

Chemistry—A Scientific Model for Family Medicine?

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The academic basis of family medicine is currently undergoing reexamination. Some would have the specialty leave the academic arena and pursue a biopsychosocial mode of practice in the community. Others would have family medicine aggressively pursue academic research, apparently by abandoning the biopsychosocial approach to medical care. Chemistry as an academic discipline and as applied in community practice has solved many of the problems facing family medicine today. This paper suggests that one may learn much from chemistry.

Four basic principles of applied science are presented from the point of view of a chemist: (1) science has an important but strictly limited contribution to make to medical practice; the humanistic goals of family medicine are philosophical decisions, and science is used to attain these goals; (2) observations are the basic reality of science; theory, to be useful, must explain and predict observations; (3) there is a basic unity in science; and (4) there is no hierarchy in scientific understanding. A model based on these four principles is presented that defines family medicine as the central, coordinating discipline in modern academic and community medical practice.

Recently, much has been written about the future of family practice as a model for modern medical care, and most of the comments have been negative. Glenn¹ believes that the biopsychosocial model is being destroyed by creeping biomedicine. Blake² believes that there is too little research (that is, too little biomedicine), and unless research efforts are increased, credibility in the academic sphere will be lost. Ruane³ believes that there is an inseparable gulf between academic science and family medicine. Phillips⁴ claims that Kuhn⁵ absolved family medicine of the need of having a scientific paradigm, since the specialty is a profession, not a scientific discipline. Reading these four editorials, all of which appeared in family practice journals in 1988, leaves one with the impression that there is a major theoretical problem in family medicine. This impression cannot instill confidence in the stability of family medicine as a discipline.

The theoretical work upon which much of the discontent

is based was done by Kuhn⁵ and Engel.⁶⁻⁸ Kuhn was writing from the perspective of a theoretical physicist who had become disenchanted with the sterility of the current research process. Engel was writing from the perspective of the psychoanalyst who was seeing experimental science rapidly taking over the field of psychiatry. His efforts were intended to help stem the tide of objectivism, which was realized in the third edition of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-III)*.⁹ Both authors expressed primarily negative views about science and medicine as they are currently practiced. Kuhn described "ordinary science" as follows:

No part of the aim of normal science is to call forth new sorts of phenomena; indeed those [phenomena] that will not fit the box are often not seen at all. Nor do scientists normally aim to invent new theories, and they are often intolerant of those invented by others.

Engel described the "crisis" of modern medicine thus:

I contend that all medicine is in crisis and, further, that medicine's crisis derives from the same basic fault as psychiatry's, namely adherence to a model of disease no longer adequate for

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the scientific tasks and social responsibilities of either medicine or psychiatry.

This "reductionistic, dualistic biomedical model" is depicted as dogma, not science. Engel continues: "Biomedical dogma requires that all disease, including 'mental' disease, be conceptualized in terms of derangement of underlying physical mechanisms." These negative views of Kuhn and Engel are seen in the editorial comments of Glenn,¹ Ruane,³ and Phillips.⁴

Associated with this doom and gloom is a real decrease in medical student interest in family medicine.¹⁰ It is tempting to suggest that the negative tone of the philosophical debate in family medicine has a negative effect on students' opinions of the field. Certainly it does little to raise the spirits of the aspiring young researcher in family medicine. A more optimistic model is needed if family medicine is to make a positive impact on the medical community.

Family physicians are now in an excellent position to become the central coordinators of medical care. Certainly financial pressures are placing them in the center of the referral networks of major insurers. To attain this central position, family physicians must demonstrate that they have unique skills and knowledge that qualify them to deliver primary care and to coordinate the efforts of other physicians to provide the best secondary care possible to optimize the outcome for patients. Using sound scientific principles combined with humanistic values, family physicians are in a good position to make this potential a reality. This paper addresses the basic principles that are used by practicing chemists, and how these principles can be used in conjunction with the current practice of science in medicine to realize the potential of family medicine.

