

21ST CENTURY MEDICINE:

*A New Model for Medical
Education and Practice*

“Clinician’s Dilemma”
An excerpt from Chapter 4

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David S. Jones, MD

Laurie Hofmann, MPH

Sheila Quinn



The Central Hub of 21st Century Medicine

The primary principle around which 21st century medicine—functional medicine—will revolve is *personalized, systems medicine*. Grouping people into categories based on organ system diseases, and then prescribing as though all people with a given diagnosis were inherently alike, is beginning to give way to a model that recognizes each patient’s genetic and environmental uniqueness. Clinicians must develop the knowledge and skills to deliver individually tailored care. They must be able (and willing) to incorporate the science of systems biology, the emerging discipline of personalized care, and a much broader array of assessment, therapeutic, and preventive strategies into a new therapeutic relationship.

Each human emerges from a mold that has but one model.^{xii} Uniqueness continues to develop throughout life as a result of myriad influences. Family, school, work, community, diet, exercise, stress, and environmental toxicity all communicate information from outside the organism to the epigenetic translational structures that are married to nuclear DNA and that create powerful downstream effects on the genome, proteome, and metabolome. This phenomenon of biochemical uniqueness was recognized, researched, and documented in the 20th century, and is the foundation from which many key constructs have evolved, including systems biology and systems medicine, prospective health care, patient-centered health care, nutrigenomics, pharmacogenomics, proteomics, and metabolomics/metabonomics (see Chapter 3).

Decision Making in the Face of Uncertainty

From this chaotic, nonlinear interplay of complex factors, involving the integration of both genetics and context of living, emerges the haunting reality that all care is provided in a context of uncertainty. This is the shadow side of modern clinical medicine and it poses a daunting conundrum—how do you structure and systematize the assessment and treatment of patients when each is the product of a multitude of unique genetic and environmental influences and interactions? Kathryn Montgomery in her scholarly book, *How Doctors Think*, directly addresses this challenging issue:

Complexity and uncertainty are built into the physician’s effort to understand the particular in light of general rules.... The obstacle they encounter is the radical uncertainty of clinical practice: not just the incompleteness of medical knowledge but, more important, the imprecision of the application of even the most solid-seeming fact to a particular patient.²⁰⁴

What elevates the importance (and the stress) of clinical care over the work of, for instance, engineers, lawyers, accountants, and other nonclinical professionals is its continuous involvement in matters of life and death. The cost of failure is so high—death, when life might have been possible; illness, when health might have been attainable. The daily unconscious concern of every clinician is the weight of this cumulative decision making—inherently uncertain and lacking full (or sometimes even adequate) information to inform the clinical picture. Dr. Jerome Groopman in his provocative book with the same title, *How Doctors Think*, addressed this issue from his clinical perspective:

^{xii}The potential for human cloning might be considered the exception to this rule. However, exact replication from a clone donor cannot duplicate the pre and post epigenetic imprinting that skews the exactness of a clone.

Uncertainty creeps into medical practice through every pore. Whether a physician is defining a disease, making a diagnosis, selecting a procedure, observing outcomes, assessing probabilities, assigning preferences, or putting it all together, he is walking on very slippery terrain. It is difficult for non-physicians, and for many physicians, to appreciate how complex these tasks are, how poorly we understand them, and how easy it is for honest people to come to different conclusions.²⁰⁵

Personalized, systems medicine serves to inform us about the enormity of the uncertainty. The message is clear: there is no one-size-fits-all solution to resolve any specific diagnosis. The limitations of clinical algorithms and evidence-based medicine can now be more clearly discerned. We can no longer allow them to skew our understanding of the larger picture, however difficult it may be to look at unflinchingly. We are at a crossroads where only honesty about the limitations of strategies that seek to avoid or ignore uncertainty will suffice.

For the great enemy of truth is very often not the lie—deliberate, contrived, and dishonest—but the myth—persistent, persuasive, and unrealistic. Too often we hold fast to the clichés of our forbears. We subject all facts to a prefabricated set of interpretations. We enjoy the comfort of opinion without the discomfort of thought.

—JOHN F. KENNEDY, YALE COMMENCEMENT, 1962

Medicine has attempted historically, through a number of shifts in perspective, to provide greater certainty to both practicing clinicians and patients, a patently valuable goal. Setting aside traditional methods of instilling confidence—oracles or shamans, for example—science has been a very important tool for reducing uncertainty.

Twentieth century medicine completed a great philosophical and practical transformation into the *organ system* model of disease and diagnosis. This provided an evolving and reassuring sense of control and certainty as a result of ever-increasing specialization (often described as knowing more and more about less and less) as well as myriad fascinating scientific breakthroughs in understanding the nature of life, health, and disease. From early x-rays through the sophisticated imaging processes in use today, through ever more complex and detailed biochemical pathways, we have explored the silos of mammalian organ systems taxonomy. Objective facts accreted in uncountable numbers during the 1900s, describing human anatomy, physiology, and mechanisms of dysfunction from the cellular level to the specific organs themselves. The medical specialties (e.g., cardiology, neurology, nephrology) emerged and grew strong from these historic breakthroughs.

Near the end of the 20th century, however, the reality of the web-like, chaotic, nonlinear and complex nature of life (and health)—exposed by advances in the systems-oriented life sciences—began to erode this reassuring sense of certainty. Twenty-first century medicine has now come face-to-face with the practical implications of uncertainty—a problem that flummoxed many mid-20th century physicists (including the great Albert Einstein, who ultimately rejected what is now an accepted principle) when they first confronted Heisenberg's articulation of the principle of uncertainty in physics. Fortunately, once the seriousness of this issue is consciously acknowledged, management strategies can be developed. First, however, we have to stop denying the presence and power of uncertainty in medicine. Research by brain scientists using advanced imaging and electronic technologies and analytic techniques equips the clinician with important knowledge for facing squarely the daunting task of assessing and treating each patient as

a unique individual, shaped by innumerable complex interactions between genetics and the cumulative influences of daily life.

The rest of this chapter will discuss these findings and will describe why the context of uncertainty in medicine requires a change in our view of evidence and the therapeutic relationship, and a considerable expansion in the clinical tool kit of the practitioner. The increasingly technical (and increasingly brief) clinical encounter that has characterized the last few decades in medicine can be transformed into a *healing partnership* through the appropriate integration of relevant evidence from clinical trials, the knowledge gained from breakthroughs in brain science and systems biology, and an expanded clinical armamentarium. Within this complex relational system can be found effective strategies for individualized assessment and treatment, taking into account the uncertainty generated by the complex genetic and environmental uniqueness of each patient—we can, in fact, begin the practice of *personalized, systems medicine* today.^{206, 207}