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Medicine and its Epistemological shift of body of Knowledge: Critical View from Socio-Philosophical Perspectives

Joydeb Patra
Doctoral Research Scholar, Department of Sociology (Medical Sociology)
Vidyasagar University, Kolkata, India

ABSTRACT

The medicine represents a specific type of knowledge about the human body that is applied to either care for or cure of the recipient of medical attention. The nature of medicine is certainly an achieve importance facing twenty-first century by socio-philosophers of medicine. One reason for its importance is that the question addresses the vital topic of Body of Knowledge and how physicians should practice medicine. During the turn of the twenty-first century, clinicians and other medical pundits have begun to accept evidence-based medicine, or EBM to Laboratory Medicine, as the best way to practice medicine. Proponents of EBM claim that physicians should engage in medical practices based on the best scientific and clinical evidence available, especially from randomized controlled clinical trials, systematic observations, and meta-analyses of that evidence, rather than on patho-physiology or an individual physicians clinical experience. Proponents also claim that EBM represents a paradigmatic shift away from traditional medicine. One specific objection is that application of evidence from population based clinical trials to the individual patient within the clinic is not as easy to accomplish as EBM proponents realize. In response, some clinicians propose patient-centered medicine (PCM). Patient-centered advocates include the patient's personal information in order to apply the best available scientific and clinical evidence in treatment. The focus then shifts from the patience's disease to the patience's illness experience. The key for the practice of patient-centered medicine is a physician's effective communication with the patient. While some commentators present EBM and PCM as competitors, others propose a combination or integration of the two medicines. The debate between advocates of EBM and PCM is reminiscent of an earlier debate between the science and art of medicine and belies a deep anxiety over the nature of medicine. Certainly, philosophers of medicine can play a strategic role in the debate and assist towards its satisfactory resolution.

Keywords: *Medicine, Medicine epistemology, Paradigm shift, Socio-philosophical Imagination*

INTRODUCTION

Medicine as a discipline cannot function in a social vacuum. Society determines the type of medicine being practice. It is the members of society directly or through their representatives who determine what sources are needed for training of healthcare professionals and delivery of healthcare across all medical disciplines. In addition, especially in psychiatry, society will determine and dictate deviance and how deviance is to be dealt with. The social contract originally between the monarchs and their subjects is simulated between physicians and society as a whole, but through its representatives, who will also dictate how the professions are regulated. It is the regulatory bodies to whom physicians answer regarding clinical practice and standards of healthcare delivery. Certain aspects of clinical medicine will remain social and be very strongly influenced by prevalent social factors. These can be applied to causative or contributory factors as well as in the intervention and management strategies. Society and cultures also determine childrearing patterns and cognitive schema as well as the way we learn to look at the world. Furthermore, for certain psychiatric conditions cultures and societies play a major role in molding the symptoms and developing illnesses. Societies define sickness behaviour, thereby dictating what type of illnesses allows individuals to behave in acceptable ways. Historically, in different schools of medicine, for example in the Greek or Ayurvedic system(India), physical or mental disorders are seen to be caused by a number of factors, e.g. familial, diet, taboos, stars and weather. These factors interact with each other and will, therefore, determine the type of illness, its potential treatment and likely outcome. The initial understanding of physical and mental disorders was largely social, and it is with the knowledge of human anatomy and physiology and relatively recent technological advances that it became possible to understand biological aspects of aetiological and management factors. Physical environment and the conditions in which individuals live have been significant factors in causation of disorders, and remain so. Fathalla1 suggests that as more physicians became technically oriented, the less socially conscious they became. As poor housing, overcrowding and other factors contributed to tuberculosis, physicians used clean air and sanatoria as treatment. Once bacillus was discovered, and antibacillus treatments made available, curative aspects became more operative than social management. However, even now overcrowding, poverty and migration can contribute to developing tuberculosis. In psychiatric disorders, something similar emerged with the introduction of antidepressants and antipsychotics, and the focus shifted to physical treatments than social ones. Poor socioeconomic conditions have an adverse influence on human beings and poverty and unemployment can directly or indirectly cause major psychiatric problems. The history of medicine as a social construct commenced in the 19th century. The relationship between society, disease and medicine is integral to our understanding of what doctors should be doing with the patient in front of them. Three common principles have emerged in this context and include social and economic conditions which impact health, disease and practice of medicine; health of the population; and promotion of health by the society using both social and individual means. Virchow highlighted the social origins of illness. Anderson et al. note that Virchow's perception was that illness was an indictment of the political system. Virchow is said to have gone further and argued that 'medicine is a social science and politics is nothing else but medicine on a large scale'. The role medicine has played in medicalising normal variants such as homosexuality as a result of social pressures reflects the degree to which medicine is all social intervention tools.

Epistemology of Medicine:

