I'm not a bot

For other uses, see Diagnosis (disambiguation).Diagnosis (pl.: diagnoses) is the identification of the nature and cause of a certain phenomenon. Diagnosis is used in a lot of different disciplines, with variations in the use of logic, analytics, and experience, to determine "cause and effect". In systems engineering and computer science, it is typically used to determine the causes of symptoms, mitigations, and solutions.[1]Bayesian networkComplex event processingDiagnosis (artificial intelligence)Event correlationFault managementFault tree analysisGrey problemRPR problem diagnosisRemote diagnosticsRoot cause analysisTroubleshootingUnified Diagnostic ServicesBayesian probabilityBlock Hackam's dictumOccam's razorRegression diagnosticsSutton's lawA piece of paper with a medical diagnosis on itMedical diagnosisMolecular diagnosticsCDR computerized assessment systemComputer-aided diagnosisDifferential diagnosisRetrospective diagnosisDELTA (taxonomy)DXplainList of diagnostic classification and rating scales used in psychiatryOrganizational diagnosticsFive whysEight disciplines problem solvingFault detection and isolationProblem solving^ "A Guide to Fault Detection and Diagnosis". gregstanleyandassociates.com. The dictionary definition of diagnosis at WiktionaryThis set index article includes a list of related items that share the same name (or similar names). If an internal link incorrectly led you here, you may wish to change the link to point directly to the intended article.Retrieved from " Tayyaba Rehman Updated on May 6, 2024Diagnosis is the singular form meaning the identification of a disease or condition; diagnoses is its plural, indicating multiple identified conditions.Diagnosis is a term used predominantly in the medical field. It refers to the identification of an illness or disorder based on its signs and symptoms. Diagnoses, on the other hand, is the plural form of diagnosis. This means that when there are multiple identifications of different illnesses or conditions in one or more individuals, the term used is diagnoses.In the realm of clinical settings, it's common for a patient to undergo a series of tests. Once the results are in, the doctor arrives at a conclusion known as a diagnosis. If the same patient has multiple issues identified, or if several patients have their conditions identified during a medical camp or session, the doctor would have made several diagnoses.Diagnosis doesn't solely pertain to medical conditions. It can also be applied to situations in which an analysis is being conducted to determine the root cause of a particular problem. Diagnoses, in a similar context, would refer to multiple determinations or analyses made over a range of problems or issues.For someone unfamiliar with medical or analytical jargon, it might be challenging to discern between diagnosis and diagnoses. However, understanding that diagnosis pertains to a single identification, and diagnoses relates to multiple identifications, simplifies the distinction.One might wonder why the distinction is crucial. In documentation or clinical records, accuracy is paramount. Recording an incorrect number of diagnosis (singular vs. plural) could lead to misinformation and subsequent errors in treatment or analysis. Thus, understanding the difference between diagnosis and diagnoses is essential for clarity and precision.One identified condition or problemMultiple identified conditions or problemsOften preceded by "a" or "the"Rarely preceded by "a" or "the"When talking about one specific conditionWhen discussing multiple conditions simultaneouslyThe diagnosis of the patient was pneumonia.The diagnoses for several patients were varied.Identification of a disease or condition based on its signs and symptoms.Her diagnosis was confirmed after the lab tests.Plural of diagnosis, indicating multiple determinations.The doctor provided three possible diagnoses for her symptoms.Diagnosis is the identification of the nature and cause of a certain phenomenon. Diagnosis is used in many different disciplines, with variations in the use of logic, analytics, and experience, to determine "cause and effect".The act or process of identifying or determining the nature and cause of a disease or injury through evaluation of patient history, examination, and review of laboratory data.A conclusion or decision reached through analysis.The engineer's diagnosis of the system failure was a faulty circuit.Several identifications of diseases based on their signs and symptoms.The health camp resulted in various diagnoses, from flu to diabetes.The art or act of identifying a disease from its signs.His expertise in diagnosis is renowned in the medical community.Multiple conclusions or decisions arrived at through analysis.The team's diagnoses of the system's issues varied.The cause or origin of a problem or situation.The diagnosis of the financial downturn was excessive corporate debt.The opinion derived from such an evaluation.The act or process of identifying or determining the nature and cause of a disease or injury through evaluation of patient history, examination, and review of laboratory data.A critical analysis of the nature of something.Critical perception or scrutiny; judgment based on such scrutiny; esp., perception of, or judgment concerning, motives and character.The quick eye for effects, the clear diagnosis of men's minds, and the love of epigram.My diagnosis of his character proved correct.The conclusion reached by such analysis.The art or act of recognizing the presence of disease from its signs or symptoms, and deciding as to its character; also, the decision arrived at.A range of statements or conclusions about several observed phenomena.The therapist had several diagnoses for the diverse cases presented.Scientific determination of any kind; the concise description of characterization of a species.