Although rapid, pattern recognition used without sufficient reflection can result in *premature closure*: mistakenly concluding that one already knows the correct diagnosis and therefore failing to complete the data collection that would demonstrate the lack of fit of the initial pattern selected. For example, a 45-year-old man presents with a 3-week history of a "flulike" upper respiratory infection (URI) including symptoms of dyspnea and a productive cough. On the basis of the presenting complaints, the clinician uses a "URI assessment form" to improve the quality and efficiency of care by standardizing the information gathered. After quickly acquiring the requisite structured examination components and noting in particular the absence of fever and a clear chest examination, the physician prescribes medication for acute bronchitis and sends the patient home with the reassurance that his illness was not serious. Following a sleepless night with significant dyspnea, the patient develops nausea and vomiting and collapses. He presents to the emergency department in cardiac arrest and is unable to be resuscitated. His autopsy shows a posterior wall myocardial infarction and a fresh thrombus in an atherosclerotic right coronary artery. What went wrong? The clinician had decided, based on the patient's appearance, even before starting the history, that the patient's complaints were not serious. Therefore, he felt confident that he could perform an abbreviated and focused examination by using the URI assessment protocol rather than considering the broader range of possibilities and performing appropriate tests to confirm or refute his initial hypotheses. In particular, by concentrating on the URI, the clinician failed to elicit the full dyspnea history, which would have suggested a far more serious disorder, and he neglected to search for other symptoms that could have directed him to the correct diagnosis.

Heuristics, also referred to as cognitive shortcuts or rules of thumb, are simplifying decision strategies that ignore part of the data available so as to provide an efficient path to the desired judgment. They are generally part of the intuitive system tools. Two major research programs have come to different conclusions about the value of heuristics in clinical judgment. The "heuristics and biases" program focused on understanding how heuristics in problem solving could be biased by testing the numerical intuition of psychology undergraduates against the rules of statistics. In contrast, the "fast and frugal heuristics" research program explored how and when decision makers' reliance on simple heuristics can produce good decisions. Although many heuristics have relevance to clinical reasoning, only four will be mentioned here.

When assessing a particular patient, clinicians often weigh the similarity of that patient's symptoms, signs, and risk factors against those of their mental representations of the diagnostic hypotheses being considered. In other words, among the diagnostic possibilities, clinicians identify the diagnosis for which the patient appears to be a representative example. Analogous to pattern recognition, this cognitive shortcut is called the *representativeness heuristic*. However, physicians using the representativeness heuristic can reach erroneous conclusions if they fail to consider the underlying prevalence (i.e., the prior, or pretest, probabilities) of the two competing diagnoses that could explain the patient's symptoms. Consider a patient with hypertension and headache, palpitations, and diaphoresis. Inexperienced clinicians might judge pheochromocytoma to be quite likely based on the representativeness heuristic with this classic symptom triad suggesting pheochromocytoma. Doing so would be incorrect given that other causes of hypertension are much more common than pheochromocytoma, and this triad of symptoms can occur in patients who do not have pheochromocytoma. Less experience with a particular diagnosis and with the breadth of presentations (e.g., diseases that affect multiple organ systems such as sarcoid) may also lead to errors.

A second commonly used cognitive shortcut, the *availability heuristic*, involves judgments based of how easily prior similar cases or outcomes can be brought to mind. For example, an experienced clinician may recall 20 elderly patients seen over the last few years who presented with painless dyspnea of acute onset and were found to have acute myocardial infarction (MI). A novice clinician may spend valuable time seeking a pulmonary cause for the symptoms before considering and then confirming the cardiac diagnosis. In this situation, the patient's clinical pattern does not fit the most common pattern of acute MI, but experience with this atypical presentation, along with the ability to recall it, directs the physician to the diagnosis.

Errors with the availability heuristic arise from several sources of recall bias. Rare catastrophes are likely to be remembered with a clarity and force disproportionate to their likelihood for future diagnosis—for example, a patient with a sore throat eventually found to have leukemia or a young athlete with leg pain eventually found to have a sarcoma—and those publicized in the media or that are recent experiences are, of course, easier to recall and therefore more influential on clinical judgments.

The third commonly used cognitive shortcut, the *anchoring heuristic* (also called conservatism or stickiness), involves estimating a probability of disease (the anchor) and then insufficiently adjusting that probability up or down (compared with Bayes' rule) when interpreting new data about the patient, i.e., sticking to their initial diagnosis. For example, a clinician may still judge the probability of coronary artery disease (CAD) to be high after a negative exercise thallium test and proceed to cardiac catheterization (see "Measures of Disease Probability and Bayes' Rule," below).

The fourth heuristic states that clinicians should use the simplest explanation possible that will account adequately for the patient's symptoms or findings (Occam's razor or, alternatively, the *simplicity heuristic*). Although this is an attractive and often used principle, it is important to remember that no biologic basis for it exists. Errors from the simplicity heuristic include premature closure leading to the neglect of unexplained significant symptoms or findings.

Even experienced physicians use analytic reasoning processes (System 2) when the problem they face is recognized to be complex or to involve important unfamiliar elements or features. In such situations, clinicians proceed much more methodically in what has been referred to as the hypothetico-deductive model of reasoning. From the outset, expert clinicians working analytically generate, refine, and discard diagnostic hypotheses. The hypotheses drive questions asked during history taking and may change based on the working hypotheses of the moment. Even the physical examination is focused by the working hypotheses. Is the spleen enlarged? How big is the liver? Is it tender? Are there any palpable masses or nodules? Each question must be answered (with the exclusion of all other inputs) before the examiner can move on to the next specific question. Each diagnostic hypothesis provides testable predictions and sets a context for the next question or step to follow. For example, if the enlarged and quite tender liver felt on physical examination is due to acute hepatitis (the hypothesis), certain specific liver function tests should be markedly elevated (the prediction). If the tests come back normal, the hypothesis may have to be discarded or substantially modified.

Negative findings often are neglected but are as important as positive ones because they often reduce the likelihood of the diagnostic hypotheses under consideration. Chest discomfort that is not provoked or worsened by exertion in an active patient reduces the likelihood that chronic ischemic heart disease is the underlying cause. The absence of a resting tachycardia and thyroid gland enlargement reduces the likelihood of hyperthyroidism in a patient with paroxysmal atrial fibrillation.

The acuity of a patient's illness may override considerations of prevalence and the other issues described above. "Diagnostic imperatives" recognize the significance of relatively rare but potentially catastrophic diagnoses if undiagnosed and untreated. For example, clinicians are taught to consider aortic dissection routinely as a possible cause of acute severe chest discomfort. Even though the typical history of dissection differs from that of MI, dissection is far less prevalent, so diagnosing dissection remains challenging unless it is explicitly and routinely considered as a diagnostic imperative **(Chap. 301)**. If the clinician fails to elicit any of the characteristic features of dissection by history and finds equivalent blood pressures in both arms and no pulse deficits, he may feel comfortable discarding the aortic dissection hypothesis. If, however, the chest x-ray shows a possible widened mediastinum, the hypothesis may be reinstated and an appropriate