CHEMISTRY AS A PRACTICAL SCIENCE

Chemistry is a discipline and a science that has solved many of the problems facing family medicine today. It is an old tradition that has escaped much of the turmoil that has embroiled modern physics and medicine. Chemistry has gained excellent credentials as an academic discipline, and is considered a central part of medical education, a prime goal of family medicine. Chemistry is the science that has traditionally been involved in the real world as well as the academic ivory tower. Family medicine is philosophically inclined to be an academic discipline as well as a force to promote health in the community. The relationship between academic and applied chemistry is excellent. Family medicine wishes to develop good ties between its academic departments and its practicing physicians. Finally, chemistry has developed excellent and fruitful working relationships with physics, biology, medicine, and psy-

chology. Family medicine needs close working ties with the basic sciences and the other specialties of medical practice to carry out its goals. Family medicine may learn from chemistry some of the techniques likely to accomplish these ends.

BASIC ASSUMPTIONS OF CHEMISTRY AS APPLIED TO FAMILY MEDICINE

The reason for chemistry's successful melding of academic science and applicability to real world situations lies in its basic assumptions, which are as applicable for family medicine as they are for chemistry. This paper presents four principles of scientific endeavor that represent the actual practice of chemistry historically and in the present from the perspective of a practicing chemist turned family physician. These principles can be related to the practice of family medicine both as an academic discipline and as a profession.

1. *The capabilities and limitations of science are very well defined.* Science is predicated on observing objectively, finding correlations between events, discovering causal relationships, and exploiting these relationships to predict and control the future. Science can predict what is possible and describe how to accomplish the possible. Science cannot address value judgments or basic ethical principles. The goals of medicine and the ethics of medical practice are not scientific questions. "Can we resuscitate patients who have a cardiac arrest?" is a scientific question.¹¹ "Should we resuscitate patients who have a cardiac arrest?" is an ethical question.¹²

The goals of an applied science, such as medicine or chemistry, are to serve the needs of society. The goals of basic science, on the other hand, are to pursue knowledge for its own sake, with no concern for its use in the greater society. The applied scientific method of medicine must respond to the needs of patients, not the intellectual curiosity of the physician.

The goal of medicine is therapeutic, that is, to reduce morbidity and premature mortality, however broadly defined, in patients who seek care. This goal is basically humanistic. The role of science in medicine is to provide the knowledge necessary to treat patients intelligently with the expectation that treatment will be of benefit. Science in medicine has been very successful in pursuing this therapeutic goal for physical illnesses, using techniques common to chemistry. The scientific diagnostic-therapeutic method of medicine divides human illness into disease categories that share common attributes. The commonalities among patients with similar diseases allow scientists and physicians to study and predict the outcomes of therapy for these patients. Therapeutic efficacy in this scientific method is easily defined and studied.

Clinical practice involves the integration of the knowledge from medical science for the therapeutic benefit of the individual patient. Scientific knowledge about the diagnosis and treatment of several individual diseases is combined in response to the unique combination of medical, psychological, and social problems and circumstances of the individual patient. This approach allows the physician to treat the patient as an individual and at the same time have some assurance that the treatment will be effective. In this model the disease orientation of the medical scientist is complementary to the patient orientation of clinical medicine, not opposed to it as in the biopsychosocial model.

The goal of Engel's biopsychosocial approach to medicine is similar to the goal of the basic scientist, that is, knowledge for its own sake. Engel states that "psychiatry now is the only clinical discipline within medicine concerned primarily with the study of man and the human condition."⁷⁷ Therapeutic effectiveness is given only little consideration. The goal of therapy appears to be the relief of symptoms. "Broadly speaking, the need of the patient is to be relieved of 'distress' rightly or wrongly attributed to 'illness,' however conceptualized."⁷⁸ The scientific goal of Engel's model is to document the effects of illness on individual humans in unique situations. Quoting Mead,¹³ he states "... reliance is on the integrative powers of the observer of a complex nonreplicable event and on the experiments that are provided by history and by animals living in particular ecological settings."⁷⁷ The emphasis on the uniqueness of each illness event in this model is in direct opposition to the search for similarities between experiences, which is essential for the diagnostic-therapeutic method of medical science. This difference explains some of the conflict between proponents of the biopsychosocial model and the mainstream of modern medicine.¹