From epistemological point of view in medicine scientific nature that the claiming "science is what scientists do" does get us to consider the disparate activities and methods that constitute science, it is, perhaps, a bit disingenuous. It likely will not satisfy philosophically minded people. Indeed, in his one-page essay, not to mention his 1927 book on the logic of modern physics, Bridgman is himself engaging in philosophical reflection about science. Science may be "what scientists do," but it is up to philosophers to help scientists see just what they are doing. Philosophers continue to ask questions about what science is and may even ask meta-questions about what the philosophy of science aspires to achieve. The question we shall address here is, what is the philosophy of medicine? This question continues to be vexing for two fundamental reasons. First, it is no easy task to define philosophy. Philosophers go about philosophizing in various ways; as a result, definitions, especially those that attempt to be interesting or profound, are controversial (Quinton 1995). Many approaches to philosophy have become so technical that they are all but incomprehensible even to philosophers in other fields. Second, the borders of medicine are not readily marked. Medicine is the encounter of one who suffers from disease with one whose goal is to restore health. Yet the complexity of this encounter far exceeds its simple description. Medicine is sometimes taken broadly to include the work not only of physicians, but also of nurses, physical therapists, radiology technicians, and so on. In other words, "medicine" is a kind of shorthand for "health care."At other times medicine is taken narrowly as what physicians do, as when we accuse an imposter of practicing medicine without a license. Medicine is commonly described as both an art and a science. This is an attempt to describe the fact that medicine essentially involves both the art of the encounter between patient and healer and the science that forms the basis for the healing action .Medicine "involves a cognitive art of bodily work which must concretize and individualize its knowledge" (Pellegrino and Thomasma 1981, p. 99).Just how this is done remains unclear. The usual distinction between the theoretical and practical science of medicine has been criticized by Hucklenbroich (1998), who argues that the methodology of medicine consists of two separate methodologies: a research methodology and a clinical methodology. Although there has been a lot of work on the former, there is no generally agreed-upon model for such things as clinical decision making and problem solving. Furthermore, there is no general agreement on what constitutes the proper goals for medicine. Curing disease, promoting individual health, and promoting public health may come to be at odds with one another. Perhaps even more significant is that social problems are increasingly “medicalized.”Medicine should not define its goals so narrowly as to exclude important matters of health, but neither should it define its goals so broadly that all social and political means to increase health become included in the practice of medicine (Nordin 1999). Nonetheless, social and political conditions have significant bearing on health, and so drawing a line between the medical and the sociopolitical will always be a challenge. Certainly medicine is about healing, but the question of which healing methods count as medicine remains controversial. Furthermore, much medical research does not directly pursue healing, but rather seeks to understand biological function. Whether that is part of medicine or a separate “medical science,” or even just a biological science, is not a settled issue. It is hard to say whether such uncertainties have led some to deny the existence of the philosophy of medicine, relegating philosophical reflection on medicine either to bioethics or to philosophy of science. Still, given the numbers of publications overtly professing to be about philosophy of medicine, the field has not achieved the status of philosophy of science or philosophy of law, for example. Returning to the question at hand, I offer this answer: philosophy of medicine is what philosophers of medicine do. This is not meant to be disingenuous; neither is it meant to be a strict definition. It is, rather, an attempt to help us see the breadth of the philosophy of medicine. If philosophy of medicine is what philosophers of medicine do, what makes people philosophers of medicine is that they do philosophy of medicine. We seem to be stuck in a circle, but this may be no worse than trying to say exactly what science is by looking at what scientists do .The problem is delineating just what philosophers of medicine do that constitutes a discipline of study. I believe that philosophy of medicine ought to include the breadth of philosophical reflection on the breadth of the subject matter related to medicine. Facing the other side of the circle, we come to the other perplexing question: who are philosophers of medicine? Philosophy of medicine, broadly construed, is rightly considered to be the provenance of more than just professional philosopher’s .Although the view I am presenting is, in a sense, operationalist, it is not Bridgman’s operationalism. It is adopted not for positivist, linguistic, or narrowly epistemic reasons, but rather in the spirit of Aristotle’s insights into the practical implications of dealing with inexactness. In my consideration of what philosophers of medicine do, I have reviewed the work published in the last 10 years in two major journals related to philosophy and medicine: The Journal of Medicine and Philosophy (volumes 22–31) and Theoretical Medicine and Bioethics (volumes 18–27).I have also looked at the books published in the same 10-year period in the Philosophy and Medicine series of D. Reidel Publishing Company (later Kluwer Academic Publishers, and now Springer). we recognize that these publications do not exhaust the resources for philosophy of medicine, but they do give some insight into what people who are reflecting philosophically on medicine are actually doing Arthur Caplan (1992) denied that the philosophy of medicine exists, although he lamented the situation. His position and some responses to it are worth exploring a bit. Caplan calls medical ethics, bioethics, health policy and medical aesthetics examples of philosophy and medicine, but he sees philosophy of medicine to be something quite different. He gives a stipulative definition: “The philosophy of medicine is the study of epistemological, metaphysical and methodological dimensions of medicine; therapeutic and experimental; diagnostic, therapeutic, and palliative” (p. 69). Certainly these studies should qualify as philosophy of medicine. Given the prominence of bioethics, Caplan does well to point out that philosophy of medicine is something different. But why should philosophy of medicine be limited in this particular way? If ethics and aesthetics are recognized as legitimate parts of philosophy, there is no reason to exclude medical ethics and medical aesthetics from philosophy of medicine. Perhaps the intent is simply to emphasize that medical ethics does not exhaust philosophy of medicine.That is a point still worth emphasizing, but it does not justify the exclusion of legitimate parts of philosophical reflection from the philosophy of medicine. Caplan’s point about the nonexistence of philosophy of medicine as a field has more to do with the way he understands a field. On his account, a field must (1) be integrated into a cognate area of inquiry, (2) have a canon, and (3) have certain problems that define its boundaries (pp.

72–73). He finds these requirements lacking for philosophy of medicine. Others, however, have argued that philosophy of medicine is a developing field that does, in fact, have at least the potential to meet all of Caplan's requirements (Velanovich 1994). A good case can be made that the requirements of a canon and defining problems are met for philosophy of medicine. Edmund Pellegrino (1998) has argued that there is a field of philosophical inquiry that "can be termed properly the philosophy of medicine" (p. 315). He speaks of four "modes" of philosophical reflection on medicine. First, philosophy and medicine is a dialogue between the disciplines, which both retain their identities as distinct disciplines. The dialogue might, for example, compare and contrast methods of study or look for similarities or differences in subject matter or mutual influences. Second, philosophy in medicine is the application of recognized branches of philosophy to medical matters. For example, the diagnostic process might be examined for its logic, or the concepts of health and disease analyzed for their metaphysical presuppositions and epistemological status. Third, medical philosophy, the vaguest of the four modes, consists of "informal reflection on the practice of medicine" about such things as "diagnostic artistry" or the doctor-patient relationship. Medical philosophy also includes the writings "based in the clinical wisdom of reflective clinicians" that serve as sources of "inspiration and practical knowledge for conscientious clinicians" (pp. 324–25). Finally, philosophy of medicine, proper, is concerned only with what is "peculiar to the human encounter with health, illness, disease, death, and the desire for prevention and healing" (p. 327). Philosophical concepts are studied only insofar as they relate to the human encounter with somatic or psychological well-being and dysfunction .Thus, the object is not merely analysis of concepts or scientific understanding of medical matters, but rather an understanding of what medicine is as experienced in the encounter of patient and physician. While Pellegrino's analysis sheds valuable light on the various modes of interaction between philosophy and medicine, it limits philosophy of medicine too much. I have favored a broader view of philosophy of medicine as being closer to what is actually being done by philosophers reflecting on medicine (Stempsey 2004). This view is akin to the model described by Schaffner and Engelhardt (1998).They see philosophy of medicine as "encompassing those issues in epistemology, axiology, logic, methodology and metaphysics generated by or related to medicine."This includes medical ethics, although it has become such a large topic that it deserves a separate discussion. Concepts of health and disease have been a "defining problem" for contemporary (and classical) philosophy of medicine, but philosophy of medicine includes any philosophical reflection on medicine. This includes investigations into the logic of diagnosis, prognosis, and evaluation of therapies, and philosophical discussion of the causation of disease. This is closer to what Pellegrino calls philosophy in medicine. Pellegrino admits that there is no essential conflict between his own view of philosophy of medicine and philosophy in medicine. In fact, much of his own work has dealt with matters of his philosophy in medicine. I would hold that his distinction will not help to further the cause of recognition of philosophy of medicine as a distinct field. Furthermore, I regard medicine more broadly and not based primarily on the foundation of the individual doctor-patient relationship. Medicine, rather, encompasses an array of clinical and research activities that ultimately aim at helping the suffering patient .These activities, however, need not necessarily arise from the very specific foundation Pellegrino requires for classification as philosophy of medicine. In my view, any philosophical reflection, whether it seeks to analyze the logic of diagnosis, to describe the phenomenology of suffering, or to seek the wisdom required to be a good physician, deserves to be counted as philosophy of medicine. The one criterion of Caplan that remains problematic for philosophy of medicine is its integration into philosophy. The reasons for this are not altogether clear, but probably are best explained by the dominance of bioethics and the relatively small number of people working in the field (if it is a field) that goes beyond bioethics (Stempsey 2007).Another contributing problem is that philosophy of medicine is being done by a variety of different people, who may not identify themselves primarily as philosophers of medicine.

