



Erwin B. Montgomery: *Medical reasoning: the nature and use of medical knowledge*

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The stakes of medical reasoning are high. In 2016, patient safety researchers at Johns Hopkins estimated that over 250,000 deaths per year in the United States are due to medical error, which would make it the third leading cause of death [1]. Medical errors are often the result of poor reasoning; so lives can be saved if medical reasoning is improved. By analyzing medical reasoning, it is possible to identify inferences that do not follow, faulty interpretations of data, and practical wisdom in application. The situations physicians find themselves in often do not admit of certainty. The effectiveness of a treatment is never certain, yet physicians must make decisions and aim to obtain as much certainty as possible. Physicians everywhere strive to speak to patients and their families with a high level of certainty about their best treatment options. So how do they obtain certainty?

Certainty is the central theme of Erwin B. Montgomery's *Medical Reasoning*. In it, he aims "to demonstrate how clinicians ... have deep and perhaps unrealized connections to the fundamental means by which to gain certainty" (p. 2). This fundamental means is reasoning. Montgomery sees the numerous avoidable medical errors as the consequence of poor reasoning (pp. 20, 25). In teaching wards, he has witnessed the confusion of doctors in training when faced with errors in medical reasoning and, after some courses in philosophy and years of experience as a neurologist and professor, he is well-equipped to address this problem.

Montgomery intends his work to present a rigorous analysis of medical reasoning, somewhat analogous to Immanuel Kant's *Critique of Pure Reason* (pp. 204–205). He appropriately notes that the book is not "an exhaustive study of medical knowledge as it is reflected in practice" (p. 3), but rather an exploration of logic in medical practice. The book's timing and purpose make sense if seen as a complement to the rising appreciation for the role of non-analytic processes in medical

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decision-making, such as intuition [2], emotional intelligence [3], and the dual process theory of cognition [4].

Medical Reasoning comprises nineteen fairly independent chapters, which are loosely structured as follows: the book begins by exploring the nature of the problems that face medical reasoning, then proceeds to review how those problems have played out in medical history, and finally concludes by addressing how such problems arise practically when caring for patients. In almost every chapter, Montgomery insightfully punctuates his informative take on the history of medicine and philosophy with real-life clinical problems.

Early in the book, Montgomery casts clinicians as epistemologists who must sort through and evaluate evidence to increase certainty (p. 42). However, clinicians are also required to *act* in the face of uncertainty—an imperative that distinguishes medicine from science (pp. 36–37). For clinicians, accumulating relevant facts is insufficient to make medical decisions. Other factors—such as social, moral, ethical, legal, and political factors—come into play (p. 48).

A primary lesson in *Medical Reasoning* is that “good medical reasoning requires understanding what constitutes judicious use of logical fallacies” (p. 23). This refrain is repeated in almost every chapter. Montgomery believes that ignorance on this point has contributed to the excessive medical errors that persist in the health care system today, claiming that “injurious uses [of logical fallacies] have been the source of woe for all” (p. 23). But I suspect that most readers will not have heard of using logical fallacies in “judicious” or “injurious” ways prior to Montgomery’s exposition. The approach is indeed unique, and Montgomery rightly admits that his is a “different perspective” on logic (p. xv). A clinician’s goal is certainty, and the most certain tool of reasoning available is deductive logic. An example of deductive logic is *modus ponens*: (1) If *a*, then *b*; (2) *a*; (3) therefore, *b*. If the premises, (1) and (2), of the argument are true, then the argument’s conclusion, (3), must be true—which is to say, it is certain. Moreover, if the premises of the argument are true, then the argument is not only valid but also sound. However, a problem with deductive logic is that it produces no new knowledge (p. 3). To obtain new knowledge, clinicians often use logical fallacies. For example, clinicians will reason: (1) If my patient has a given disease, then a given test will be positive; (2) the test is positive; (3) therefore, my patient has the disease. While this argument form resembles *modus ponens*, it is actually the well-known fallacy of affirming the consequent, also known as abduction. The key to good medical reasoning is understanding the level of certainty produced by certain fallacies in context. Montgomery dedicates a chapter to overviewing the basics of logic, in which he explores the use of deduction, abduction, induction, and probability syllogisms in medical examples. This exploration illuminates the use and misuse of logical concepts like the principle of excluded middle, the principle of transitivity, and Mill’s methods, as well as provides examples of the judicious use of fallacies like the fallacy of induction and the fallacy of pseudotransitivity. These concepts recur throughout the remainder of the book.

