Introduction/Preface

Robert L. Trowbridge Jr., MD, FACP
Joseph J. Rencic, MD, FACP
Steven J. Durning, MD, PhD, FACP

Physicians of the 21st century must possess abilities in a considerable number of wide-ranging and disparate domains of practice. Physicians must have a broad and deep knowledge of both basic and clinical sciences. They are required to have robust communication skills, including the ability both to speak the highly technical language of modern medicine and to explain complex and ambiguous concepts to patients. They need both to lead a team and to function within a team. Many must also possess highly developed technical and procedural abilities. Perhaps nothing is more central to the high-level functioning of the physician, however, than clinical reasoning.

Broadly defined, clinical reasoning may include nearly all of the cognitive tasks expected of a physician. Thus, everything from determining the best approach to screening for occult malignancy, to devising a primary disease prevention strategy for an individual patient, to evaluating a symptom or physical sign, to considering the best therapeutic plan for a patient falls within the realm of clinical reasoning. Those who think clinical reasoning cannot be explicitly taught may think the title of this book is presumptuous and that valuable books have been written with the focus on learning rather than teaching clinical reasoning (1). To this we respond that all teachers of medicine teach clinical reasoning whether intentionally or not and have been doing so for millennia. We believe that the theoretical and

empirical knowledge of cognition, education, and expertise have developed to a degree that valuable constructs now exist to guide teachers of clinical reasoning.

❖ Defining Clinical Reasoning

We define clinical reasoning as "the cognitive and noncognitive process by which a health care professional consciously and unconsciously interacts with the patient and environment to collect and interpret patient data, weigh the benefits and risks of actions, and understand patient preferences to determine a working diagnostic and therapeutic management plan whose purpose is to improve a patient's well-being." This definition seeks to incorporate the modern understanding of reasoning, or thinking, as both a conscious and subconscious process that is dramatically affected by physical and environmental factors. It entails establishing both a diagnosis and a treatment plan that is specific to a patient's circumstances and preferences.

❖ The Focus of This Book: Diagnostic Reasoning

For the purposes of the book, however, we have narrowed the focus of clinical reasoning to establishing a diagnosis or *diagnostic reasoning*. We chose to address only diagnostic reasoning for purposes of clarity and focus. This aspect of clinical reasoning includes the processes used in collecting and analyzing the information that contributes to the establishment of a working diagnosis, acknowledging that it is not always practical or even possible to make a diagnosis. A substantial portion of the diagnostic reasoning literature has emerged from the psychology, expertise, and education literature, whereas therapeutic reasoning has traditionally been described in the medical decision-making or decision analysis world with a strong mathematical focus. Many excellent books have been written on this medical decision-making (2), and we did not wish to duplicate them. Although we touch upon therapeutic reasoning and many of the suggestions made can be applied to the teaching of therapeutic reasoning, this book's explicit recommendations relate to the teaching of diagnostic reasoning.

❖ The Purpose and Contents of This Book

This book, written by experts in education, clinical reasoning, and clinical medicine, aims to consolidate current knowledge regarding the teaching and learning of clinical reasoning and to provide guidance on

how to enhance learners' and clinicians' clinical reasoning abilities. We approach this through a variety of lenses and from multiple perspectives. We acknowledge that much remains to be learned about how clinicians reason, how the process may fail, how to assess reasoning, and how best to foster this ability among both novices and experts. Given the current level of understanding, no gold standard for teaching clinical reasoning exists; therefore, the book provides a menu of options from which teachers may choose based on their goals.

The book begins with a general discussion of diagnosis in "Clinical Reasoning and Diagnostic Error." This establishes the importance of clinical reasoning in medicine and argues that teaching clinical reasoning should be central to medical education rather than a passive byproduct of clinical experience. This chapter also details the current rates of diagnostic failure and the impact of diagnostic error in medicine, including a discussion of the many factors that may contribute to suboptimal diagnostic performance.

We believe that understanding current theories of clinical reasoning is an important foundation on which to build. Chapter 2, "Theoretical Concepts to Consider in Providing Clinical Reasoning Instruction," provides this basis, discussing the current knowledge of the clinical reasoning process and how such an understanding can inform instruction in clinical reasoning. It stresses the concept of context specificity, which has important implications for the teaching of clinical reasoning.