Medicine: certain therapeutic interventions tend to produce certain effects. – Inquiry embedded in the practices of helping sick people. – Ethical context of inquiry (not only in medicine but in any field of inquiry.

Transformation of medicine Bedside to Laboratory Medicine :

From tasting urine to microscopy to molecular testing, the sophistication of diagnostic techniques has come a long way and continues to develop at breakneck speed. The history of the laboratory is the story of medicine's evolution from empirical to experimental techniques and proves that the clinical lab is the true source of medical authority. Three distinct periods in the history of medicine are associated with three different places and therefore different methods of determining diagnosis: From the middle ages to the 18th century, bedside medicine was prevalent; then between 1794 and 1848 came hospital medicine; and from that time forward, laboratory medicine has served as medicine's lodestar. The laboratory's contribution to modern medicine has only recently been recognized by historians as something more than the addition of another resource to medical science and is now being appreciated as the seat of medicine, where clinicians account for what they observe in their patients. The first medical diagnoses made by humans were based on what ancient physicians could observe with their eyes and ears, which sometimes also included the examination of human specimens. The ancient Greeks attributed all disease to disorders of bodily fluids called humors, and during the late medieval period, doctors routinely performed uroscopy. Later, the microscope revealed not only the cellular structure of human tissue, but also the organisms that cause disease. More sophisticated diagnostic tools and techniques-such as the thermometer for measuring temperature and the stethoscope for measuring heart rate-were not in widespread use until the end of the 19th century. The clinical laboratory would not become a standard fixture of medicine until the beginning of the 2Oth century. This 2-part article reviews the history and development of diagnostic methods from ancient to modern times as well as the evolution of the clinical laboratory from the late l9th century to the present. Ancient diagnostic methods In ancient Egypt and Mesopotamia, the earliest physicians made diagnoses and recommended treatments based primarily on observation of clinical symptoms. Palpation and auscultation were also used. Physicians were able to describe dysfunctions of the digestive tract, heart and circulation, the liver and spleen, and menstrual disturbances; unfortunately, this empiric medicine was reserved for royalty and the wealthy. Other less-than-scientific methods of diagnosis used in treating the middle and lower classes included divination through ritual sacrifice to predict the outcome of illness. Usually a sheep would be killed before the statue of a god, its liver was examined for malformations or peculiarities; the shape of the lobes and the orientation of the common duct were then used to predict the fate of the patient. Ancient physicians also began the practice of examining patient specimens. The oldest known test on body fluids was done on urine in ancient times (before 400 BC). Urine was poured on the ground and observed to see whether it attracted insects. If it did, patients were diagnosed with boils. The ancient Greeks also saw the value in examining body fluids to predict disease. At around 300 BC, Hippocrates promoted the use of the mind and senses as diagnostic tools, a principle that played a large part in his reputation as the "Father of Medicine." The central Hippocratic doctrine of humoral pathology attributed all disease to disorders of fluids of the body. To obtain a clear picture of disease, Hippocrates advocated a diagnostic protocol that included tasting the patient's urine, listening to the lungs, and observing skin color and other outward appearances. Beyond that, the physician was to “understand the patient as an individual." Hippocrates related the appearance of bubbles on the surface of urine specimens to kidney disease and chronic illness. He also related certain urine sediments and blood and pus in urine to disease. The first description of hematuria, or the presence of blood in urine, by Rufus of Ephesus surfaced at around AD 50 and was attributed to the failure of kidneys to function properly in filtering the blood. Later (c. AD 180), Galen (AD 131-201), who is recognized as the founder of experimental physiology, created a system of pathology that combined Hippocrates' humoral theories with the Pythagorean theory, which held that the four elements (earth, air, fire, and water), corresponded to various combinations of the physiologic qualities of dry, cold, hot, and moist. These combinations of physiologic characteristics corresponded roughly to the four humors of the human body: hot + moist = blood; hot + dry = yellow bile; cold + moist = phlegm; and cold + dry = black bile. Galen was known for explaining everything in light of his theory and for having an explanation for everything. He also described diabetes as "diarrhea of urine" and noted the normal relationship between fluid intake and urine volume. His unwavering belief in his own infallibility appealed to complacency and reverence for authority. That dogmatism essentially brought innovation and discovery in European medicine to a standstill for nearly 14th centuries. Anything relating to anatomy, physiology, and disease was simply referred back to Galen as the final authority from whom there could be no appeal. Middle Ages In medieval Europe, early Christians believed that disease was either punishment for sin or the result of witchcraft or possession. Diagnosis was superfluous. The basic therapy was prayer, penitence, and invocation of saint. Lay medicine based diagnosis on symptoms, examination, pulse, palpitation, percussion, and inspection of excreta and sometimes semen. Diagnosis by "water casting" (uroscopy) was practiced, and the urine flask became the emblem of medieval medicine. By AD 900, Isaac Judaeus, a Jewish physician and philosopher, had devised guidelines for the use of urine as a diagnostic aid; and under the Jerusalem Code of 1090, failure to examine the urine exposed a physician to public beatings. Patients carried their urine to physicians in decorative flasks cradled in wicker baskets, and because urine could be shipped, diagnosis at long distance was common. The first book detailing the color, density, quality, and sediment found in urine was written around this time, as well. By around AD 1300, uroscopy became so widespread that it was at the point of near universality in European medicine. Medieval medicine also included interpretation of dreams in its diagnostic repertoire. Repeated dreams of floods indicated "an excess of humors that required evacuation"; and dreams of flight signified "excessive evaporation of humors." Seventeenth century The medical advances of the 17th century consisted mostly of descriptive works of bodily structure and function that laid the groundwork for diagnostic and therapeutic discoveries that followed. The status of medicine was helped along by the introduction of the scientific society in Italy and by the advent of periodical literature. Considered the most momentous event in medical history since Galen's time, the discovery of the circu1ation of blood by William Harvey (1578-1657) marked the beginning of a period of mechanical explanations for a variety of functions and processes including digestion, metabolism, respiration, and pregnancy. The English scientist proved through vivisection, ligation, and perfusion that the heart acts as a muscular pump propelling the blood throughout the body in a continuous cycle. The invention of the microscope opened the door to the invisible world just as Galileo's telescope had revealed a vast astronomy. The earliest microscopist was a Jesuit priest, Anthanasius Kircher (1602-168O) of Fulda (Germany), who was probably the first to use the microscope to investigate the causes of disease. His experiments showed how maggots and other living creatures developed in decaying matter. Kircher's writings included an observation that the blood of patients with the plague contained “worms"; however, what he thought to be organisms were probably pus cells and red blood corpuscles because he could not have observed Bacillus pestis with a 32-power microscope. Robert Hooke (1635-1703) later used the microscope to document the existence of "little boxes' or cells, in vegetables and inspired the works of later histologists; but one of the greatest contributions to medical science came from Italian microscopist, Marcello Malpighi (1628-1694). Malpighi, who is described as the founder of histology, served as physician to Pope Innocent XII and was famous for his investigations of the embryology of the chick and the histology and physiology of the glands and viscera. His work in embryology describes the minutiae of the aortic arches, the head fold, the neural groove, and the cerebral and optic vesicles. Uroscopy was still in widespread use and had gained popularity as a method to diagnose "chlorosis," or love-sick young women, and sometimes to test for chastity. Other methods of urinalysis had their roots in the l7th century as well. The gravimetric analysis of urine was introduced by the Belgian mystic, Jean Baptiste van Helmont (1577-1644). Van Helmont weighed a numher of 24- hour specimens, but was unable to draw any valuable conclusions from his measurements. It wasn't until the late 17th centurywhen Frederik Dekkers of Leiden, Netherlands, observed in 1694 that urine that contained protein would form a precipitate when boiled with acetic acid that urinalysis became more scientific and more valuable. The best qualitative analysis of urine at the time was pioneered by Thomas Willis (1621-1675), an English physician and proponent of chemistry. He was the first to notice the characteristic sweet taste of diabetic urine, which established the principle for the differential diagnosis of diabetes mellitus and diabetes insipid us. Experiments with blood transfusion were also getting underway with the help of a physiologist in Cornwall, England, named Richard Lower (1631-1691). Lower was the first to perform direct transfusion of blood from one animal to another. Other medical innovations of the time included the intravenous injection of drugs, transfusion of blood, and the first attempt to use pulse rate and temperature as indicators of health status. Eighteenth century is regarded as the Golden Age of both the successful practitioner as well as the successful quack. Use of phrenology (the study of the shape of the skull to predict mental faculties and character), magnets, and