A 1957 study of diagnostic errors starts with this sentence: "The cornerstone of internal medicine is correctness of diagnosis." This concept readily extends to most physician specialties. Without the correct diagnosis, our advice to patients will lack accuracy about treatment possibilities and prognosis. Because correct diagnosis has such importance, medical education should stress diagnostic excellence as a key goal.

Brush and colleagues discuss one aspect of diagnostic excellence: probability revision. Medical students revise probabilities at a better rate than chance alone. Brush and colleagues found that students who received specific training on posttest probability revision performed slightly better on a paper task than those who learned about some disease manifestations, but all moved toward the correct posttest probability.

Diagnostic reasoning is a dynamic, multidimensional activity of gathering and analyzing information. The data collection begins with a history and examination and often involves laboratory testing, imaging, and invasive testing. Unfortunately, errors in this process are prevalent. An Institute of Medicine report, "Improving Diagnosis in Health Care," recognized diagnostic errors as a major cause of preventable patient harm. Many additional factors unrelated to an individual clinician's diagnostic performance contribute to this issue, but the pursuit of diagnostic excellence is necessary for our patients' benefit.

The challenge becomes evident as one considers all the steps involved in making correct diagnoses. The process starts with taking the patient's history, during which many diagnoses may become evident or substantial progress in narrowing our differential diagnosis is made.

History taking is a more complex art than initially meets the eye, requiring broad knowledge of typical and atypical manifestations of a myriad of diseases. For example, when a patient has a chief concern of diarrhea, one must first characterize the bowel movements. Not all patients having diarrhea as a chief concern have stools that meet the technical definition of diarrhea. As we work to understand the patient's presenting symptoms, their duration, and associated symptoms, we are (at least implicitly) matching the patient's story with our illness scripts, akin to the processing that occurs when key words are entered into a search engine (eg, "best high intensity interval training class in DC"). As we ask questions, we are trying to develop a reasonable differential diagnosis for the patient's symptoms. While we do not often assign numeric probabilities to this ever-changing list of possible causes, we repeatedly prioritize our differential diagnosis in the form of iterative hypothesis testing as new data are collected. Importantly, this process involves first the probability of a diagnosis but also considers the morbidity of potential diagnoses. That is, we consider a low-probability diagnosis because missing that diagnosis could have severe consequences.

After taking the history, we look for physical findings that might help us refine our differential diagnosis. However, there are occasions in which history taking is delayed and/or guided by the initial inspection of the patient—sick vs not sick. For example, a patient with hypoxia gasping for air prioritizes stabilization over history taking. Depending on the history, we may focus more attention on certain aspects of the physical examination (ie, hypothesis-driven examination). Examining the patient can help us adjust our working differential diagnosis. Importantly, the diagnostic path is not a 1-way street; our examination sometimes will prompt further history. For example, 1 of us (R.M.C.) admitted a patient with chest pain. The initial differential diagnosis prioritized cardiovascular causes such as acute coronary syndrome and pulmonary embolism. The examination revealed right upper...
quadrant tenderness. This prompted obtaining further history regarding the right upper quadrant pain (eg, associated fevers), which ultimately led to the diagnosis of hepatic abscess.

At this point, we have approximate pretest probabilities (again, often implicit rather than explicit). We often can focus our test ordering to help refine these probabilities. But this decision represents the most challenging step for clinicians. We are not usually good at assigning pretest probabilities. If we lack accuracy here, then even perfect probability revision will result in inaccurate posttest probabilities.

Each time we get a test result, we have the opportunity to reassess our probabilities, but we rarely do. We do note that the probability of several diagnoses has increased while that of others has decreased. Some tests make a diagnosis likely enough to initiate treatment. For example, auscultation of a pericardial friction rub in a patient with chest pain is highly specific for acute pericarditis and should prompt treatment. Potentially morbid diagnoses are often treated as we await further testing even if they have a very low probability initially. For example, a patient with extensive coronary artery disease who presents with atypical chest pain should be given 325 mg of aspirin before troponin levels return.

Often, we initiate treatment before we establish diagnostic certainty and use the patient's response to therapy as an additional diagnostic test. This return to the history—that is, the ailment that brought the patient to care—affords the opportunity to complete the diagnostic circle; a lack of response should cause us to reconsider our working diagnosis. For example, a persistent fever on day 5 of antibiotics for a patient with presumed community-acquired pneumonia raises concern for an alternative diagnosis.

Understanding the general concept of probability revision can help us make better diagnostic decisions. But the diagnostic process has great complexity, and no single skill will make us better diagnosticians.

Medical education requires exposure to patients. In the words of Sir William Osler, “to study the phenomena of disease without books is to sail an uncharted sea, but to study books without patients is not to go to sea at all.”

Patients teach us how diseases manifest. As we have these experiences, we should supplement them with targeted learning. Clinician educators should help our learners refine their skills at history taking and clinical reasoning. We need to teach our learners about the value of testing. Rarely do we need precise probabilities; rather, we should understand when a test would change our treatment or lead to further invasive testing. The principles of probability revision are but one tool in our diagnostic toolbox. Expertise requires the ability to use all the tools.

ARTICLE INFORMATION
Open Access: This is an open access article distributed under the terms of the CC-BY License. © 2019 Centor RM et al. JAMA Network Open.

Corresponding Author: Robert M. Centor, MD, Division of General Internal Medicine, University of Alabama at Birmingham, FOT 720, 1530 Third Ave S, Birmingham, AL 35294-3407 (rcentor@uabmc.edu).

Author Affiliations: Division of General Internal Medicine, School of Medicine, University of Alabama at Birmingham (Centor); Department of Medicine, University of California, San Francisco (Geha); Medical Service, San Francisco VA Medical Center, San Francisco, California (Geha, Manesh); Division of General Internal Medicine, Johns Hopkins University, Baltimore, Maryland (Manesh).

Conflict of Interest Disclosures: None reported.

REFERENCES