Few published clinical reasoning curricula exist in undergraduate or graduate medical education, in part a result of the challenges of clinical reasoning assessment. Much of clinical reasoning teaching relies on the rather haphazard and unstandardized approach of simply providing medical students and residents with clinical experiences under the direction of a more experienced clinician. We believe a more standardized curricular approach is necessary given the recent advances in the science of clinical reasoning, recognizing that guided clinical experience is still the cornerstone of learning clinical reasoning. Chapter 3, "Developing a Curriculum in Clinical Reasoning," outlines several approaches to building a model of clinical reasoning instruction. It discusses the importance of grounding the curriculum in the theories described in the previous chapter and suggests content appropriate for different levels of learners. It additionally addresses several barriers to building a curriculum, including those generally inherent in the process as well as those specific to clinical reasoning.

Cognitive errors occur with remarkable frequency. Chapter 4, "Educational Approaches to Common Cognitive Errors," describes this phenomenon and outlines an approach teachers may take in speaking

to such errors. This discussion highlights the concept of "diagnosing the learner." This "diagnosis" serves as the basis for choosing teaching methods to improve clinical reasoning going forward. Interventions that may be appropriate for specific levels of learners, both experienced and inexperienced, are additionally described.

Clinical reasoning is primarily taught at the bedside in the context of clinical care. Unfortunately, many clinician-educators may lack awareness of the educational techniques that can be used to teach clinical reasoning, even when they are clinical reasoning experts themselves. Chapter 5, "General Teaching Techniques," details many of these techniques, their theoretical basis, and their impact on learning clinical reasoning. The authors describe techniques that may apply to all levels of learners and specifically address the challenges the individual clinician may face in implementing these teaching practices.

The concept of "diagnosing the learner" is again addressed in Chapter 6, "Assessment of Clinical Reasoning." Assessment of the clinical reasoning process remains challenging because of our limited understanding of the process. In the past, assessment of clinical reasoning rested with clinical supervisors who may have evaluated learners solely on the basis of their diagnostic accuracy in a few cases. A more nuanced and detailed understanding of how clinical reasoning works, including the importance of context specificity, however, has led to the development of multiple methods of assessing clinical reasoning in both the classroom and the clinical setting. Although the most valid and reliable means of assessing clinical reasoning remains unclear, some progress has been made. This chapter delineates how a program of assessment many be implemented, as well as the details of the individual components of such a program.

As mentioned previously, many clinician-educators may have advanced clinical reasoning abilities but possess little knowledge of the theory, vocabulary, or tenets that underlie teaching clinical reasoning. To enhance the teaching of clinical reasoning, faculty need to understand the process better, especially as methods of learning and assessment evolve. Chapter 7, "Faculty Development and Dissemination," provides a blueprint for creating a faculty development program, describing practices for engaging the busy clinician-educator. The authors specifically address how these practices may apply to teaching the teachers about clinical reasoning, although the literature on this specific subject is remarkably limited.

In developing the faculty for teaching clinical reasoning, many may be interested in improving their own clinical reasoning yet have no clear means of doing so. Chapter 8, "Lifelong Learning in Clinical Reasoning," describes several approaches that individual clinicians may use to further their own capabilities. These practical techniques, grounded in deliberate

practice, capitalize on many of the clinical opportunities for learning present in day-to-day clinical experience that may be implemented relatively easily.

At the other end of the continuum, struggling learners often fail to develop the expected level of clinical reasoning ability. Educators can be flummoxed on how to approach such learners, especially given that the process of arriving at a diagnosis is often opaque, rendering it difficult to ascertain the exact nature of the leaner's problems. Chapter 9, "Remediation of Clinical Reasoning," builds on the concepts presented in the chapters on cognitive errors and assessment and presents an approach to problems common to the struggling learner. This chapter provides specific suggestions for improving the learner's abilities by using several illustrative cases centered on aspects of clinical reasoning with which learners often struggle.