various powders and potions for treatment of illness were a few of the more popular scams. The advancement of medicine during this time was more theoretical than practical. Internal medicine was improved by new textbooks that catalogued and described many new forms of disease, as well as by the introduction of new drugs, such as digitalis and opium. The state of hospitals in the l8th century, however, was alarming by today's standards. Recovery from surgical operations was rare because of septicemia. The concept of antisepsis had not yet been discovered, and hospitals were notorious for filth and disease well into the 19th century. One notable event that is a forerunner to the modern practice of laboratory measurement of prothrombin time, plasma thromboplastin time, and other coagulation tests, was the discovery of the cause of coagulation. An English physiologist, William Hewson (1739-1774) of Hexham, Northumberland, England, showed that when the coagulation of the blood is delayed, a coagulable plasma can be separated from the corpuscles and skimmed off the surface. Hewson found that plasma contains an insoluble substance that can be precipitated and removed from plasma at a temperature slightly higher than 50'C. Hewson deducted that coagulation was the formation in the plasma of a substance he callcd "coagulable lymph," which is now known as fibrinogen. A later discovery that fibrinogen is a plasma protein and that in coagulation it is converted into fibrin, attests to the importance of Hewson's work. The clinical diagnostic methods of percussion, temperature, heart rate, and blood pressure measurements were further refined, and there were some remarkable attempts to employ precision instruments in diagnosis. Leopold Auenbrugger (1722-1809) was the first to use percussion of the chest in diagnosis in 1754 in Vienna. This method involved striking the patient‟s chest while the patient holds his or her breath. Auenbrugger proposed that the chest of a healthy person sounds like a cloth-covered drum. A student of Auenbrugger's, Jean Nicolas Corvisart, a French physician at La Charite in Paris, pioneered the accurate diagnosis of heart and lung diseases using Auenbrugger's chest thumping technique. The resulting sounds are different when the lungs contain lesions or fluids than in healthy people. This observation was validated by postmortem examination. James Currie (1756-1805), a Scot, was the first to use cold baths in treatment of typhoid fever; and by monitoring the patient's temperature using a thermometer, he was able to adjust the temperature and frequency of the baths to treat individual patients. It took another hundred years, however, before thermometry became a recognized feature in clinical diagnosis. In 1707, Sir John Floyer (1649-1734) of Staffordshire, England, introduced the concept of measuring pulse rate by timing pulse beat with a watch. He counted the beats per minute, and tabulated the results; but his work was ignored because of a healthy skepticism for an old Galenic doctrine of there being a special pulse for every disease. The groundbreaking work for measuring blood pressure was done by Stephen Hale, (1677-1761), an English clergyman. By fastening a long glass tube inside a horse's artery. Hales devised the first manometer or tonometer, which he used to make quantitative estimates of the blood pressure, the capacity of the heart, and the velocity of blood current. Hales' work was the precursor for the development of the sphygmomanometer used today to measure arterial blood pressure. Additional advances in urinalysis occurred with J.W. Tichy's observations of sediment in the urine of febrile patients (1774); Matthew Dobson's proof that the sweetness of the urine and blood serum in diabetes is caused by sugar (1776); and the development of the yeast test for sugar in diabetic urine by Francis Home (1780). Table 1: Evolution of diagnostic tests as documented in textbooks of laboratory medicine 1892 Sir William Osler. Textbook of Medicine Hemoglobin estimation, red and white blood cell counts, malaria parasite identification, simple urinalysis, examination of sputum for tuberculosis. 1898 Sir William Osler. Textbook of Medicine Blood culture, agglutination test for typhoid fever, isolation of Klebs-Loffler bacillus with virulence tests in diphtheria, lumbar puncture, examination of cerebrospinal f1uid in suspected meningitis, amino aciduria in liver disease. 1901 Sir William Osler. Textbook of Medicine Isolation of typhoid bacilli from urine and the clotting time in hemophilia. 1912 Sir William Osler. Textbook of Medicine Tissue examination for spirochetes in syphilitic lesions, the Wassermann test, osmotic fragility tests, a crude form of the glucose tolerance test. 1914 P.N. Patton. Title Unknown. Blood counts and examination of stained smears, agglutination reactions, the Wassermann test, parasitology, blood cultures, spectroscopic examination, visual detection of bilirubinemia, Gmelin tests, Garrod technique for uric acid, alkalinity of blood, bacteriology (basic staining and culture methods in use today), urinalysis (pus, red blood cells, albumin, sugar), test meals in use, fecal examinations for fat and stercobilin, histology (frozen section and paraffin embedding). Nineteenth century The emergence of sophisticated diagnostic techniques and the laboratories that housed them coincides roughly with the worldwide political, industrial, and philosophical revolutions of the 19th century, which transformed societies dominated by religion and aristocracy into those dominated by the industrial, commercial and professional classes. In the decades after the Civil War, American laboratories and their champions were met with a vehement skepticism of science, which was viewed by some as an oppressive tool of capitalist values. The lay public, as well as many practitioners, saw the grounding of medicine in the laboratory as a removal of medical knowledge from the realm of common experience and as a threat to empiricism. Many American physicians who went abroad to Germany and France for supplementary training came back to impart the ideals of European medicine, as well as those of higher education fur its own sake to an American society that found these beliefs threatening. The lab itself was not seen as a threat, but rather the claims it made to authority over medical practice were assailed. The empiricists and the "speculative medical experimentalists" were for the most part divided along generational lines. The older empiricists had a stake in continuing their careers independent of a medical infrastructure or system, while the younger physicians 'aspired to careers in academic medical centers patterned after German institutions. The younger, more energetic ranks had to first lobby for such facilities to be built and as older doctors retired from teaching posts and turned over editorship of scientific journals, this opposition to the lab faded. Medical historians also note that the 19th century was one in which the rest of therapeutics lagged behind, and called it an era of public health. New discoveries in bacteriology allowed for water treatment and pasteurization of milk, which significantly decreased mortality rates. In addition, the advent of antiseptic surgery in the 19th century reduced the mortality from injuries and operations and increased the range of surgical work. Medical practitioners relied, for a time, more on increased hygiene and less on drugs. Advances in public and personal hygiene had dramatically improved the practice of medicine; predictions were even made that the pharmacopoeia of the time would eventually be reduced to a small fraction of its size. At the beginning of the century, physicians depended primarily on patients' accounts of symptoms and superficial observation to make diagnoses; manual examination remained relatively unimportant. By the 1850s, a series of new instruments, including the stethoscope, ophthalmoscope, and laryngoscope began to expand the physician's sensory powers in clinical examination. These instruments helped doctors to move away from a reliance on the patients' experience of illness and gain a more detached relationship with the appearance and sounds of the patient‟s body to make diagnoses. Another wave of diagnostic tools--including the microscope and the X-ray, chemica1 and bacteriological tests, and machines that generated data on patient‟s physiological conditions, such as the spirometer and the electrocardiogram reproduced data seemingly independent of the physician's as well as the patient's subjective judgment. These developments had uncertain implications for professional autonomy: They further reduced dependence on the patient, but they increased dependence on capital equipment and formal organization of medical practice. These detached technologies added a highly persuasive rhetoric to the authority of medicine. They also made it possible to move part of the diagnostic process behind the scenes and away from the patient where several physicians could have simultaneous access to the evidence. The stethoscope, for example, could only be used by one person at a time, but lab tests and X-rays enabled several doctors to view and discuss the result. This team approach to diagnosis strengthened the medical community's claim to objective judgment. Equipped with methods for measuring, quantifying, and qualifying, doctors could begin to set standards of human physiology, evaluate deviations, and classify individuals. Microscopy. Many scientists were making great strides in bacteriology, microbiology, and histology as well. Improvements in the microscope allowed further exploration of the cellular and microbial worlds in the 19th century. Johannes Evangelista Purkinje was an important Bohemian pioneer of the use of the microscope. In 1823, he was appointed professor of physiology at the University of Breslau and a year later, he started a physiologic laboratory in his own house. Purkinje's work includes descriptions of the germinal vesicle in the embryo, description and naming of protoplasm, discovery of the sudoriferous glands of the skin and their excretory ducts, and numerous descriptions of brain, nerve, and muscle cells. When John Snow studied the great London cholera outbreak in 1854, he brought it under control by tracing it to the Broad Street Pump and eliminating access to this source of contaminated water. Snow's work foreshadowed some of the earliest successful applications of laboratory methods to public hygiene that came in the 1860s and '70s with the breakthroughs in bacteriology made by Louis Pasteur and Robert Koch. Louis Pasteur (1822-1895) discovered the anaerobic character of the bacteria of butyric fermentation and introduced the concepts of aerobic and anaerobic bacteria around the year 1861. About the same time, he discovered that the pellicle that is necessary in the formation of vinegar from wine consisted of a rod-like microorganism, Mycoderma aceti. In 1867, the wine industry of France reported a significant gain in revenue because of Pasteur's discovery that me spoiling of wine by microorganisms can be prevented by partial heat sterilization (pasteurization) at a temperature of 55--60°C without any alteration of the taste. Later {c. 1878), an accident brought about the discovery of preventive inoculation with the weakened form of a virus. While Pasteur was away on vacation, virulent cultures of chicken cholera became inactive; and when injected into animals they were found to act as preventive vaccines against subsequent injection of a live organism. 