(Biology) A brief description of the distinguishing characteristics of an organism, as for taxonomic classification.The identification of the nature and cause of something (of any nature).To distinguish or identify (a disease, for example) by diagnosis.A statement or conclusion concerning the nature of an observed phenomenon.The psychologist's diagnosis explained the reasons for the child's behavior.To identify (a person) as having a particular disease or condition by means of a diagnosis.The conclusion reached by such analysis.To analyze the nature or cause ofDiagnose the reasons for an economic downturn.(Biology) A brief description of the distinguishing characteristics of an organism, as for taxonomic classification.Multiple recognized origins or causes of problems.His diagnoses of the company's problems were spot-on.(taxonomy) A written description of a species or other taxon serving to distinguish that species from all others; especially a description written and published in Latin.Hence, the act or process of identifying the nature or cause of some phenomenon, especially the abnormal behavior of an animal or artifactual device; as, diagnosis of a vibration in an automobile; diagnosis of the failure of a sales campaign; diagnosis of a computer malfunction.Identifying the nature or cause of some phenomenonThe opinion derived from such an evaluation.A critical analysis of the nature of something.(medicine) The identification of the nature and cause of an illness.Diagnosis refers to the identification of a disease, condition, or problem based on its signs, symptoms, and other relevant information.While commonly used in medical contexts, diagnosis can also be applied in other areas, like determining the root cause of technical or mechanical problems.No, diagnoses is plural and should be used when discussing multiple identified illnesses or problems.Differentiating is especially vital in medical documentation or any context where precision and clarity are paramount.Diagnoses is the plural form of diagnosis, denoting multiple instances of identifying diseases, conditions, or problems.Yes, a patient can have multiple conditions or illnesses identified, resulting in multiple diagnoses.No, diagnosis is pronounced as "dai-ug-NOH-sis," while diagnoses is "dai-ug-NOH-seez."No, both words are primarily used as nouns. The verb form would be "diagnose" (e.g., "The doctor will diagnose the condition").The word diagnosis originates from the Greek word "diagnsis," meaning "a distinguishing."Remember that diagnosis refers to a single identification, while diagnoses denotes multiple identifications.Border vs. BoarderOpera vs. OratorioTayyaba Rehman is a distinguished writer, currently serving as a primary contributor to askdifference.com. As a researcher in semantics and etymology, Tayyaba's passion for the complexity of languages and their distinctions has found a perfect home on the platform. Tayyaba delves into the intricacies of language, distinguishing between commonly confused words and phrases, thereby providing clarity for readers worldwide. This chapter provides an overview of diagnosis in health care, including the committee's conceptual model of the diagnostic process and a review of clinical reasoning. Diagnosis has important implications for patient care, research, and policy. Diagnosis has been described as both a process and a classification scheme, or a pre-existing set of categories agreed upon by the medical profession to designate a specific condition (Jutel, 2009).1 When a diagnosis is accurate and made in a timely manner, a patient has the best opportunity for a positive health outcome because clinical decision making will be tailored to a correct understanding of the patient's health problem (Holmboe and Durning, 2014). In addition, public policy decisions are often influenced by diagnostic information, such as setting payment policies, resource allocation decisions, and research priorities (Jutel, 2009; Rosenberg, 2002; WHO, 2012).The chapter describes important considerations in the diagnostic process, such as the roles of diagnostic uncertainty and time. It also highlights the mounting complexity of health care, due to the ever-increasing options for diagnostic testing2 and treatment, the rapidly rising levels of biomedical and clinical evidence to inform clinical practice, and the frequent comorbidities among patients due to the aging of the population (IOM, 2008, 2013b). The rising complexity of health care and the sheer volume of advances, coupled with clinician time constraints and cognitive limitations, have outstripped human capacity to apply this new knowledge. To help manage this complexity, the chapter concludes with a discussion of the role of clinical practice guidelines in informing decision making in the diagnostic process.To help frame and organize its work, the committee developed a conceptual model to illustrate the diagnostic process (see Figure 2-1). The committee concluded that the diagnostic process is a complex, patient-centered, collaborative activity that involves information gathering and clinical reasoning with the goal of determining a patient's health problem. This process occurs over time, within the context of a larger health care work system that influences the diagnostic process (see Box 