Although we now better understand how clinicians reason, there is much we do not know about teaching, assessing, and remediating clinical reasoning. Chapter 10, "Innovations and Future Directions," details several intriguing and innovative teaching and assessment strategies, while acknowledging that these methods require further exploration to advance our knowledge of clinical reasoning.

❖ Closing

With this book, we aim to help teachers at all levels of medical education and have attempted to describe teaching techniques that may be most beneficial for learners at differing levels of experience, specifically the preclinical student, the clinical student/resident, and the practicing clinician. Although we frequently refer to "learners," many of the teaching techniques described may be useful for clinicians at all levels of experience, including the seasoned clinician.

We also acknowledge some overlap among the chapters. Although we have strived to avoid unnecessary redundancy, key topics are mentioned several times in multiple chapters with the recognition that many readers may not read this book cover to cover. In view of this, each chapter also includes summative "Take-Home Points," and many of the chapters have practical "Teaching Tips" that emphasize the key content for busy clinician educators. A glossary of common terms is also included at the end of the text. Finally, the online component of the book available at www.acponline.org/teachingbooks contains considerable supplemental content. Included are examples of clinical reasoning curricula, practical teaching tips, the discussed assessment methods, and outlines for faculty development workshops.

Given the progress made in the understanding of clinical reasoning, we believe now is an excellent time to reflect on the current state of affairs and provide practical guidance to those who are required to practice and teach clinical reasoning every day. We recognize that there is likely no single "right" way to teach and learn clinical reasoning, but we hope this book will provide strategies already being used and encourage exploration of new methods in teaching and assessing clinical reasoning.

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Clinical Reasoning and Diagnostic Error

Robert L. Trowbridge Jr., MD, FACP
Mark L. Graber, MD, FACP

Rory Staunton was a 12-year-old boy from New York City who fell ill after sustaining a minor cut diving for a basketball. Just a few days after the seemingly inconsequential arm injury, Rory developed abdominal pain, fever, and vomiting. He was seen by both his pediatrician and emergency department staff, and he and his parents were told he had a common viral infection, which was rampant throughout the community at the time. He was treated supportively with fluids and pain relievers and sent home. Yet Rory had several factors that were discordant with the diagnosis of a viral infection, including abnormal vital signs, "blotchy" skin, and an elevated white blood cell count. The results of the blood test, however, were not available until after his discharge from the emergency department. Within days of release from the emergency department, he died of an overwhelming streptococcal infection (1).

The death of a 12-year-old boy who saw multiple physicians and other health care professionals raises a powerful question: "Why?" Why did all his physicians misdiagnose his infection before its progression to septic shock and death? Why did their clinical reasoning fail them as they attempted to make the diagnosis? At this point, the question, "Why is clinical reasoning important?" can be simply answered, "Because a patient's life may depend upon it." Although this story may seem sensational, morbidity and mortality caused by faulty clinical

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KEY POINTS
- Diagnostic errors are common and result in substantial patient morbidity and mortality.
- Diagnostic errors often have multiple causes, with many having their origins in both systems and cognitive failures.
- Improvement in the clinical reasoning abilities of clinicians has the potential to limit diagnostic error and the harm incurred.

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reasoning are not rare (2). Exploring the complexity of clinical reasoning provides some insight into the causes of such errors.

Indeed, perhaps no task of the practicing physician is more challenging than assigning a clinical diagnosis. The sheer number of diagnostic possibilities alone can make the process difficult for both experienced and novice clinicians; the International Classification of Diseases, 10th Revision, lists more than 12,000 discrete diagnoses, and new diseases are discovered every year (3). The volume of potential diagnoses, however, represents just a small aspect of the complexity of making a diagnosis. Much of the data necessary to make a correct diagnosis, for example, can be difficult to obtain. Taking an efficient and targeted history is a skill that can take years to master. Many of the most important findings on physical examination are technique dependent, such that only those who devote themselves to the craft become skilled enough to put trust in their findings (4, 5). Laboratory and imaging studies can be helpful, but they take time and come with myriad shortcomings. A test that is very useful for one disease, for example, may be near-useless for a closely related disorder. Furthermore, reconciling these multiple sources of data, which are often conflicting, can be tremendously difficult. The clinical examination, for instance, may strongly suggest one disorder, whereas the "confirmatory" imaging study suggests an altogether different process.