'The attenuated virus could be carried through several generations and still maintain its immunizing property. In 1881, Pasteur produced a vaccine against anthrax and lowered the mortality rate to 1 % in sheep and to 0.34% in cattle. In 1885, the Pasteur Institute was opened, and here Pasteur worked with several proteges for the rest of his life. A contemporary of Pasteur's, Robert Koch, (1843-1910), began a brilliant career and a series of discoveries with his report in 1876 on the complete life history and sporulation of the anthrax bacillus. His culture methods were confirmed by Pasteur; and in 1877, Koch published his methods of fixing and drying bacterial films on coverslips, of staining them with Weigert's aniline dyes, of staining flagella and of photographing bacteria for identification and comparison. The following year, he published a memoir that included an etiology of traumatic infectious disease in which the bacteria of 6 different kinds of surgical infection are described, with the pathological findings of each microorganism breeding true through many generations in vitro or in animals. In 1881, he developed a method of obtaining pure cultures of organisms by spreading liquid gelatin with meat infusion on glass plates, forming a solid coagulum. Koch also played a role in perfecting the method of steam sterilization. The year after that, he discovered the tubercle bacillus by other special culture and staining methods and formulated a rule for determining the specificity of disease-causing organisms. The rule, called Koch's postulates or Koch's law, stipulated that the specificity of a pathogenic microorganism could only be established if: (I) it is present in all cases of the disease, (2) inoculations of its pure cultures produce disease in animals, (3) from these cultures it can again be obtained, and (4) then it can again be propagated in pure cultures. In 1883, Koch discovered Cholera vibrio and recognized its routes of transmission as drinking water, food and clothing. In 1893, he wrote an important paper on waterborne epidemics showing how they could he prevented by proper filtration. Finally, in 1905, Koch received the Nobel Prize. These two bacteriologists were responsible for the isolation of the organisms responsible for major infectious diseases and led public health officials to make more focused efforts against specific diseases. Sand filtration of the water supply was introduced in the l890s and proved to be effective in preventing typhoid. Regulation of the milk supply also cut infant mortality dramatically. Antiseptic surgery, which reduced the mortality from injuries and operations and increased the range of surgical work, represented another successful application of the work of these two scientists. The emergence of quantitative diagnosis and the hospital laboratory: By the mid-1800s, lab tests had been introduced to detect tuberculosis, cholera, typhoid, and diphtheria, but cures for these diseases would not come until later. Physicians also began to study pulse, blood pressure, body temperature, and other physiological indicators, even though simple, practical instruments to measure these signs were not developed until the end of the century. The use of precise measurements in diagnosis became standard in medicine in the early 1900s. Standardized eye tests, weight and height tables, and IQ tests were all part of a movement to identify statistical norms of human physiology and behavior. The first hospital lab in Britain, which was set up at Guys Hospital, was organized into clinical wards. Two of these wards were designated for medical student rotations and had a small laboratory attached for clinical work. By 1890, most laboratory procedures in the U.S. were performed by the physician with a microscope in his home or office. In 1898, Sir William Osler, a Canadian physician, professor, and one of the first well-known authors in the clinical laboratory literature, established ward laboratories at Johns Hopkins Hospital, where routine tests were carried out by attending physicians, and more complex procedures and research problems were referred to the pathology laboratory. An increasing number of useful laboratory tests were discovered in the second half the 1800s, and by the turn of the century, specific chemical and bacteriologica1 tests for disease emerged rapidly. In the 1880s, the organisms responsible for tuberculosis, cholera, typhoid, and diphtheria were isolated and by the mid-l890s, lab tests had been introduced to detect these diseases. The spirochete that causes syphilis was identified in 1905; the Wasserman test for syphilis was introduced in 1906. Advances in the analysis of urine and blood gave physicians additional diagnostic tools. These innovations were the result of progress in basic science that made it possible to duplicate successful applications more rapidly than ever before. The earlier advances in immunization, such as smallpox vaccination, had been purely empirical discoveries and were not quickly repeated. Microbiology for the first time enabled physicians to link disease-causing organisms, symptoms, and lesions systematically. The principles that Pasteur demonstrated in the development of anthrax and rabies vaccines now provided a rational basis for developing vaccines against typhoid cholera, and plague. Surgery. Surgery enjoyed tremendous gains in the late 1800s. Before anesthesia, surgery required brute force and speed because it was important to get in and out of the body as quickly as possible. After William T. G. Morton's (1819-1868) demonstration of ether at the Massachusetts General Hospital in 1846, use of anesthesia allowed for slower and more careful operations. Joseph Lister's (1827-1912) methods of antisepsis using carbolic acid, first published in l867, became general practice around 1880 and improved the previously grim mortality rates for all types of surgery. Before antiseptic techniques, the mortality rate for amputations was about 40%. Surgeons were reluctant to penetrate the major bodily cavities and then only as a last resort. After surgeons were able to master the tedious procedures demanded in antisepsis, they began to explore the abdomen, chest, and skull and developed special techniques for each area. The sophistication and success of surgery blossomed in the 1890s and early 19UOs, spurred on by the development of x-rays in 1895. Surgeons were able to operate earlier and more often for a variety of ills, including appendicitis, gall bladder disease, and stomach ulcers. The growth in surgical work provided a means for expanding profit in hospital care as well. Hematology. In the later part of the century, several discoveries emerged as the foundation of hematologic methods. In 1877, K. Vierordt introduced coagulation time as an index of blood coagulative power. Sir Almroth Edward Write, an Irish professor of pathology in Dublin, was the first to observe the role of calcium salts in the coagulation of blood. He also devised a coagulometer to estimate coagulation time. In 1879, Paul Ehrlich (1854-1915), a Czech cellular pathologist and chemist, was enamored with dyes and developed many methods of drying and fixing blood smears using heat. Ehrlich also discovered mast cells and saw their granulations using a basic analine stain. His classification of white blood cells into different morphological types (neutrophils, basophils, and oxyphilic) paved the way for identifying many diseases of the blood. Ehrlich also contributed to microbiology the discovery of methylene blue as a bacterial stain. Brief History of the Hospital The earliest hospitals in pre-industrial societies were charitable institutions used for tending the sick as opposed to medical institutions that provided for their cure. Medieval hospitals were operated by religious or knightly orders in individual communities. The facility was essentially a religious house in which the nursing personnel had united as a vocationa1 community under a religious rule. In colonial America, almshouses were the first institutions to provide care for the sick. These facilities also had a communal character in that they provided a substitute residence for people who were homeless, poor, or sick. Founded as early as the 17th century in America, almshouses offered sanctuary to all kinds of dependent people from the elderly to the orphaned, the insane, the ill, and the debilitated. In a number of large cities, hospitals evolved from almshouses: The Philadelphia Almshouse became Philadelphia General Hospital; the New York Almshouse became Manhattan's Bellevue Hospital; and the Baltimore County Almshouse became part of the Baltimore City Hospitals. The next rendition of the hospital was a facility that served the sick but limited its services to the poor. Not until the 19th century did hospitals serving all classes emerge. In 1752, the Pennsylvania Hospital in Philadelphia became the first permanent general hospital in America founded especially for care of the sick. New York Hospital was chartered in 1717, but wasn't opened for another 20 years, and the Massachusetts General Hospital opened in Boston in 1821. These institutions were termed "voluntary" because they were financed with donations, rather than with taxes. In Europe, hospitals figured prominently in medical education and research, but were mostly ignored in America until the founding of Johns Hopkins. Between 1670 and 1910, however, hospitals began to play this part in the U.S. as well. Before 1900, the hospital offered no special advantages over the home in terms of surgery. The infections that periodically swept through the wards made physicians cautious about sending patients there. Antiseptic techniques were for a short time adapted for use in patients' homes. "Kitchen surgery" became more inconvenient for patient and surgeon alike as procedures became more demanding and more people moved into apartments, as antiseptic techniques improved, and the stigma of disease in the hospital died out, surgery was brought back into the hospital.