Family medicine as a specialty holds strong humanistic values. Patients are individuals who are to be respected and treated in the context of their human experiences. Humanistic values are consistent with the diagnostic-therapeutic method of medical science, as has been demonstrated by the work of Lamaze,¹⁴ Klaus and Kennel,¹⁵ and Kuebler-Ross.¹⁶ Lamaze demonstrated the benefits of human contacts in pregnancy, labor, and childbirth. This work opened labor and delivery suites to fathers and other support persons chosen by the woman in labor. Klaus and Kennel demonstrated the value of parent-child contact after delivery. Their studies resulted in parents being encouraged to care for their infants even in neonatal intensive care units. Kuebler-Ross documented the stages of grieving, and thus made it possible for physicians to respond intelligently to the reactions of patients facing death.

2. *Objective observation is the final reality in chemical science.* Valid observations form the common experience upon which useful science is built. The observations of Boyle and Lavoisier remain as valid today as they were

centuries ago. The present diagnostic-therapeutic method of medicine recognizes this essential aspect of shared experiences in medical science. Precise clinical observations combined with selected laboratory studies are the basis of diagnostic and therapeutic medicine. These observations will be valid in the future, even as new medical theory appears to reinterpret them.

Theory serves the purpose of organizing and explaining observations in science. There are several levels of theoretical understanding in common use, each of which has its uses and limitations. Descriptive theory serves to document and organize perceptions in a useful form. Descriptive theory may address commonalities of observations, such as the descriptions of the organs in human anatomy. Descriptive theory may also address the uniqueness of a set of observations, such as descriptions of anatomical variations among patients. Most of the emphasis of the biopsychosocial theory is on the latter aspect of observations. Descriptive theory cannot predict the future, however, and thus is useful in diagnosis of medical problems, but not in predicting therapeutic effectiveness.

Correlational theory, used extensively in epidemiology, seeks to document reproducible relationships among observations. These correlations are useful in predicting the occurrence of events in the future, based on knowledge of events in the present. The presence of high blood pressure is correlated with an increased frequency of atherosclerotic heart disease in humans. Thus an individual patient with high blood pressure is more likely to develop atherosclerosis than another individual with normal blood pressure. Correlational theory cannot ascribe causality to its correlations, however, so it cannot be the basis of therapeutic medicine. One cannot say that elevated blood pressure causes atherosclerosis on epidemiological grounds alone.

Causal theory seeks to establish causal relationships between events in the present and events in the future. Destruction of pancreatic beta cells causes insulin deficiency, which causes type I diabetes mellitus. Any agent that destroys these cells, including an autoimmune reaction in idiopathic type I diabetes, streptozocin in experimental diabetes in animals, or a blunt trauma to the abdomen that destroys the pancreas, will invariably cause this disease entity. The intent of medical treatment is to effect a decrease in morbidity or mortality for the patient. Causal theory is essential to demonstrate treatment efficacy and is essential to the practice of modern medicine. Only experimental science is able to establish causal relationships. Thus, experimental science is an essential aspect of any successful model of family medicine.

Frequently causal theory has been taught as the essence of science, especially in physics. Newton's laws, rather than Newton's observations, are remembered as the basis for classical physics. This reification of theory leads to philosophical problems whenever present theory is unable

to account for new observations. Physics experienced a revolution in theory in the beginning of the 20th century with the discovery of the need for a quantum theory to explain the behavior of atomic and subatomic particles. Einstein's commitment to his theoretical stance was so strong that he was never able to accept Heisenberg's uncertainty principle, an important concept in quantum mechanics, since it violated his commitment to absolute determinism in nature. The problems for physics caused by this theoretical crisis are the subject of Kuhn's work.⁵

Family medicine, to be both effective and scientific, should stay with the basic observational, experimental method of the chemist, recognizing both the uses and limitations of theoretical constructs. Family medicine research appears to be following this model in the study of the family as well as the study of disease. Smilkstein,¹⁷ for example, proposed an objective measure of family function that has served as a model for the objective study of the effects of family dysfunction on medical care. This approach has also been used recently to document important aspects of the relationship between family physicians and their patients and families.¹⁸⁻²⁰ Schmidt's recent editorial in this journal²¹ strongly supports this objective approach to the study of these relationships.