Simply integrating all of the above variables into the diagnostic process stretches the limits of human cognition. Making a diagnosis is further complicated by the high stakes of establishing the correct diagnosis because at the core of all this is the patient. Clinicians recognize the consequences a wrong or missed diagnosis can have for an individual and they feel the pressure. Without the correct diagnosis, treatment is uninformed and prognosis is unclear. Furthermore, clinicians may be subject to innumerable biases, unconscious predispositions, or preconceptions that influence thinking as they approach the patient. They may have positive or negative feelings toward specific patients or may be particularly wary of

or sensitive to a certain disease, skewing the objectivity of the diagnostic process (6). All these factors render an already complicated process rife with potential for error and, more important, patient harm.

Given all these challenges, it is remarkable that physicians establish the correct diagnosis at the current level of accuracy, estimated to be in the range of 95% to 98% for physicians in the perceptual specialties (radiology, pathology, and dermatology) and over 85% for primary care specialties (2, 7–9). The question remains, however, can these rates be improved? If the overall error rate in the emergency department, medical and surgical wards, and primary care clinics is 10% to 15%, patients are being harmed from diagnostic error every day in the typical health care organization. Furthermore, the effect of even a single diagnostic error can be devastating, as demonstrated by the Rory Staunton case. With hindsight, it is easy to impugn the care that Staunton received, as may be done with many instances of faulty reasoning. Yet such errors are neither limited to low-performing physicians nor uncommon. All physicians, despite being talented, dedicated, and caring professionals, are subject to faulty reasoning (10, 11).

❖ Rationale for Teaching Clinical Reasoning

Given the centrality of clinical reasoning to the practice of medicine, the inherent difficulty of the reasoning process, and especially the current level of sub-optimal performance, it should be evident that clinical reasoning should be a major focus of medical education. Yet there is a relative dearth of formal instruction on the subject at both the undergraduate and graduate levels of medical education. Traditionally, the accrual of clinical experience under the tutelage of experienced mentors was believed sufficient to achieve competence in clinical reasoning. A shift toward concentrating on developing the critical thinking skills of learners was reflected in the wide adoption of the problem-based learning that occurred in the late 20th century (12–14). This method of education, however, has been largely scaled back because educational outcomes were disappointing (15). These results may have been in part secondary to the concept that achieving excellence in reasoning is context specific (i.e., performance depends on the clinical content as well as the environment and good performance in one situation is not necessarily "transferable" to other situations). Relatively few undergraduate schools have explicit curricula in clinical reasoning or faculty development programs that teach their faculty how to teach and assess clinical reasoning. Graduate medical education programs are similarly lacking in formal instruction in clinical reasoning. The Accreditation Council for Graduate Medical Education, with its shift to the "Milestones"

paradigm, has the potential to shift significant attention to this domain, but these changes have yet to be realized (16).

By extension, and not surprisingly, few continuing medical education opportunities focus on improving the clinical reasoning skills of the practicing clinician. Journal-based clinical problem-solving cases and clinical problem-solving sessions at several national meetings center on this concept, but little else is available (17). This lack of emphasis on the clinical reasoning skills of faculty members clearly affects their ability to teach the subject themselves.

❖ The Case for Improving Clinical Reasoning: Diagnostic Error

To fully understand why the teaching of clinical reasoning is so important, the current limits of diagnostic accuracy, the frequency with which the correct diagnosis is identified in a timely fashion, must be discussed in greater detail. Several different definitions of diagnostic error have been advanced, all with subtle but important differences. The most straightforward definition describes diagnostic error as a situation in which the clinician had at his or her disposal all the information necessary to make the diagnosis but then made the diagnosis later (delayed diagnosis), made a different diagnosis (wrong diagnosis), or missed the diagnosis altogether (missed diagnosis) (7). This definition has the advantage of simplicity, but it requires a "gold standard" and does not take into account patient harm, as many would argue that a diagnostic error with no potential for patient harm is inconsequential. Another definition considers diagnostic error as a missed opportunity in the diagnostic process (18). This occurs when the correct diagnosis could have been made earlier on the basis of information available at the time or, at the very least, further evaluation should have been undertaken given the available information. A third definition views making a diagnosis as a function of a multifaceted and multidisciplinary process and errors as breakdowns anywhere in this complex and interwoven route (19). Each of these definitions have merit and make important distinctions, although all are based on the premise that the correct diagnosis could have been established earlier in the diagnostic process with the potential for improved patient outcomes.