2-1). The committee's depiction of the diagnostic process draws on an adaptation of a decision-making model that describes the cyclical process of information gathering, information integration and interpretation, and forming a working diagnosis (Parasuraman et al., 2000; Sarter, 2014).The diagnostic process proceeds as follows: First, a patient experiences a health problem. The patient is likely the first person to consider his or her symptoms and may choose at this point to engage with the health care system. Once a patient seeks health care, there is an iterative process of information gathering, information integration and interpretation, and determining a working diagnosis. Performing a clinical history and interview, conducting a physical exam, performing diagnostic testing, and referring or consulting with other clinicians are all ways of accumulating information that may be relevant to understanding a patient's health problem. The information-gathering approaches can be employed at different times, and diagnostic information can be obtained in different orders. The continuous process of information gathering, integration, and interpretation involves hypothesis generation and updating prior probabilities as more information is learned. Communication among health care professionals, the patient, and the patient's family members is critical in this cycle of information gathering, integration, and interpretation.The working diagnosis may be either a list of potential diagnoses (a differential diagnosis) or a single potential diagnosis. Typically, clinicians will consider more than one diagnostic hypothesis or possibility as an explanation of the patient's symptoms and will refine this list as further information is obtained in the diagnostic process. The working diagnosis should be shared with the patient, including an explanation of the degree of uncertainty associated with a working diagnosis. Each time there is a revision to the working diagnosis, this information should be communicated to the patient. As the diagnostic process proceeds, a fairly broad list of potential diagnoses may be narrowed into fewer potential options, a process referred to as diagnostic modification and refinement (Kassirer et al., 2010). As the list becomes narrowed to one or two possibilities, diagnostic refinement of the working diagnosis becomes diagnostic verification, in which the lead diagnosis is checked for its adequacy in explaining the signs and symptoms, its coherency with the patient's context (physiology, risk factors), and whether a single diagnosis is appropriate. When considering invasive or risky diagnostic testing or treatment options, the diagnostic verification step is particularly important so that a patient is not exposed to these risks without a reasonable chance that the testing or treatment options will be informative and will likely improve patient outcomes.Throughout the diagnostic process, there is an ongoing assessment of whether sufficient information has been collected. If the diagnostic team members are not satisfied that the necessary information has been collected to explain the patient's health problem or that the information available is not consistent with a diagnosis, then the process of information gathering, information integration and interpretation, and developing a working diagnosis continues. When the diagnostic team members judge that they have arrived at an accurate and timely explanation of the patient's health problem, they communicate that explanation to the patient as the diagnosis.It is important to note that clinicians do not need to obtain diagnostic certainty prior to initiating treatment; the goal of information gathering in the diagnostic process is to reduce diagnostic uncertainty enough to make optimal decisions for subsequent care (Kassirer, 1989; see section on diagnostic uncertainty). In addition, the provision of treatment can also inform and refine a working diagnosis, which is indicated by the feedback loop from treatment into the information-gathering step of the diagnostic process. This also illustrates the need for clinicians to diagnose health problems that may arise during treatment.The committee identified four types of information-gathering activities in the diagnostic process: taking a clinical history and interview; performing a physical exam; obtaining diagnostic testing; and sending a patient for referrals or consultations. The diagnostic process is intended to be broadly applicable, including the provision of mental health care. These information-gathering processes are discussed in further detail below.Acquiring a clinical history and interviewing a patient provides important information for determining a diagnosis and also establishes a solid foundation for the relationship between a clinician and the patient. A common maxim in medicine attributed to William Osler is: Just listen to your patient, he is telling you the diagnosis (Gandhi, 2000, p. 1087). An appointment begins with an interview of the patient, when a clinician compiles a patient's medical history or verifies that the details of the patient's history already contained in the patient's medical record are accurate. A patient's clinical history includes documentation of the current concern, past medical history, family history, social history, and other relevant information, such as current medications (prescription and over-the-counter) and dietary supplements.The process of acquiring a clinical history and interviewing a patient requires effective communication, active listening skills, and