3. *There is a fundamental unity of science.* No observation by any scientist may be in conflict with a theory or observation by another scientist, regardless of field. Rutherford's nuclear atom is as valid in chemistry as in physics. The properties of iron in hemoglobin are no different from the properties of iron in steel. Useful theories also are fundamentally in agreement in their explanations of observations. Quantum mechanical equations of motion for small particles become identical to classic Newtonian equations of motion when applied to particles with large masses. No valid observation in biological or psychological science has yet been shown to be in conflict with any valid observation in chemistry or physics.

The unity of scientific medicine is best realized in family medicine, which is the only specialty with enough breadth of experience and interest to be able to see the whole of medical practice. Biochemical, anatomical, psychological, and social observations and studies must all be in basic agreement for appropriate scientific medical care to be given. Biochemical and psychological descriptions of the depressed patient are expected to be congruent, and biochemical and psychological treatment for depression should be assessable by similar methods. Failure to accept the unity of science has led to persistent disagreements among disciplines, which have hindered the progress of understanding and treatment of important problems. Ruane³ states, "For each discipline depression is different, a phenomenon constructed by its own theory." The problem of doing meaningful psychiatric research in this atmosphere of disagreement was the reason for the development

of operational criteria for mental illness, resulting in DSM-III.

Family medicine can become the unifying discipline that looks at the apparent differences among other disciplines and finds a valid resolution of these differences, leading to improved care of the patient as a whole person. This focus will help to solve the problem posed by the separation of biochemical, anatomical, psychological, and social aspects of medical care. Engel was unable to solve this problem using his biopsychosocial model⁶⁻⁸ because he was unable to accept the validity of the biochemical approaches to psychiatric problems. He dismissed biochemical psychiatry as "reductionistic" and less valid than purely psychiatric descriptions. Thus, the biopsychosocial model has received only limited acceptance¹ by members of the medical community for whom the biochemical models of disease and treatment are central to their disciplines.

4. *There is no hierarchy in science.* No level of scientific understanding or endeavor is higher or lower than any other. Mendel's understanding of genetics based on the color of sweet peas is as valid as the Watson and Crick double helix. Mendel's genetics is more useful in directing experiments in animal and plant breeding that underlie modern farming. Watson and Crick are better able to understand the effects of ionizing radiation on the integrity of the genome, and thus explain mutagenesis and carcinogenesis in a useful manner. There is also no hierarchy in academic versus applied science. The developmental chemist at Dow Chemical company is neither higher nor lower in stature than the chemist doing basic research at Harvard.

There should be no hierarchy by discipline in the scientific understanding of human illness or its treatment. Psychiatry, surgery, biochemistry, and medicine all are intrinsically of equal value in understanding and treating illness. The contribution of each discipline to the understanding and treatment of a given patient's problem will be determined by the amount of useful insight each discipline has to offer for solving that problem. Each discipline tends to make itself the most important, however. Cardiologists believe that the heart is the only important organ in the body. Obstetricians focus only on the adult uterus. Engel, focusing on the mind, considers all other forms of understanding "reductionistic" and of less value to his own. The family physician becomes the one who decides on the relative value of the contribution from each to the care of the patient, not allowing any one specialty to become more important than any other. The family physician also has the responsibility to ensure that appropriate scientific standards are applied by all.

The nonhierarchical nature of family medicine applies also to the relation of the academic and community branches of the specialty. Practicing family physicians are neither better nor worse than academic family physicians,

and individuals are at present relatively free to move between community and academic practice. This cooperative attitude is scientifically and academically sound and needs to be nurtured. Such cooperation of equals solves the theory-practice problem of Ruane³ as well as the discipline-specialty problem of Phillips⁴ while maintaining for family practice a central place in both academic and community medicine.

COMMENT

This model solves many of the problems facing family medicine today. The family physician's central place in providing primary care and coordinating secondary care is well defined. The conflict between disease-oriented research and patient-oriented medical care is resolved, maintaining the benefits of both orientations. The problem of using scientific methodology to achieve humanistic goals is resolved. Finally, a method of resolving the conflicts among specialized fields of medical research and practice is presented.