The history of the laboratory continues:
Advances made in the lab eradicate life-threatening illnesses, and laboratorians establish their own identities and societies. At the beginning of the 20th century, therapeutic agents were still relatively few, and many common diseases that are easily cured today were still considered life-threatening. As improvements were made in diagnostic techniques and new drugs were discovered, the laboratory galvanized the authority of medicine by endowing it with the ability to identify and cure disease. Clinical labs began to evolve into permanent institutions within U.S, hospitals as new diagnostic tools were derived from advances in physics. These included radioactive isotopes, electrophoresis microspectrophotometry, the electroencephalogram, and electromyogram. Other techniques such as ventriculography, intracardiac catheterization, and tomography greatly extended the physician's understanding of body function. In 1840, the only laboratory the average European physician was likely to have used was that of a pharmacist; but by 1900, a host of laboratory types emerged, including physiological laboratories, pharmaceutical and pharmacologic laboratories, as well as forensic, public health and microbiological laboratories. The lab, in one form or another, became an "obligatory passage point" for researchers who wanted to make new discoveries. Microbiology Developments in microbiology attested to the link between the diagnosis and treatment of disease. 'The arrival of antibiotics and sulfonomides was especially important in curing previously fatal diseases. The accidental discovery of penicillin by Sir Alexander Fleming (1881-1955) in 1928 was paramount in initiating the antibiotic era. The Scottish scientist had been studying the natural bacterial action of the blood and antibacterial substances that would not be toxic to animals. While working on the influenza virus, he observed a mold that had accidentally developed on a staphylococcus culture plate. Around the mold was a bacteria-free circle around. Fleming experimented with the mold and found it could prevent growth of staphylococcus even when diluted 8oo times. Later, Gerhard Johannes Paul Domagk (1895-1964), a German anatomic pathologist and bacteriologist, discovered that a red dye called prontosil rubrum protected laboratory animals from lethal doses of staphylococcus and hemolytic streptococci. Prontosil was a derivative of sulphanilamide. Domagk was not convinced the substance would be equally effective in humans, but when his daughter became very sick with a streptococcal infection he gave her a dose of prontosil in desperation. She made a complete recovery, but these results were not divulged until 1935 when other clinicians had tested the new drug on patients. Domagk's discovery of the antibacterial action of the sulphonomides gave medicine and surgery a new weapon against many infectious diseases. CIinical chemistry There were many outstanding biochemists of the time. One who conferred a repertoire of tests to the laboratory was Otto Folin: a Swedish professor of biological chemistry at Harvard (1907). Between 1904 and 1922, Folin developed quantitative analytical methods for several urine analytes including urea, ammonia, creatinine, uric acid, total nitrogen, phosphorus, chloride, total sulfate, and acidity. He also attempted to measure blood ammonia and introduced Jaffe's alkaline picrate method for creatinine. Folin showed the effect of uricosuric drugs on blood and uric acid levels in gout; introduced the colorimetric method for measuring epinephrine and published the first normal values for uric acid, nonprotein nitrogen (NPN), and protein in blood. Folin is also responsible for establishing the relationship of uric acid, NPN, and blood urea nitrogen to renal function. The Folin Cicalteau reagent among others developed by Folin, is still used today for protein determinations. Blood banking New discoveries about the biochemical nature of blood made possible the transfusion of blood between humans, which greatly advanced the success rate of surgery. By the early 1940s, blood banking was established in the U.S. In 1900, the Viennese pathologist Karl Landsteiner (1868-1943) discovered the concept of the human blood types and the following year, described the ABO blood group. Accounts of previously unsuccessful blood transfusions from animals to humans reported that the foreign blood corpuscles were clumped and broken up in the human blood vessels, thus liberating hemoglobin. Landsteiner reported a similar reaction in transfusion of blood from human to human. Shock, jaundice, and hemoglobinuria accompanied these early blood transfusions. After Landsteiner's