tailoring communication to the patient based on the patient's needs, values, and preferences. The National Institute on Aging, in guidance for conducting a clinical history and interview, suggests that clinicians should avoid interrupting, demonstrate empathy, and establish a rapport with patients (NIA, 2008). Clinicians need to know when to ask more detailed questions and how to create a safe environment for patients to share sensitive information about their health and symptoms. Obtaining a history can be challenging in some cases: For example, in working with older adults with memory loss, with children, or with individuals whose health problems limit communication or reliable self-reporting. In these cases it may be necessary to include family members or caregivers in the history-taking process. The time pressures often involved in clinical appointments also contribute to challenges in the clinical history and interview. Limited time for clinical visits, partially attributed to payment policies (see Chapter 7), may lead to an incomplete picture of a patient's relevant history and current signs and symptoms.There are growing concerns that traditional bedside evaluation skills (history, interview, and physical exam) have received less attention due the large growth in diagnostic testing in medicine. Verghese and colleagues noted that these methods were once the primary tools for diagnosis and clinical evaluation, but the recent explosion of imaging and laboratory testing has inverted the diagnostic paradigm. [Clinicians] often bypass the bedside evaluation for immediate testing (Verghese et al., 2011, p. 550). The interview has been called a clinician's most versatile diagnostic and therapeutic tool, and the clinical history provides direction for subsequent information-gathering activities in the diagnostic process (Lichstein, 1990). An accurate history facilitates a more productive and efficient physical exam and the appropriate utilization of diagnostic testing (Lichstein, 1990). Indeed, Kassirer concluded: Diagnosis remains fundamentally dependent on a personal interaction of a [clinician] with a patient, the sufficiency of communication between them, the accuracy of the patient's history and physical examination, and the cognitive energy necessary to synthesize a vast array of information (Kassirer, 2014, p. 12).The physical exam is a hands-on observational examination of the patient. First, a clinician observes a patient's demeanor, complexion, posture, level of distress, and other signs that may contribute to an understanding of the health problem (Davies and Rees, 2010). If the clinician has seen the patient before, these observations can be weighed against previous interactions with the patient. A physical exam may include an analysis of many parts of the body, not just those suspected to be involved in the patient's current complaint. A careful physical exam can help a clinician refine the next steps in the diagnostic process, can prevent unnecessary diagnostic testing, and can aid in building trust with the patient (Verghese, 2011). There is no universally agreed upon physical examination checklist; myriad versions exist online and in textbooks.Due to the growing emphasis on diagnostic testing, there are concerns that physical exam skills have been underemphasized in current health care professional education and training (Kassirer, 2014; Kugler and Verghese, 2010). For example, Kugler and Verghese have asserted that there is a high degree in variability in the way that trainees elicit physical signs and that residency programs have not done enough to evaluate and improve physical exam techniques. Physicians at Stanford have developed the Stanford 25, a list of physical diagnostic maneuvers that are very technique-dependent (Verghese and Horwitz, 2009). Educators observe students and residents performing these 25 maneuvers to ensure that trainees are able to elicit the physical signs reliably (Stanford Medicine 25 Team, 2015).Over the past 100 years, diagnostic testing has become a critical feature of standard medical practice (Berger, 1999; European Society of Radiology, 2010). Diagnostic testing may occur in successive rounds of information gathering, integration, and interpretation, as each round of information refines the working diagnosis. In many cases, diagnostic testing can identify a condition before it is clinically apparent; for example, coronary artery disease can be identified by an imaging study indicating the presence of coronary artery blockage even in the absence of symptoms.The primary emphasis of this section focuses on laboratory medicine, anatomic pathology, and medical imaging (see Box 2-2). However, there are many important forms of diagnostic testing that extend beyond these fields, and the committee's conceptual model is intended to be broadly applicable. Additional forms of diagnostic testing include, for example, screening tools used in making mental health diagnoses (SAMHSA and HRSA, 2015), sleep apnea testing, neurocognitive assessment, and vision and hearing testing.Laboratory Medicine, Anatomic Pathology, and Medical Imaging. Although it was developed specifically for laboratory medicine, the brain-to-brain loop model is useful for describing the general process of diagnostic testing (Lundberg, 1981; Plebani et al., 2011). The model includes nine steps: test selection and ordering, sample collection, patient identification, sample transportation, sample preparation, sample analysis, result reporting, result interpretation, and clinical action (Lundberg, 1981). These