

10 - 10 Diagnosis- Reducing Errors and Improving Quality

10 Diagnosis: Reducing Errors and Improving Quality

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Diagnosis: Reducing

Errors and Improving

Quality PART 1 The Profession of Medicine Diagnosing patients' illnesses is the essence of medicine. Patients present to doctors seeking an answer to the question, "What is wrong with me?" Ideally, no clinician would want to treat a patient without knowing the diagnosis or, worse yet, erroneously treat a misdiagnosed illness. From the earliest moments of medical school, the defining quest toward becoming a knowledgeable and proficient physician is learning how to put a diagnostic label on patients' symptoms and physical findings, and clinicians pride themselves on being "good diagnosticians." Yet the centuries-old paradigm of mastering a long list of diseases, understanding their pathophysiology, and knowing the cardinal ways they manifest themselves in signs and symptoms, while still of fundamental importance, is being challenged by new insights illuminated by the glaring spotlight of diagnostic errors. Basic internal medicine diseases, such as asthma, pulmonary embolism, congestive heart failure, seizures, strokes, ruptured aneurysms, depression, and cancer, are misdiagnosed at shockingly high rates, often with 20-50% of patients either being mislabeled as having these conditions (false-positive diagnoses) or having their diagnosis missed or delayed (false negatives). How and why do physicians so often get it wrong, and what can we do to both diagnose and treat the problem of delayed diagnosis or misdiagnosis? Diagnosis is both an ancient art and a modern science. The current science of diagnosis, however, goes far beyond what typically comes to clinicians' and patients' minds when they conjure up images of state-of-the-art molecular, genetic, or imaging technologies. Improvements in diagnosis are just as likely to come from other areas, many with origins outside of medicine, as they are from advanced diagnostic testing modalities. These diverse sciences that the field of diagnostic safety has, and must, draw from include systems and human factors engineering, reliability science, cognitive psychology, decision sciences, forensic science, clinical epidemiology, health services research, decision analysis, network medicine, learning health systems theory, medical sociology,

team dynamics and communication, risk assessment and communication, information and knowledge management, and health information technology, especially artificial intelligence and clinical decision support. A clinician reading this chapter is likely to find this list of overlapping and intersecting domains quite daunting. However, rather than feeling overwhelmed, we urge readers to view them as the basic science supports that will ultimately make their lives easier and diagnosis more accurate and timely. Rather than feeling intimidated, clinicians should feel a sense of relief and assurance in understanding that good diagnosis does not rest entirely on their shoulders. Instead, it is a systems property, where an infrastructure and a team, one that especially includes the patient, can in a coordinated way work together to achieve more reliable and optimal diagnosis. ■ ■EMERGENCE OF DIAGNOSIS ERROR AS AN IMPORTANT PATIENT SAFETY ISSUE Over the past two decades, a series of studies culminating in a landmark report from the U.S. National Academy of Medicine (NAM), *Improving Diagnosis in Health Care*, have shone a spotlight on diagnostic errors. Reports from patient surveys, malpractice claims, and safety organizations have found that diagnostic errors are the leading type of medical error. Although errors in diagnosis can be defined in various ways, the NAM Committee defined diagnostic error as “the failure to (a) establish an accurate and timely explanation of the patient’s health problem(s) or (b) communicate that explanation to the patient.”* *Source: National Academies of Sciences, Engineering, and Medicine. 2015. *Improving Diagnosis in Health Care*. <https://doi.org/10.17226/21794>. Adapted and reproduced with permission from the National Academy of Sciences, Courtesy of the National Academies Press, Washington, D.C.