classification of blood types into the well-known A, B, AB, and 0 groups in 1909, the catastrophes of earlier blood transfusions were eliminated by transfusing blood only between individuals of the same blood group. Later, Landsteiner studied bleeding in newborns- and contributed to the discovery of the Rh factor, which relates human blood to the blood of the rhesus monkey. Another icon of modern blood banking is Charles Drew, MD (1914-1950), an African-American physician from Washington, DC. Early in 1940, the American Red Cross and the Blood Transfusion Betterment Association of New York began a project to collect blood for shipment to the British Isles. Eight New York City hospitals collected blood for what became known as the Plasma for Britain Project. During this project, Drew successfully used the laboratory experiments and blood research done by others to mass produce plasma. Drew heard that the British had successfully modified a cream separator to separate plasma from the red cells in blood, so he ordered 2 of the machines and constructed similar equipment to produce clear plasma on a large scale. Drew became a leading authority on mass transfusions and blood processing method, and was later asked by the American Red Cross and U.S. government to establish a similar program for the Plasma for Britain Project. The quality movement the 20th century marks the beginning of a quality movement in hospitals and laboratories that began with physicians and healthcare workers. As part of that movement, those who ran hospitals began to appreciate the skills that clinical chemists could bring to the hospital laboratory. In the early part of the century, many hospitals began reorganizing their laboratories so that they were headed by biochemists. Professional organizations emerged as self-regulating groups that helped ensure the skills and knowledge of laboratory professionals would pass the scrutiny of the hospitals that employed them. These professional organizations also served their members by lobbying in Washington for advantageous legislation. The American College of Surgeons conducted the first inspections of hospitals in 1918. Initially, the inspections were based on a single page of standards, including a requirement for an adequately staffed and equipped laboratory. Surveyors inspected 671 hospitals of 100 beds or more, and of these, 81 passed initially. One hundred more passed re inspection after improvements were made. That same year brought the first call for a method of certifying technologists on a national scale by John Kolmer, who published "'The Demand for and Training of Laboratory Technicians" which included a description of the first formal training course in medical technology. Also during that year, the Pennsylvania State Legislature passed a law requiring all hospitals and institutions, particularly those receiving state aid, to install and equip an adequate laboratory and to employ a laboratory technician on a fulltime basis. By 1920, clinical laboratories in large hospitals were distinct administrative units of service directed by a chief physician. They usually consisted of 4 or 5 divisions including biochemistry, clinical pathology, bacteriology, serology, immunology, and radiology. Trained, often salaried, professionals staffed each. An American Medical Association survey later showed that 48% of U.S, hospitals had clinical laboratories by 1923, and another survey in 1925 showed that 14% of all U.S. clinical laboratories were commercial or reference laboratories by this date. In spite of possible economies of scale, reference labs performed only a small share of tests over the next several decades. The American College of Surgeons figured prominently in ensuring that hospital laboratories remained under the control of pathologists by promulgating certification standards that required hospitals to have a laboratory with a pathologist in charge. Because pathologists had a monopoly on laboratory tests in the hospital, these labs became extremely lucrative as the number of available tests increased. Certification of lab professionals Physicians in the clinical lab have always played a large role in the status of other lab professionals. Until the last 20 to 30 years, physicians have managed to resist corporate domination throughout the history of medicine. Doctors were motivated not only to preserve their autonomy, but also to prevent third parties from making a profit that might otherwise go to the doctor. In 1934, the AMA stated in a section of its code of ethics that profit from medica1 work "is beneath the dignity of professional practice, is unfair competition with the profession at large, is harmful alike to the profession of medicine and the welfare of the people, and is against sound public policy." This is not to say that the AMA didn't want physicians to make profits for themselves; only that they should not become a part of a larger organization whose function it was to make money. Whether the motivation for this policy was capitalistic or humanitarian is still the subject of debate. This policy helped physicians establish a medical infrastructure that allowed them to delegate to other healthcare professionals work that was repetitive and time-consuming. To maintain their autonomy, physicians needed technical assistants to help them use hospitals and laboratories without being employees of these facilities. The allied health professional began to emerge in the first 30 years of the century with the encouragement of the doctors who needed them. Doctors needed technical assistants who were competent enough to work in their absence yet not threaten their authority. These professionals were developed by physicians in 2 ways: (1) the encouragement of a kind of responsible professionalism among the higher ranks of subordinate healthcare workers, and (2) the employment of women in these auxiliary roles who could he professionally trained but would not challenge the authority or economic position of the doctor. Because clinical pathologists were striving for professional recognition among other physicians, the American Society for Clinical Pathology was founded in 1922. Among the Society's objectives were the goals of maintaining the status of clinical pathologists as well as "encouraging a closer cooperation between the practitioner and the clinical pathologist." In the late 1950s, MTs sought governmental recognition of their educational qualifications through personnel licensure laws and position reclassification in the Civil Service and armed forces. By the end of the first half of the 20th century, laboratory medicine had earned professional legitimacy through contributions to diagnosing disease and discovering drugs to treat formerly' life-threatening illnesses. Professional societies emerged to develop professional identity and to provide educational support. While, Medicare and Medicaid, and the myriad of regulations faced by modern laboratories.