This model also preserves the attributes of modern medicine that have been so successful in improving the health of patients. The diagnostic-therapeutic method of medical research is kept, and its usefulness in understanding psychological and social problems is demonstrated. The patient-oriented values of traditional family medicine have been preserved and their place in modern medicine is well defined. The therapeutic emphasis of modern medicine has been restored to its proper central place in clinical practice.

Family medicine has a bright future as the central coordinating discipline in modern medical practice. If it is to realize this potential, all physicians must be viewed as equals cooperating in the care of patients. The model presented here gives specific guidelines for cooperation among physicians, and thus would seem appropriate for the discipline of family medicine.

Commentary

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In the preceding article, Urberg¹ describes perspectives on the ongoing discussion of the nature and role of family medicine as both a practical science and an academic endeavor. He accurately portrays the reactive, nega-

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tive, or defensive tone of much of the discourse in this area and, as would a good family physician, offers a positive, comforting, and productive solution to the distress evidently afflicting other authors on this topic, using the field

of chemistry as a model for family medicine to emulate. A principal contribution of this analysis is that it provides a convincing model for what most family physicians do both in practice and in research. Other authors have tended to concentrate their attention on the difficult or unusual aspects of family medicine and thus formulate models too broad to be of much use in everyday practice. Paralleling the description by Thomas Kuhn of the working scientist doing "ordinary science," Urberg provides a model for "ordinary family medicine" (ordinary here having no pejorative connotation, but relating to the vast majority of what family physicians do both as practitioners and academicians).

Along with the presentation of this model, Urberg picks up on what might be the most important factor shaping the future of family medicine, a factor that might well have required the invention of family medicine if it had not already existed—the role of the personal family physician in providing the bulk of medical care for the patient and in guiding the patient in obtaining subspecialty medical care. This role, debased and decried as the "gatekeeper function,"² has always been an important element of family medicine and will remain an essential role as medical practice evolves. It represents the best and perhaps the only hope that either reason or justice can be brought to bear on our recklessly extravagant nonsystem of health care.

To accomplish this important synthesis, Urberg has, I believe, glossed over a few issues that are relevant to a comprehensive model for family medicine. The two issues that deserve further consideration are the "basic unity of science" and the relationship between scientific knowledge and the expression of social values. (I should acknowledge here that many of the temperamental characteristics that attract physicians to family medicine express themselves in impatience with the philosophical wallowing and navel gazing inherent in such discussions. This sort of commentary should occupy no greater than its current small place in the central literature of our field.)

IS THERE A BASIC UNITY OF SCIENCE?

It seems clear there is no such basic unity among the variety of fields that are considered sciences. While a number of disciplines from physics to molecular biology share the common paradigm of atomic and molecular theories and what is called scientific method, these models and methods do not transfer in useful ways to such other sciences as psychology, sociology, economics, and anthropology. These latter sciences do not contradict atomic theory, they simply find it irrelevant.

As Sigmund Freud provided us with revolutionary insights into human behavior so compelling that they have become intrinsic parts of our culture and language, he

struggled with the relationship between his ideas and the accepted structure of scientific inquiry. Through much of his career he worked on his "project for a scientific psychology," which attempted to express psychoanalytic discoveries and theories in the then current language of the physical and biological scientists. Freud made little real progress in this area; he never published and ultimately attempted to destroy this aspect of his work. Conversely, psychoanalysts tried over several decades to bridge the gap between clinical medicine based on biological science and psychoanalysis by defining behavioral or personality causes and correlates of, say, asthma, colitis, or hypertension. This endeavor was equally unsuccessful and has been largely abandoned, as such correlations eluded demonstration.

Subsequent formulations of psychologic theory have either ignored this "mind-body" problem or admitted an inability to connect somatic phenomena with psychological theory.³ The *Diagnostic and Statistical Manual of Mental Disorders*⁴ (DSM-III) is intentionally atheoretical. Even at the apparent borderland of neurobiology and behavior, Kandel⁵ was able to describe eloquently the dichotomy between the biological scientist and the psychologist.