Adverse Outcomes Diagnostic Process Failures Delayed, Missed, or Wrong Diagnosis FIGURE 10-1 What is a diagnosis error? (Adapted from GD Schiff et al: *Diagnosing diagnosis errors: Lessons from a multi-institutional collaborative project*, in *Advances in Patient Safety: from Research to Implementation*. Vol. 2 Concepts and Methodology, Rockville, MD, 2005, pp. 255-278, and GD Schiff, L Leape: *Acad Med* 87:135, 2012.) One way to visualize diagnostic errors is through a Venn diagram

(Fig. 10-1), which illustrates the fact that many things can go wrong in the diagnostic process (e.g., failure to ask an important history question, physical examination sign overlooked, laboratory specimen erroneously switched between two patients, x-ray not followed up), but this usually does not result in a wrong diagnosis or patient harm. Similarly, a patient can be misdiagnosed but unharmed, without any identifiable error in the care received. Our greatest concern is where these three circles intersect, with conservative estimates suggesting that 40,000–80,000 patients die each year in U.S. hospitals alone from diagnostic errors. The NAM report outlined eight recommendations that are the foundation for this chapter (Table 10-1). ■ ■NEW WAYS TO THINK ABOUT DIAGNOSIS AND DIAGNOSTIC ERRORS Medical textbooks have historically given attention to “clinician reasoning” and associated cognitive heuristics and biases. Errors in clinical reasoning can be summarized in three broad groups: (1) hasty judgments, (2) biased judgments, and (3) inaccurate probability estimates. Research from cognitive psychology has identified scores of common mental shortcuts or “heuristics” humans are prone to use in everyday life, many of which are useful for efficient diagnosis but can also lead to biases and errors. Table 10-2 lists some of the common cognitive biases that can lead diagnosis astray (this topic is discussed further in Chap. 4). TABLE 10-1 National Academy of Medicine Recommendations for Improving Diagnosis in Health Care

1. Facilitate more effective teamwork in the diagnostic process among health care professionals, patients, and their families.
 2. Enhance professional education and training in the diagnostic process in areas such as clinical reasoning; teamwork; communication with patients, families, and other health care professionals; and appropriate use of diagnostic tests.
 3. Ensure that health information technologies support patients and health care professionals in the diagnostic process.
 4. Develop and deploy approaches to identify, learn from, and reduce diagnostic errors and near misses in clinical practice including providing systematic feedback on diagnostic performance.
 5. Establish a work system and culture that supports the diagnostic process and improvements in diagnostic performance.
 6. Develop a reporting environment and medical liability system that facilitates improved diagnosis by learning from diagnostic errors and near misses.
 7. Design a payment and care delivery environment that supports the diagnostic process.
 8. Provide dedicated funding for research on the diagnostic process and diagnostic errors.
- Source: National Academies of Sciences, Engineering, and Medicine. 2015. Improving Diagnosis in Health Care. <https://doi.org/10.17226/21794>. Adapted and reproduced with permission from the National Academy of Sciences, Courtesy of the National Academies Press, Washington, D.C.

TABLE 10-2 Selected Cognitive Biases Contributing to Diagnostic Errors

1. Premature closure: accepting a diagnosis before it has been fully verified
2. Anchoring: tendency to fixate on a specific symptom or piece of information early in the diagnostic process with subsequent failure to appropriately adjust
3. Confirmation bias: tendency to look for confirming evidence to support one's diagnostic hypothesis, rather than disconfirming evidence to refute it
4. Search satisficing: tendency to call off a search, satisfied once a piece of data or presumed explanation is found, and not considering/searching for additional findings or diagnoses
5. Availability bias: tendency to give too much weight to diagnoses that come more readily to mind (e.g., recent dramatic case)
6. Base-rate neglect: failing to adequately take into account prevalence of a particular disease (e.g., erroneously interpreting a positive test as indicating disease in a low-prevalence population using a test with 5% false-positive rate)
7. Knowledge deficit (on part of provider, with accompanying lack of awareness)
8. Framing bias: judgement overly influenced by the way the problem was presented (how it was framed in words, settings, or situations)
9. Social/demographic/stereotype bias: biases from personal or cultural beliefs about women, historically marginalized populations such as African Americans, people with differing sexual identities, or other patient groups for whom prejudices may distort diagnostic assessment. However, clinicians will also benefit from having a better understanding of diagnosis as a "system" rather than just what takes place in clinicians' minds. Classic teaching exhorting trainees and practicing physicians to have a broad differential and "high index of suspicion" for various diseases is challenged not only by these