The struggle in defining diagnostic error is mirrored by the difficulty in identifying such errors. Determining the presence of an error is a subjective judgment because the reviewer must ascertain whether the diagnosis "should" have been made (or at least tested for) on the basis of the information available at the time. Most of these errors are identified retrospectively, and such analysis is highly subject to hindsight bias (2). The reviewer usually knows that an error was made or that harm has

occurred, making it difficult to objectively evaluate whether the diagnosis "should" have been made. It is also extraordinarily difficult to retrospectively recreate the true context of patient care in evaluating a diagnostic error. Thus, identifying both the error and the contributory causes is, at best, an inexact and subjective process.

Despite all of the difficulties in evaluating the diagnostic process, the effect of diagnostic errors on the healthcare system is undeniable. Most important, diagnostic breakdowns result in a remarkable degree of patient harm. Diagnostic errors result in an estimated 40,000 to 80,000 deaths annually in the United States alone (20, 21). Data from autopsy studies support the significant scope and effect of these errors, with 5% to 20% of postmortem studies revealing a lethal diagnosis that, had it been recognized and treated antemortem, may have averted patient death (22). Patient safety studies have revealed similar numbers; one showed that 17% of adverse events in hospitalized patients were secondary to diagnostic missteps (23).

Patient satisfaction is also remarkably affected by errors in the diagnostic process. It is extraordinarily difficult for patients to realize they have been undergoing treatment for a disorder they don't actually have or to recognize that a serious diagnosis could have been caught at an earlier and more treatable stage. Clinicians who are involved in diagnostic errors are also subject to psychological harm. Making a diagnosis is central to the physician's role in the care of patients, and accepting mistakes in this realm can be very difficult. This may be particularly true in the more cognitively based specialties, such as internal medicine and pediatrics, where "thinking is the procedure." Finally, despite the recognition that all clinicians make mistakes, recognizing that one's cognitive error resulted in significant patient harm can be devastating to an individual clinician.

The financial impact of diagnostic errors is also unmistakable. At the most basic level, diagnostic errors are cited as one of the top causes of tort claims in multiple patient populations. In fact, claims data show that the payout for diagnostic error exceeds that for surgical and medication errors, each of which has been a major focus of the patient safety movement (24, 25). Malpractice claims, however, represent but a small fraction of the financial cost of diagnostic error. The delayed recognition of serious diagnoses, for example, leads to significantly higher health care costs. A patient who is diagnosed with early-stage colon cancer and cured with surgery, for example, incurs much less cost than if the diagnosis is delayed until after metastases have developed. Furthermore, missed diagnoses may result in unnecessary and costly testing for an alternate diagnosis. A patient may present with clear symptoms of a viral upper respiratory tract infection, for example, but unnecessary testing is subsequently done for pulmonary

embolism, perhaps because the clinician recently missed the diagnosis of pulmonary embolism in another patient and is overly sensitive to doing so again.

❖ Causes of Diagnostic Error

Given the complexity of the diagnostic process, it is not surprising that the causes of diagnostic error are multifactorial and difficult to ascertain. Several different classification schemes have been proposed, but all account for the fact that failures commonly occur at the level of both health care systems and human cognition. In fact, most errors are rooted in multiple causes; a study of errors in the internal medicine population, for example, found an average of 6 contributors to each event (2).