Conclusion:

Besides its nature, twenty-first century medicine also faces a number of crises, including economic, malpractice, healthcare insurance, healthcare policy, professionalism, public or global health, quality-of-care, primary or general care, and critical care—to name a few (Daschle, 2008; Relman, 2007). Philosophers of medicine can certainly contribute to the resolution of these crises by carefully and insightfully analyzing the issues associated with them. For example, considerable attention has been paid in the literature to the crisis over the nature of medical professionalism (Project of the ABIM Foundation, *et al*., 2002; Tallis, 2006). The question that fuels this crisis is what type of physician best meets the patient's healthcare needs and satisfies medicine's social contract. The answer to this question involves the physician's professional demeanor or character. However, little consensus as to how best to define professionalism is palpable in the literature. Philosophers of medicine can aid by furnishing guidance towards a consensus on the nature of medical professionalism.

Philosophy of medicine is a vibrant field of exploration into the world of medicine in particular, and of healthcare in general. Along traditional lines of metaphysics, epistemology, and ethics, a cadre of questions and problems face philosophers of medicine and cry out for attention and resolution. In addition, many competing forces are vying for the soul of medicine today. Philosophy of medicine is an important resource for reflecting on those forces in order to forge a medicine that meets both physical and existence. There is no widely accepted notion of what a scientific theory is. The logical positivists thought that theories are sets of propositions, formalizable in first-order logic, at one point, and as classes of set-theoretic models at another. For our purposes here one can distinguish two senses of theory, a narrower and a broader sense. In the narrower sense, a theory comprises a set of symbols and concepts used to represent the entities in a domain of discourse as well as a set of simple general-purpose principles that describe the behavior of these entities in abstract terms. In the broader sense, theory refers to any statement or set of statements used to explain the phenomena of a given domain.

In medicine one can find theories in both the narrower and the broader sense. Humorism, for instance, holds that the human body is filled with four basic substances or "humors": black bile, yellow bile, phlegm, and blood. The humors are in balance in a healthy person; diseases are explained by excesses or deficiencies in one or more humors. Humorism has ancient origins and influenced Western medicine well into the 18th century. Eastern medicine has analogous systems of thought. Indian Ayurveda medicine, for example, is a theory of the three primary humors wind, bile, and phlegm, and diseases are similarly understood as imbalances in humors (Magner 2002).

In contemporary Western medicine, such highly unifying and general theories play a limited role, however. Evolutionary and Darwinian medicine may well constitute exceptions but these are at best emergent fields at present (see Méthot 2011). Contemporary Western medical researchers and practitioners instead seek to explain medical outcomes using mechanistic hypotheses about their causes—

symptoms by hypotheses about diseases, diseases by hypotheses about antecedents, epidemics by hypotheses about changes in environmental or behavioral conditions (Thagard 2006). What distinguishes these contemporary medical theories from the ancient approaches is that the causes of symptoms, diseases, and epidemics can in principle be as multifarious as the outcomes themselves; in the ancient approaches, lack of humoral balance was the only possible cause. In contemporary Western medicine, there is no presupposition concerning number, form, or mode of action of the causes that explain the outcome other than there *being* some cause or set of causes responsible.

Not every cause is equally explanatory. A given person's death can be described as one by cardiac arrest, pulmonary embolism or lung cancer, for instance. The lung cancer may have had a genetic mutation, the deposition of carcinogens in lung tissue and smoking in its causal history. The smoking, in turn, was caused by the smoker's proneness to addictive behavior, peer pressure and socio-economic environment, let us suppose. Which of the many candidate hypotheses of the form "*X* causes (or caused) *Y*", where *Y* refers to the patient's death, does best explain the outcome? There is no absolute answer to this question. The goodness of a medical explanation depends in part on the context in which it is given (see entry on scientific explanation). When asked "Why did happen?" a coroner might refer to the pulmonary embolism, the patient's physician to the lung cancer and an epidemiologist to the patient's tobacco consumption. The adequacy of a medical explanation is related to our ability to intervene on the factor in question. A pulmonary embolism can be prevented by screening the patient for blood clots. The accumulation of carcinogens in lung tissue can be prevented by stopping smoking. By contrast, even though certain kinds of genetic mutations are in the causal history of any cancer, the mutation is not at present of much explanatory interest to most clinicians, as this is not a factor on which they can easily intervene. There is considerable current medical research to identify mutations associated with various subtypes of cancer and using these to develop targeted therapies and interventions, as well as to provide more accurate prognostic information. Medical explanation, thus, is closely related to our instrumental interests in controlling, preventing and controlling outcomes (Whitbeck 1977).

One issue that is currently debated in the philosophy of medicine is the desirability (or lack thereof) of citing information about the mechanisms responsible for a medical outcome to explain this outcome. While mechanisms are usually characterized in causal terms (e.g., Glennan 2002; Woodward 2002; Steel 2008), it is not the case that every cause acts through or is a part of some mechanism, which is understood as a more or less complex arrangement of causal factors that are productive of change (e.g., Machamer et al. 2000). Absences, such as lack of sunlight, can cause medical outcomes but are not related to them through continuous mechanisms from cause to effect (Reiss 2012). Neuroscientific explanations are often acceptable despite the lack of knowledge or false assumptions about mechanisms (Weber 2008). However, we may ask whether mechanistic explanations are generally *preferable* to non-mechanistic causal explanations.

Many medical researchers and philosophers of medicine subscribe to a reductionist paradigm, according to which bottom-up explanations that focus on the generative physiological mechanisms for medical outcomes are the only acceptable ones or at least always preferable. Indeed, macro-level claims such as "Smoking causes lung cancer" seem to raise more questions than they answer: Why does smoking have adverse health consequences? To prevent these consequences, is it necessary to stop smoking? Is it possible to produce cigarettes the smoking of which has fewer or no adverse consequences? What is the best policy to improve morbidity and mortality from lung cancer? Knowing that it is specific carcinogens in tobacco smoke and genetic susceptibility that are jointly responsible for the onset of the disease helps to address many of these questions.

Nevertheless it would be wrong to assume that we cannot explain outcomes without full knowledge of the mechanisms responsible. When, in the mid-1950s, smoking was established as a cause of lung cancer, it was certainly possible to explain lung cancer epidemics in many countries where people had exchanged pipe smoking for cigarette smoking half a century earlier—even though the mechanism of action was not understood at the time. Differences in lung cancer incidence between men and women or between different countries can be explained with reference to different smoking behaviors. Policy interventions, in this case the addition of warning labels to cigarette packets, could not wait until sufficient mechanistic knowledge was available, nor did they have to wait.

For reasons such as these, a number of philosophers of medicine have proposed to adopt an "explanatory pluralism" for medicine (De Vreese et al. 2010; Campaner 2012). If nothing else, this is certainly a position that is consistent with the explanatory practices in the field.

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