unconscious biases but also by limitations of human memory, information shortfalls, constrained encounter time, system process failures, and the myriad nonspecific symptoms that patients bring to clinicians. Many symptoms are self-limited, defy a precise diagnosis or etiology, and do not portend harmful outcomes. Insights from safety and cognitive sciences call for rethinking traditional approaches to diagnosis and suggest new approaches to overcome current limitations (Table 10-3).

TABLE 10-3 New Models for Conceptualizing Diagnosis and Diagnosis Improvement

TRADITIONAL WAYS OF THINKING ABOUT DIAGNOSIS AND DIAGNOSTIC ERROR	NEW PARADIGMS/BETTER WAYS TO THINK ABOUT DIAGNOSIS AND IMPROVING DIAGNOSIS
General	A good diagnostician gets it right the first time, almost all of the time
Diagnosis is an inexact science with inherent uncertainties	Goal is to minimize errors and delays via more reliable systems and follow-up
Lore of masterful/skillful academic expert diagnostician who knows/recalls everything; need to look to them if seeking diagnostic excellence	Less reliance on (fallible) human memory
Quality diagnosis is based on well-coordinated distributed network/team of people and reliable processes	All patients entitled to receive quality diagnosis, regardless of where and from whom they receive care
Diagnosis is the doctor's job	Co-production of diagnosis among clinicians (including lab, radiology, specialists, nurses, social workers) and, especially, the patient and family
Patients often viewed as overly anxious, exaggerating, time-consuming, questioning, with sometimes unreasonable demands and expectations	Patients are key allies in diagnosis; hold key information
Need to address understandable/legitimate fears, desires for explanations	Leveraging patient questions and questioning of diagnosis to stimulate rethinking the diagnosis where needed
Diagnosis and treatment as separate stages in patient care (i.e., make a diagnosis, then treat)	Prioritizing diagnostic efforts to target treatable conditions
More integrated strategies and timing for testing and treatment depending on urgency for treatment	Clinical practices
Order lots of tests to avoid missing diagnoses	Judicious ordering: targeted, well-organized data and testing
Appreciation of test limitations (false positives or negatives, incidental findings, overdiagnosis, test risks) and resulting harms	More referrals to avoid missing rarer/specialized diagnoses; concomitant utilization barriers (copays, prior authorization) to minimize overuse
"Pull systems" to lower barriers and make it easier to pose questions, obtain real-time virtual consults	Co-management approaches to enable collaborative watch-and-wait conservative strategies where appropriate
Frequent empirical drug trials when uncertain of diagnosis	Conservative use of drugs to avoid confusing clinical picture or labeling patients with diseases they may not have
Physician attention/efforts to ensure disease screening	Automating, delegating clerical functions; teamwork to free up physician cognitive time

■ ■ **UNCERTAINTY IN DIAGNOSIS** Given variations in ways patients present, illnesses evolve, and tests performed, it is often not possible or practical to "make" a definitive diagnosis, particularly in the primary care setting early in the course of a patient's illness. Clinicians need to harness these uncertainties to both have enhanced situational awareness of where things can go wrong and create safety nets to protect patients against harms from delayed diagnosis and misdiagnosis. Terms such as preliminary diagnosis, working diagnosis, differential diagnosis, deferred diagnosis, undiagnosed illness, diagnoses with uncertain or multifactorial etiologies, intermittent diagnoses, multiple/dual diagnoses, self-diagnosis, or at times contested diagnosis need to be part of our vocabulary, thinking, and communications with patients to convey that diagnosis is often

imprecise. Anxious patients worried about a condition, for example, cancer, COVID-19 infection, or a diagnosis to which a relative or a friend has recently succumbed, come seeking reassurance and may not welcome an uncertain answer. Thus, we have to work with patients, listen to and respect their concerns, and take their symptoms seriously yet modestly acknowledge our limitations. We need to tailor this approach to patients' differing levels of health literacy, trust in our clinical advice, and experiences with the health system.