A wide variety of systems issues may result in or contribute to a diagnostic error (2, 7). Issues rooted at the organizational level are very common and often reflect difficulties with communication. A critical laboratory or imaging result, such as an elevated prostate-specific antigen level or abnormal mammogram, for example, may not be communicated to the ordering physician, resulting in an avoidable delay in the diagnosis of cancer. Clinicians may not be aware of critical policies or procedures, such as the need to obtain approval before a specialized laboratory test is run and without which the test is never completed. The balkanization of care between specialists and the inpatient and outpatient settings may also facilitate the loss of critical data when the patient moves from one care setting or clinician to another, resulting in delayed or missed diagnoses.

Organizational issues may also go beyond the realm of communication. The imaging services necessary to make an expedited diagnosis, such as magnetic resonance imaging for potential cord compression from epidural metastatic disease, for example, may not be available off-hours or on weekends, resulting in delays in time-critical diagnoses. Institutionally defined productivity concerns may also be a barrier to clinicians spending the necessary time with patients to obtain the proper history or perform an adequate physical examination. Similarly, external interference may occur, such as the insurance company that requires the completion of an onerous and opaque precertification process before referral to a specialist or an imaging test may be completed.

Less commonly, technical issues may result in diagnostic error. A blood chemistry machine, for example, may misread the serum calcium as normal when it is actually elevated, or a poorly calibrated glucometer may incorrectly show a patient to be hyperglycemic. Similarly, a faulty computed tomography machine may result in poor image quality, obscuring

a diagnostic finding. Such technical failures, however, are much less frequent than organizational issues.

Although such systems-based errors are common, most errors also contain an element of faulty cognition on the part of the clinician. It is likely that improvements in clinical reasoning skill can prevent many such errors. Cognitive errors and their prevention should be a major focus of instruction in clinical reasoning (6, 26). It is also increasingly recognized that expertise in human factor interactions will be needed to understand the interplay between cognitive and systems-based issues. An example is an overwhelmed emergency physician working in a loud and understaffed department who misses the heart murmur in a patient whom he must examine in the hallway because no beds are available. This difficulty, however, should not preclude a careful consideration of how improved skills in clinical reasoning could have prevented such an error.

❖ Differentiation of Teaching Clinical Reasoning and Avoidance of Diagnostic Error

Distinguishing between the promotion of expert performance in clinical reasoning and the avoidance of diagnostic error is a valuable exercise. These concepts significantly overlap, and the differences are, in large part, a result of the differing origins of the two "fields." The academic treatment of clinical reasoning is strongly rooted in the educational, expertise, and psychology literature. These fields have provided the basis for much of our knowledge of the clinical reasoning process. In contrast, the more focused, specific, and relatively new principle of avoidance of diagnostic error has its origins in the patient safety movement. Although diagnostic error was not a focus of the original Institute of Medicine report that spurred international interest in patient safety, appreciation of the importance of diagnostic accuracy has increased dramatically over the past decade (27). The patient safety movement's work in reducing diagnostic error has concentrated on improving systems rather than the performance of the individual clinician, despite explicitly recognizing the critical importance of cognitive processes in diagnosis.

Although distinguishing cognitive from system-based elements simplifies the process of assigning the "root causes" of diagnostic error, this distinction is artificial and oversimplifies the true state of affairs. Many concepts that at first glance seem to involve just the cognitive performance of clinicians actually reside in both worlds. Decision-support resources are illustrative: These tools are a "systems" resource but are used to augment the cognitive processes of deriving an appropriate diagnosis. The distinction between systems and cognitive elements is better reconciled by the

emergence of social cognitive theories, such as situativity and human factors research, both of which emphasize the impact of patient and environmental factors on clinician performance (28, 29). Thus, as advances in both fields continue, the distinction between the two will probably continue to diminish, perhaps completely. Even issues traditionally considered "systems issues," such as the erroneous reporting of a laboratory result on the basis of machine malfunction or the lack of availability of specialty testing in resource-poor settings, may be addressed in an expanded model of clinical reasoning, such as social cognitive theories.