Another major theme in *Medical Reasoning* is the distinction between the allopathic and empiric approaches to medical reasoning. The heterogeneity of humans in health and disease presents a problem for medical reasoning: should variety be seen as variation from an archetypal form or should each human be seen as ontologically

distinct? The allopathic approach sees variety as variability, which implies variability around a central tendency or archetypal form. Montgomery traces the allopathic approach through Aristotle and Galen (p. 79). Aristotle said, “the physician does not prescribe what is healthy for a single eye, but for all eyes or for a determinate species of eye” (*Posterior Analytics*, 97b.27–28, in [5]). This observation aligns with the allopathic approach: different eyes vary in relation to the archetypal form of an eye or a certain type of eye. Allopaths seek to account for variation via a set of economical explanatory elements because they think there will be generalizable reasons why certain eyes stray from the central tendency. On the other hand, the empiric approach sees variety as diversity; every patient is ontologically distinct. In other words, “each individual patient becomes an *n of 1* experiment in understanding” (p. 23). For the empiric, all humans are not variants of a single archetypal form, but rather each human is her or his own archetype. Today, allopathic medicine reigns supreme and is the leading mode of thought at most medical schools and among most doctors. The empiric approach is represented by homeopathy or alternative medicine. Montgomery explains that the reason for the supremacy of allopathic medicine is not simply that its results were vindicating, but that it won political and strategic battles against the empirics in the nineteenth and twentieth centuries (chs. 6, 11). The 1910 Flexner Report on medical education solidified allopathic medicine’s success in the United States and led to the elimination of many non-allopathic medical schools (p. 76). Montgomery provides an insightful history of this battle between medical traditions and the evolution of medical reasoning more broadly. He also explains how the allopathic approach resonates with Cartesian science, which uses deduction and rationalism, whereas the empiric approach resonates with Baconian science because of its resistance to authority derived from general principles (p. 91).

Medical Reasoning explores the metaphysical and epistemic presuppositions underlying different approaches to medicine. One such presupposition is Aristotle’s notion of contraries. Because allopaths seek economical explanations for variety, they must seek out general principles that explain variety. Contraries are one-dimensional push–pull systems that combine two extremes (p. 82). For example, one can explain every shade of gray in terms of an excess or deficiency of white and black, rather than characterizing each shade of gray on its own terms. Montgomery explains, “Dichotomizing forces and entities achieve a great economization of underlying mechanisms and principles; hence its attraction to ... allopathic physicians” (p. 82). However, the fact is that the reality of human health is more complicated than the notion of contraries allows. For instance, commitment to the simple dynamics of contraries likely bred undue optimism for genetic therapies arising from the Human Genome Project, based on the assumption that genetic disorders were the result of a certain gene’s having a greater or lesser effect on function; the relation between one’s genes and one’s health is now known to be far more complex (pp. 82–83). Nevertheless, in many areas of medicine, speaking in terms of contraries has remained prevalent. The point is that such presuppositions play “an important role in medical science and medical reasoning—whether or not it is recognized” (p. 131).

In chapters 7 and 8, Montgomery explains a problem for allopathic medicine that is highlighted by the rise of evidence-based medicine. The gold standard for

adjudicating medical questions in evidence-based medicine is the randomized controlled trial (RCT). An RCT might establish the mean effect of a treatment for a particular disease, but it is all too easy to mistake the mean for the “real effect” of the treatment (p. 94). Evidence-based medicine is allied with allopathic medicine in seeing variety as variability around a central tendency, so it is common to think that the central tendency has an ontological status of its own. However, sometimes this status implies that the central tendency (i.e., the mean) is “the measure of any individual subject,” which is simply not the case (p. 95). For example, if the mean height in a male population is 5' 10", it cannot be concluded that the norm—the “healthy” height—for a male is 5' 10". In fact, it could be the case that no single male in that population is 5' 10". It is important for clinicians to understand what information the mean conveys because they may need to use that information to make a clinical decision or inform their patient. Consider a patient who has a chronic illness for which there is only one treatment available and for whom any amount of improvement would be valuable. The treatment has several minor negative side effects, and an RCT shows that the mean improvement of the treatment is 50%. The mean alone may not provide enough information to inform a treatment decision: it could be that half of the RCT population experienced zero improvement while the other half experienced full improvement, or it could be that every patient in the RCT experienced 50% improvement. These differences would certainly matter to the patient who values *any* improvement but strongly disvalues the prospect of experiencing negative side effects with *no* improvement. Thus, it is crucial for clinicians to recognize when the mean does not provide sufficient information for their own or their patient's decision-making process. Montgomery discusses helpful ways to present different types of data using mode, quartiles, standard deviation, and so forth in such cases when the mean is not sufficient (pp. 98–107).