CHAPTER 10 Diagnosis: Reducing Errors and Improving Quality

■ ■DON'T MISS DIAGNOSES AND RED FLAGS Uncertainty should not be a license for complacency. Particularly for diseases that (1) progress rapidly, (2) require specific treatments that depend on making the correct diagnosis, or (3) have public health or contagion implications, clinicians need to be poised, and systems designed, to consider and, where appropriate, pursue critical "don't miss" diagnoses. While clinicians are generally aware of more common "don't miss" diagnoses (e.g., acute myocardial infarction, sepsis), Table 10-4 illustrates examples of less common diagnoses that warrant similar consideration. Throughout this textbook, readers should orient themselves to recognize such critical diagnoses and think about presentations and syndromes where they may be lurking. An important related concept is so-called "red flags" or "alarm symptoms." This construct has its origins in guidelines for back pain but has increasingly been applied to many other problems, such as headache, red eye, swollen joint, or even abdominal pain and chest (Continued)

TABLE 10-3 New Models for Conceptualizing Diagnosis and Diagnosis Improvement

TRADITIONAL WAYS OF THINKING ABOUT DIAGNOSIS AND DIAGNOSTIC ERROR	NEW PARADIGMS/BETTER WAYS TO THINK ABOUT DIAGNOSIS AND IMPROVING DIAGNOSIS
Diagnosis errors and challenges	Diagnosis errors and challenges
Diagnostic error viewed as a personal failing	Errors classified as either "system" or "cognitive"
Many errors/delays rooted in processes and system design/failures	Errors multifactorial with interwoven, interacting, and inseparable cognitive and system factors
PART 1 The Profession of Medicine	Errors are infrequent; hit-and-miss ways to learn about errors
Errors are common;	systematic proactive follow-up is needed to recognize potential for errors
Surveilling of high-risk situations and one's own diagnostic performance and outcomes	Clinicians' reactions: denial, defensive, others to blame, pointing to others also making similar errors
Culture of actively and nondefensively seeking to uncover, dig deep to learn from, and share errors and lessons	Dreading complex, frustrating diagnostic dilemmas
Welcoming/enjoying intellectual/professional challenges	Adequate support (time, help, consultations) for more complex patients
Diagnoses as distinct labels, events	Diagnoses can be indistinct, interacting comorbidities, socially constructed, multifactorial, evolving over time, or have overlapping genotype-phenotype expressions
Documentation/communication	Viewed as time-consuming, mindless, primarily to document for billing code and/or bulwark against malpractice claims
Documentation as useful tool for reflecting, crafting, sharing assessments, differential diagnosis, reflecting about unanswered questions	Opportunities for decision support interacting with computer
Notes open for patients to read to help understand and critique diagnosis	Say and write as little as possible about uncertainties, lest it be used against you in malpractice allegation
Share uncertainties to maximize communication and engagement with other caregivers, patients	Don't let patient know about errors so they don't become angry, mistrustful, or sue
Patients have right to honest disclosure; often find out about errors anyway (e.g., cancer evolves); anticipate, engage their concerns	Patients advised to call if not better; no news is good news (test results: "We'll call if anything is abnormal.")
Systematic proactive follow-up to close loop on all tests and any worrisome symptoms, to check how patient is	