❖ Barriers to Teaching Clinical Reasoning

Despite the centrality of clinical reasoning and avoidance of diagnostic error to the practice of medicine, there are significant barriers to incorporating explicit discussion of clinical reasoning into the curriculum of both graduate and undergraduate medical education. Primary among these barriers is lack of curricular time. Traditionally medical education has centered on the dissemination of facts, the sheer volume of which has expanded logarithmically over the past several decades. Competing with this conventional priority is the shift toward developing physician skills in multiple other domains that have not been considered in traditional curricula. Influential calls for expanding the skill sets of physicians have been made, with remarkable effect on medical education, as initiatives in shared decision-making, palliative care, geriatric care, and global health have all been advanced and championed over the past 10 years (30, 31). The addition of formal instruction in clinical reasoning will need to compete with these and other emerging educational priorities.

Another major barrier to the addition of clinical reasoning to the formal curriculum is a lack of consensus regarding the best means of teaching the ability to reason (14, 32). Despite the growth in interest in "how doctors think" and the progress reflected in the psychology, expertise, and educational literature, there has been relatively little rigorous investigation into how to effectively teach clinical reasoning. The beneficial effect of clinical experience and deliberate practice under the guidance of coaches and mentors, however, is clear and represents the means by which most practicing clinicians, at least in part, have acquired their own reasoning ability (14). Some thus argue that explicit instruction is not necessary and that it is sufficient to simply provide the opportunity for budding clinicians to obtain their "10,000 hours of experience" under the tutelage of experienced clinicians. Yet this argument ignores the random nature of experience, the lack of time for reflection-on-action, and the noncognitive and at

times menial nature of much of a learner's or trainee's first "10,000 hours" of work, all of which lessen clinical reasoning development.

Even if we imagine that educational techniques proven to improve clinical reasoning are developed, the lack of faculty expertise in teaching clinical reasoning remains a significant barrier (33). Most faculty are not well versed in cognitive psychology and the nomenclature of the diagnostic process. Teaching the teachers how to teach a subject in which they themselves received little formal training may be challenging. This particular challenge may go beyond educators' inexperience with the underlying theory. Clinician-educators may resist teaching a subject closely tied to evidence-based medicine, a domain that has been derided as "cookbook medicine" and lacking a basis in the "art of medicine."

A final barrier to instituting more formal clinical reasoning instruction is the lack of clear means of assessing both the effectiveness of this instruction and the performance of the learners themselves (34). No gold standard exists for the assessment of the clinical reasoning process, and assessing only outcomes (e.g., diagnostic accuracy) limits the ability to provide feedback to the learner. Furthermore, because performance in clinical reasoning is context-specific, it is difficult to ascertain the overall clinical reasoning of an individual without extensive sampling in multiple contexts. Without robust assessment methods, it is difficult to provide feedback on performance to both programs and individuals. This clearly has important implications for educators as they try to devise and implement programs and techniques in clinical reasoning.

❖ The Future of Diagnosis

With the increasing recognition of the complexity of the diagnostic process and the limitations of human cognition, the way we view the diagnostic process may change significantly (19). Emphasis on the role of the clinical team in diagnosis will probably increase, with more specific and tangible participation of the patient in the process. There may be a shift away from the "master diagnostician" model and a movement toward clinicians as experts in integrating their clinical acumen with input from others and clinical support systems (35). Experience with atypical presentations of illnesses and uncommon diseases may be taught through simulation, replacing years of actual practice. Global health care costs and the development of even more sophisticated and expensive diagnostics will also force physicians to carefully consider the diagnostic evaluation and the best means of safely and efficiently establishing a diagnosis. These potential changes, however, far from mitigate the importance of an individual clinician being

an expert in clinical reasoning. If anything, the individual clinician must be even more of an expert in how to reason clinically given the remarkable increase in available data and information.

Current training programs are focused appropriately on competency—acquiring a broad knowledge base, learning the art of the physical examination, and synthesizing information to derive appropriate diagnostic considerations. But competency is not enough; the quest to improve clinical reasoning demands that we also produce well-calibrated physicians who know when to slow down, ask for help, or defer making a diagnosis if need be.

At its most fundamental level, medicine is a conversation and a relationship between patient and clinician. Although systems changes and diagnostic aids are likely to effect improvements in diagnostic reliability, a clinician's ability to obtain the information at hand and reason through to a correct diagnosis will remain fundamental in defining what it means to be a clinician. It is the clear responsibility of medical educators to teach and nurture this ability among learners.

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