In chapters 9, 10, and 13, Montgomery explores hypothesis generation. He thinks that intuition, along with the fallacy of pseudotransitivity, plays a major role in generating hypotheses. Montgomery pushes back against the view that intuition is devoid of rationale, claiming instead that intuition “represents a unique mode of reasoning” (p. 108) and that it “is a logic that is made implicit” (p. 110). As such, intuition can be subject to valuable lessons of logic and probability, such as resistance to testimonials, appreciation of complexity, whole-to-part applications, and so forth (p. 111). Montgomery thinks that intuition can work through metaphor, in the form of the fallacy of pseudotransitivity (if $a \rightarrow b$ and $c \rightarrow b$, then $a \rightarrow c$); via metaphor, intuition can produce a hypothesis that then becomes the first premise of an abduction which shapes further medical evaluation (p. 118). He says, “every time a clinician interpolates or extrapolates findings from any clinical study to an individual patient, the clinician is engaging in metaphor” (p. 160). He provides the following metaphor as a rudimentary example: “my patient is to tremor as Parkinson's disease is to tremor” (p. 119). There are, of course, bad metaphors, and so Montgomery helpfully explains what makes metaphors bad—that is, what constitutes injudicious use of the fallacy of pseudotransitivity.

Medical Reasoning also contains several chapters dedicated to other issues that arise in medical reasoning, like its relationship to medical technology, the problem of irreproducibility, and medical solipsism. Montgomery ends the book by

considering practical medical reasoning—namely, real-time reasoning in specific contexts. He includes a discussion of communication aimed at extracting relevant patient history (p. 218), and he addresses the problem of accountability in medicine, including issues with self-policing and the absence of free market accountability due to a lack of transparency (pp. 223–224).

While *Medical Reasoning* is a valuable and worthwhile addition to the literature, it is not without its weaknesses. Montgomery's conception of "judicious uses of logical fallacies" may be one of these weaknesses. This conception is an odd way to characterize certain types of reasoning and may not be an effective way to introduce logical concepts. Telling readers to use fallacies in the right way indeed sounds contradictory. Instead of calling them logical fallacies, these useful non-deductive argument forms could be characterized as "strong" or "cogent" types of induction, abduction, metaphor, and so forth—as they typically are in logic textbooks (e.g., [6]). This characterization is an intuitive way to convey the same idea, so why reinvent the wheel? Reconceptualizing this point would not detract from Montgomery's objectives in the book but may make his objectives more accessible.

Another weakness of *Medical Reasoning* is that it seems to offer a one-sided approach to medical reasoning—one that is narrowly fixated on logic. Montgomery claims that "logic—when used properly—is the only source of confidence in decision-making" (p. xvi); that the ontology of health and disease necessarily has a logic to it that "can be exploited" (p. 3); and that intuition is actually an implicit logic (p. 110). Though he does admit that there are other factors that influence medical practice that he will not focus on in the book, a full read nevertheless gives the reader the impression that logic is all that is required for good clinical reasoning. As a reader, I would have liked to see Montgomery more clearly situate the role of logic in relation to the role of emotional intelligence and other non-analytic processes. Or if he thinks those processes are implicitly or explicitly logical, I would have liked to see a more robust defense of that view.

As for minor points, *Medical Reasoning* contains a few philosophical mischaracterizations, such as "Aristotle was a ... materialist" (p. 80). There are also several typos—for example, "theist and antithesis" rather than "thesis and antithesis" (p. 82); "knowledge the he sought" rather than "knowledge that he sought" (p. 1); "the epirics" rather than "the empirics" (p. 18); and "seems as odds" rather than "seems at odds" (p. 130). Additionally, it is worth noting that the book reads more like a reference text for philosophers of medicine than an accessible exploration of medical reasoning for the average medical professional or student. That said, I would certainly refer to specific chapters for Montgomery's valuable insights and explanations, such as his chapters on the evolution of medical reasoning and the meaninglessness of the mean.

It is important that clinicians like Montgomery, who are well-versed in both philosophy and medicine, produce works like this book, bridging a gap that is all too common in our compartmentalized world. Ultimately, *Medical Reasoning* should be read by anyone interested in the reasoning behind medical reasoning.

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