doing, monitor outcomes Global remedies Knowing/memorizing more medical knowledge Knowing more about the patient (including psychosocial, past history, environmental contexts) Attention to the “objective” data (physical exam, tests) to reliably make diagnoses Renewed emphasis on history, history-taking, listening Acknowledgment of ubiquitous subjective cognitive biases; efforts to anticipate, recognize, counteract Exhortations to have “high index of suspicion” of various diagnoses Less reliance on memory recall of lectures/reading; more just-in-time info look-up Affordances, alerts to red flags engineered into workflow Delineation of “don’t miss” diagnoses with design of context-relevant decision support reminders Ensuring physician is copied on everything, thorough/ voluminous notes, widespread reminders/alerts Biggest problem no longer lack of access to information, but rather information overload; strategies to organize, minimize Continuing medical education (CME) courses to expand medical knowledge Real-time, context-aware reminders of pitfalls, critical differential diagnoses, and key differentiating features. Ready access to medical references, second opinions Redundancies, double-checks Recognition that single, highly reliable systems are often better than multiple halfway solutions Clear delineation of responsibilities for follow-up tasks Fear of malpractice suits to motivate physicians to be more careful and practice defensive medicine Drive out fear, make it safe to learn from and share errors Shared situational awareness of where pitfalls lurk More accountability, financial incentives, and penalties tied to performance metrics Clinician engagement in improvement based on trust, collaboration, professionalism, financial neutrality Metric modesty, recognizing many best practices yet to be defined/proven More rules, requirements; target outlier physicians for better compliance Standardization with flexibility; learning from deviations More time with patients Better time spent with patients: offloading distractions, more efficient history collection/organization, longitudinal continuity, and, where needed, additional time to talk/think/explain during, before, or after visits Easier access for patients to reach or be seen by clinicians when experiencing concerning symptoms Reflex changes in response to errors Avoiding “tampering,” which entails understanding/diagnosing difference between “special cause” versus “common cause” (random) variation Source: Modified from GD Schiff: Quality and Safety in Health Care 2013. pain. Examples of widely cited red flags for back pain that should trigger consideration of more serious etiologies include fever, weight loss, history of malignancy or intravenous drug use, or neurologic signs and symptoms. In theory, many presenting syndromes could benefit from identification of such clues to more serious diagnoses. Evidence-based medicine calls for better data on the sensitivity, specificity, yield, and discriminatory ability of various clinical “red flag” clues; yet few have been rigorously evaluated. Nonetheless, clinicians find them useful as simple ways to reassure themselves and their patients that a common symptom such as back pain or headache is, or is not, likely an indicator of more urgent or serious pathology. Interwoven with the challenges of not missing critical diagnoses is the problem of overtesting and overdiagnosis—performing

(Continued) unnecessary and even potentially harmful tests whose benefit does not justify the risks or costs or that may lead to diagnoses that would have never caused any symptoms or problems. Diagnosticians need to weigh carefully this “other side of the coin” of missed diagnosis to avoid such harms and expenses. Thus, being more conservative in diagnostic testing should not be primarily about conserving resources, but more an approach for ensuring laboratory or imaging studies truly benefit patients, while minimizing short- and longer-term harms. ■ ■DIAGNOSTIC PITFALLS One of the important ways of learning in medicine is learning from the missteps of those who have walked the path ahead of us. By learning about commonly missed diagnoses and the ways accurate, timely

TABLE 10-4 Examples of “Don’t Miss” Diagnoses METABOLIC/ HEMATOLOGIC/ ENVIRONMENTAL INFECTIONS/ INFLAMMATION CARDIAC/ISCHEMIC/ BLEEDING Spinal epidural abscess Aortic dissection Leaking/ruptured abdominal aortic aneurysm Diabetes ketoacidosis Hyperosmolar hyperglycemia Necrotizing fasciitis Pericardial tamponade Myxedema/ thyrotoxicosis Meningitis Wolff-Parkinson-White Prolonged QT Addison’s disease Endocarditis Pulmonary embolism B12 deficiency anemia Peritonsillar abscess Tension pneumothorax von Willebrand’s disease Tuberculosis-active pulmonary, other Acute mesenteric ischemia Sigmoid volvulus Hemochromatosis COVID-19 infection Esophageal, bowel perforation Celiac sprue Guillain-Barré syndrome Cerebellar hemorrhage Carbon monoxide, lead, pesticide poisoning Ebola infection Spinal cord compression Food poisoning Temporal arteritis Testicular, ovarian torsion Malignant hyperthermia Rhabdomyolysis Ectopic pregnancy Alcohol, benzodiazepine, barbiturate withdrawal Angioedema Retroperitoneal hemorrhage Tumor lysis syndrome Hypo-/hypercalcemia diagnosis

