a doctor and a patient takes place linguistically before laboratory analysis of some numerical data.

There is always uncertainty especially in social studies such as medicine, law, and economics. Words are treated as absolute true or false without any middle content in idioms and sentences and in two-value logic expressions. Patients explain their complaints to the physician with verbal ambiguities in words and sentences. In this respect, one of the first things that medical graduates should do is to have interviews with patients in order to gain expertise by considering fuzzy logic rules instead of two-value logic (crisp logic). All the rules of logic and reasoning in the

previous chapters had some implicit assumptions. First, two-value and mathematical symbolic logics are based entirely on the principles of certainty. Although the probability is said to be similar to fuzziness, the latter includes verbal and numerical data and statements to arrive at a final inference.

In the field of medicine, while majority of diagnoses were based on verbal information in the past, much more in-depth and precise diagnoses can be reached with supporting numerical information today. The main reasons for this are technological updates, engineering software and devices that enable digital data processing. In addition to the most commonly used Magnetic Resonance (MR) devices today, there are many different devices besides X-rays offered to medical professionals for visual examinations, such as layer by layer scanning of the human body. If measurements are available, it is possible to diagnose with more meaningful interpretations by converting this set of numbers into graphical forms that provide visual inspections and enable the physician to make more meaningful diagnoses.

The final chapter presents some of the methodologies commonly achieved byengineering studies and physicians, and the possibilities for further collaboration. Especially, in the field of medicine, some basic mathematical foundations are explained with appropriate mathematical formulation derivatives.

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