The fields of sociology and anthropology claim uniqueness and assert their independence from other sciences by declaring the theories and language of other sciences to be incomplete, irrelevant, or by definition simply "wrong." In a shocking and convincing analysis of the social sciences, the philosopher Alasdair MacIntyre⁶ argues that the social sciences have failed to produce even a single "law like generalization" of the sort that characterizes the physical and biological sciences. Included in his arguments is economics, the most mathematical of the social sciences. The seriousness with which the economic analyst or news anchor explains precisely why the stock market rose or fell each day reflects our need to believe that we can understand the complex human phenomena that have defied attempts at real understanding and predictability.

A unity of science can be achieved by dismissing as science those fields that do not predominantly use physical science models, language, and laws in their everyday practice. To do so, however, leaves us with little ability to understand much of what we experience, as most behavioral and interpersonal and virtually all social phenomena have thus far failed to yield to hard scientific analysis. We would also be left with a single, unopposed source of knowledge of our world.

SCIENCE AND VALUES

At the same time that we fail to appreciate the discontinuities existing among academic fields, we tend to overlook the connection between "scientific knowledge"

and social values and policy. If there is, ultimately, a unity of science, a single appropriate language and method for understanding all experience, how can that knowledge not determine and define our values? A debate on these issues flared over the past decade, with the biologists E.O. Wilson and Stephen Jay Gould championing opposing sides. Wilson,⁷ working to understand behavior and social phenomena in biological terms, argued for a sociobiology. Gould resisted this model as the predominant guiding force of science, persuasively describing the injustice and inhumanity perpetrated in the name of "objective science" in the area of determination of human intelligence and worth.⁸

Wilson and Gould are, of course, both right. Many previously mysterious phenomena have been explained in biological and chemical terms with resultant specific treatment and relief of suffering. Chemical mechanisms have replaced metaphor in explaining and responding to illness. Many human phenomena, however, continue to defy such mechanistic explanations, leaving those committed to only biological science explanations to invent a bewildering variety of "diseases"—chronic fatigue syndrome, myofascial pain syndrome, and systemic yeast infection being only a few notable examples—to account for their (or their patients') distress. Workers in the fields of substance abuse and other behavioral problems straddle the fence. To preclude negative moral judgments, they claim a biological basis for the behaviors that they study and treat, but they would certainly resist a label or stigma of biological inferiority for their subjects, deferring assessments of the value or worth of the substance abuser and psychiatric patient to an ethic and understanding that defies or supersedes biological explanations.

THE SOCIAL ROLES OF THE FAMILY PHYSICIAN

An additional way of exploring the nature of family medicine rests on descriptions of the roles of the family physician in practice. Family physicians bring scientific understanding and effective treatment to a variety of problems. They listen to and provide empathy and support for patients with a variety of problems that resolve, without ever really understanding their cause or meaning or providing any specific treatment. They embrace the role of the personal physician in their self-definition and express ambivalence about this role when it is accompanied by bureaucratic correlates such as the "gatekeeper" issue.

Some portrayals of the role of family physician are less flattering. They are seen as the foot soldiers of a "medical nemesis"⁹ "medicalizing," for their own profit, experiences of everyday life. Other sociologists see family physicians as apologists for an unjust and corrupt social system, supporting the status quo by defining social distress as personal

illness and locating it in the individual. John Sassa, a British general practitioner, described his discomfort with this role by questioning "... how far should one help a patient to accept conditions which are at least as unjust and wrong as the patient is sick?" and "How much right have we to go on being patient on behalf of others?"¹⁰ Consideration of these widely disparate yet not mutually exclusive roles, while outside any single coherent system of scientific analysis, can illuminate many aspects of family physicians' work and their response to that work.

CONCLUSIONS

Family medicine is a humane craft exercised on behalf of patients using models, methods, and skills derived from an array of disparate sources. Family physicians play a role in our social system that brings with it certain responsibilities to patients and to society and that provides them with status, income, and power to be exercised in a variety of ways. Academic family medicine seeks to describe and improve the practitioner function through observation, description, and analysis of that practice, scientific research, and social commentary, and to perpetuate the field through its contributions to the training of future family physicians.

The experiences of the family physician in his or her work are as broad and varied as the human experience itself, defying any unitary model or explanation, but yielding the satisfactions and pleasures of knowledge and human interaction to its prepared and sensitive practitioners.

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