went astray, we can avoid making similar mistakes. Anticipating the potential for similar types of errors can both create situational awareness of traps to avoid and contribute to learning from our own personal and collective patterns of mistakes. Several studies have examined common or recurring pitfalls in diagnosis. An example of a common disease-specific diagnostic pitfall in breast cancer diagnosis is ordering a mammogram for a woman with a palpable breast lump and, when the mammogram returns as normal, reassuring her that cancer has been “ruled out” by the negative test. Any unexplained mass or lesion palpable on physical examination needs assessment including further testing and biopsy, where warranted. Diagnostic pitfalls can be classified into a number of generic scenarios (Table 10-5). We now have large databases that have the potential to track “diagnoses outcomes”— i.e., whether a new diagnosis emerges that suggests an initial diagnosis was incorrect or a diagnosis of a patient’s symptoms was suboptimally delayed. This should, in the future, allow us to more rigorously focus on these cases, to identify contributing factors and recurring patterns, and to help point the way for systemwide improvement strategies.

■ ■DIAGNOSIS SAFETY CULTURE Just as diagnosing bacterial infections relies on a proper culture medium to grow and identify etiologic organisms, good diagnosis also requires a healthy safety culture that will allow it to grow and flourish. While clinicians may be inclined to view “safety culture” as something too subjective to be important in their quest to make a definitive diagnosis, this view is misguided. Multiple studies have demonstrated adverse consequences resulting from organizational cultures that inhibit openness, learning, and sharing and create a climate where staff and patients are afraid to speak up when they observe problems or have questions. Most importantly, patients need to be encouraged to question diagnoses and be heard, particularly when they are not responding to treatment as expected or developing symptoms that are either not consistent with the diagnosis or represent possible red flags for other diagnoses or complications. Studies examining “high-reliability organizations” outside of medicine and “learning health care organizations” have distilled a series of fundamental properties that are correlated with more reliable and safer outcomes. Just as a thermometer or recording of a pulse can suggest how ill a patient is, we now have instruments that can measure safety culture.

TABLE 10-5 Generic Types of Diagnostic Pitfalls PITFALL EXAMPLES • Aortic dissection misdiagnosed as Disease A mistaken for disease B Diseases often mistaken/misdiagnosed with each other acute myocardial infarction • Bipolar disorder misdiagnosed as CHAPTER 10 depression • Breast lump dismissed after Misinterpretation of test result(s) False-positive or false-negative results with failure to recognize test limitations negative mammogram • Negative COVID-19 test early or late in course Diagnosis: Reducing Errors and Improving Quality

- Apathetic hyperthyroidism
- Sepsis in elderly patient who is Failure to recognize atypical presentation, signs, and symptoms afebrile or hypothermic
- Compartment syndrome
- Pericardial tamponade
- Tension pneumothorax Failure to assess appropriately the urgency of diagnosis Urgency of the clinical situation was not appreciated and/or delays critical diagnoses
- “Lucid interval” in traumatic Perils of intermittent symptoms or misleading evolution Intermittent symptoms dismissed due to normal findings (exam, lab, electrocardiogram) when initially seen
- Epidural hematoma
- Paroxysmal arrhythmias
- Intermittent hydrocephalus (Bruns’ syndrome)
- Empiric treatment with steroids, Confusion arising from response/ masking by empiric treatment
- Proton pump inhibitors, antibiotics, pain medication erroneously masking serious diagnosis
- Septic joint signs misattributed to Chronic disease or comorbidity presumed to account for new symptoms Especially in medically complex patients chronic rheumatoid arthritis
- Mental status change due to infection or medication misattributed to underlying dementia
- Many; fortunately, by definition, Rare diagnosis: failure to consider or know rare, but still warrant consideration especially if urgent or treatable
- Ventricular arrhythmia related to Drug or environmental factor not considered/overlooked Underlying etiology causing/ contributing to symptoms, or disease progression not sought, uncovered QT-prolonging drug
- Achilles tendon rupture related to quinolone
- Family history of breast, colorectal Failure to appreciate risk factors for particular disease cancer not solicited and/or weighed in diagnostic evaluation or screening
- Overweighing absence of Failure to appreciate limitations of physical exam Now with ↑ telemedicine, missing physical exam entirely tenderness, swelling in deep vein thrombosis
- Missing pill-rolling tremor during telemedicine visit

These safety measurement tools typically are validated staff surveys that assess (1) communication about errors with staff willingness to report mistakes because they do not feel these mistakes are held against them; (2) openness and encouragement to talk about hospital/office problems; (3) existence of a learning culture that seeks to learn from errors and improve based on lessons learned; (4) leadership commitment to safety, prioritizing safety over production speed and the “bottom line” by providing adequate staffing and resources to operate safely; and (5) accountability and transparency for following up safety events and concerns. Each of these generic culture attributes translates into specific implications for diagnostic safety. These include the following:

- Making it “safe” for clinicians to admit and share diagnostic errors
- Proactive identification, ownership, and accountability regarding error-prone diagnostic workflow processes (particularly around test results, referrals, and patient follow-up)
- Leadership making diagnosis improvement a top priority based on recognition that patients and malpractice insurers report that diagnostic errors are the leading patient safety problem

- Mutual trust and respect for challenges that clinicians often face in

making diagnoses and caution in applying the lens of hindsight bias in judging what in retrospect might seem like an “obvious” diagnosis that a clinician initially missed. ■ ■HEALTH INFORMATION TECHNOLOGY AND THE FUTURE OF DIAGNOSIS Clinicians now spend more time interacting with computers than they do interacting with patients. This is especially true for diagnosis and will likely be even more so in the future. Interactions with patients, consultants, and other staff are increasingly mediated through the computer. Key activities, such as collecting patients’ history (past and current), interpreting data to make a diagnosis, conveying diagnostic assessments (to others on the team and, increasingly, to the patient via open notes), and tracking diagnostic trajectories as they evolve over time, are now computer based. With the rise of telemedicine, even elements of the physical examination have been rerouted to electronic encounters, with important

implications for diagnostic safety. PART 1 The Profession of Medicine While many complain the computer has “gotten in the way” of good diagnosis, distracting clinicians from quality time listening to patients and miring doctors in reading and writing notes filled with copied/ pasted/templated information of questionable currency and accuracy, medicine needs to harness the computer’s capabilities to improve diagnosis (Table 10-6). Although supporting these basic diagnosis capabilities should be the foundation of health information technology and everyday workflows, electronic medical records have historically been largely designed around other needs, such as ordering medications, billing, and documentation to guard against malpractice claims. They instead need to be redesigned radically to better support diagnostic processes, as well as save clinicians time. With the rise of generative artificial intelligence large language learning models, many are looking to the computer to take over the job of making diagnoses, answering patients’ diagnostic questions, or resolving diagnostic dilemmas. However, despite its significant capabilities for image and data analysis, pattern recognition, creating clinical notes, and decision support including generating differential diagnoses, there are fundamental limitations, challenges, and unanswered questions related to data accuracy and how to incorporate human relational elements into AI-driven diagnostic processes. ■ ■

DIAGNOSIS OF DIAGNOSIS ERRORS AND SAFETY: PRACTICAL CONCLUSIONS In practice, there are frequent and meaningful opportunities for improving diagnosis in each of the three NAM-defined areas to make it (1) more reliable and (2) timely, and (3) to improve diagnosis-related communication with patients. Clinicians in training, practicing physicians, nurses, and others should develop the habit of regularly asking themselves three questions about individual patients in their care, and another three questions regarding the systems in which they work. For each patient being assessed, clinicians should ask:

1. What else might this be? (forcing a differential diagnosis to be made)
2. What doesn’t fit? (making sure unexplained abnormal findings are not dismissed)
3. What critical diagnoses are important not to miss? (injecting consideration of “don’t miss” diagnoses, red flags, and known pitfalls) And to diagnose safely, each practitioner must recognize that they are working within a larger system. Questions to be asking continually, ensuring we are maximizing reliability and timeliness and minimizing potential for errors, include:
4. Do we have reliable “closed loop” systems to provide reliable, ideally automated tracking and following up of patients’ symptoms, abnormal laboratory or imaging findings, and critical referrals that we order?
5. What is the culture-of-safety climate in our organization, office, or clinic?
6. How does the electronic (or even paper) medical record as currently implemented help versus impair efficient, timely, accurate, and failsafe diagnosis, and how can it be improved? The challenge will be to take these questions to the next developmental stage in order to ensure diagnostic errors are recognized both in individual patients as well as prioritized for systemic changes in

TABLE 10-6 Areas Where Health Information Technology Has Potential to Help Improve Diagnosis and Reduce Errors

FUNCTION EXAMPLES

- Facilitate collection/ gathering of information
- Quickly access past history from prior care at same and outside institutions
- Electronic collection of history of present illness, review of systems, and social determinant risks in advance of visits
- Enhanced information entry, organization, and display
- Visually enhanced flowsheets showing trends, relationships to treatment
- Reorganized notes to facilitate summarization and

simplification and prevent items from getting lost
Generating differential diagnosis • Automated creation of lists of diagnoses to consider based on patient's symptoms, demographics, risks • ChatGPT augmenting physician's diagnostic considerations
Weighing diagnoses likelihoods • Tools to assist in calculation of posttest (Bayesian) probabilities
Aids for formulating diagnostic plan, intelligent test ordering • Entering a diagnostic consideration (e.g., celiac disease, pheochromocytoma) and computer suggests most appropriate diagnostic test(s) and how to order
Access to diagnostic reference information • Info-buttons instantly linking symptom- or diagnosis-relevant questions to Harrison's, Up-toDate chapters, references
Ensuring more reliable follow-up • Hardwiring "closed loops" to ensure abnormal labs, missed referrals, worrisome symptoms are tracked and followed up
Support screening for early detection • Collaborative tools that patients, clinicians, and offices can use to know when due, order and track screening based on individualized demographics, risk factors, prior tests
Collaborative diagnosis; access to specialist • Real-time posing/answering of questions • Electronic consults; virtual co-management
Facilitating feedback on diagnoses • Feeding back new diagnoses (from downstream providers, patients) that emerge suggesting potential misdiagnosis/errors to clinicians, emergency rooms that saw patient previously
Source: Modified from G Schiff, DW Bates: N Engl J Med 362:1066, 2010, and R El-Karah et al: BMJ Qual Saf Suppl 2:ii40, 2013. medicine. In the decade following the ground-breaking National Academy of Medicine report there have been a host of quality improvement and research efforts to better understand the epidemiology, causes, and ways to prevent diagnostic errors. While these efforts have had mixed success, they have enhanced understanding of where, how, and why things go wrong. Transforming diagnostic safety culture, ensuring reliable follow-up and feedback, learning from diagnostic errors, leveraging health IT, and more deeply partnering with patients will be essential elements for highest quality diagnosis in the future. ■ ■ FURTHER READING Moore Foundation: Viewpoint series aims to broaden understanding of diagnostic excellence. [https://www.moore.org/article-detail?](https://www.moore.org/article-detail?newsUrlName=viewpoint-series-aims-to-broaden-understanding-of-diagnostic-excellence)

[newsUrlName=viewpoint-series-aims-to-broaden-understanding-of-](https://www.moore.org/article-detail?newsUrlName=viewpoint-series-aims-to-broaden-understanding-of-diagnostic-excellence)

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