steps occur during five phases of diagnostic testing: prepre-analytic, pre-analytic, analytic, post-analytic, and post-post-analytic phases. Errors related to diagnostic testing can occur in any of these five phases, but the analytic phase is the least susceptible to errors (Eichbaum et al., 2012; Epner et al., 2013; Laposata, 2010; Nichols and Rauch, 2013; Stratton, 2011) (see Chapter 3).The pre-pre-analytic phase, which involves clinician test selection and ordering, has been identified as a key point of vulnerability in the work process due to the large number and variety of available tests, which makes it difficult for nonspecialist clinicians to accurately select the correct test or series of tests (Hickner et al., 2014; Laposata and Dighe, 2007). The pre-analytic phase involves sample collection, patient identification, sample transportation, and sample preparation. During the analytic phase, the specimen is tested, examined, or both. Adequate performance in this phase depends on the correct execution of a chemical analysis or morphological examination (Hollensead et al., 2004), and the contribution to diagnostic errors at this step is small. The post-analytic phase includes the generation of results, reporting, interpretation, and follow-up. Ensuring accurate and timely reporting from the laboratory to the ordering clinician and patient is central to this phase. During the post-post-analytic phase, the ordering clinician, sometimes in consultation with pathologists, incorporates the test results into the patient's clinical context, considers the probability of a particular diagnosis in light of the test results, and considers the harms and benefits of future tests and treatments, given the newly acquired information. Possible factors contributing to failure in this phase include an incorrect interpretation of the test result by the ordering clinician or pathologist and the failure by the ordering clinician to act on the test results: for example, not ordering a follow-up test or not providing treatment consistent with the test results (Hickner et al., 2014; Laposata and Dighe, 2007; Plebani and Lippi, 2011).The medical imaging work process parallels the work process described for pathology. There is a pre-pre-analytic phase (the selection and ordering of medical imaging), a pre-analytic phase (preparing the patient for imaging), an analytic phase (image acquisition and analysis), a post-analytic phase (the imaging results are interpreted and reported to the ordering clinician or the patient), and a post-post-analytic phase (the integration of results into the patient context and further action). The relevant differences between the medical imaging and pathology processes include the nature of the examination and the methods and technology used to interpret the results.In 2008 a Centers for Disease Control and Prevention (CDC) report described pathology as an essential element of the health care system, stating that pathology is integral to many clinical decisions, providing physicians, nurses, and other health care providers with often pivotal information for the prevention, diagnosis, treatment, and management of disease (CDC, 2008, p. 19). Primary care clinicians order laboratory tests in slightly less than one third of patient visits (CDC, 2010; Hickner et al., 2014), and direct-to-patient testing is becoming increasingly prevalent (CDC, 2008). There are now thousands of molecular diagnostic tests available, and this number is expected to increase as the mechanisms of disease at the molecular level are better understood (CDC, 2008; Johansen Taber et al., 2014) (see Box 2-3).The task of selecting the appropriate diagnostic testing is challenging for clinicians, in part because of the sheer volume of choices. For example, Hickner and colleagues (2014) found that primary care clinicians report uncertainty in ordering laboratory medicine tests in approximately 15 percent of diagnostic encounters. Choosing the appropriate test requires understanding the patient's history and current signs and symptoms, as well as having a sufficient suspicion or pre-test probability of a disease or condition (see section on probabilistic reasoning) (Pauker and Kassirer, 1975, 1980; Sox, 1986). The likelihood of disease is inherently uncertain in this step; for instance, the clinician's patient population may not reflect epidemiological data, and the patient's history can be incomplete or otherwise complicated. Advances in molecular diagnostic technologies and new diagnostic tests have introduced another layer of complexity. Many clinicians are struggling to keep up with the growing availability of such tests and have uncertainty about the best application of these tests in screening, diagnosis, and treatment (IOM, 2015a; Johansen Taber et al., 2014).Diagnostic tests have operating parameters, including sensitivity and specificity that are particular to the diagnostic test for a specific disorder (see section on probabilistic reasoning). Even if a test is performed correctly, there is a chance for a false positive or false negative result. Test interpretation involves reviewing numerical or qualitative (yes or no) results and combining those results with patient history, symptoms, and pretest disease likelihood. Test interpretation needs to be patient-specific and to consider information learned during the physical exam and the clinical history and interview. Several studies have highlighted test interpretation errors, such as the misinterpretation of a false positive human immunodeficiency virus (HIV) screening test for a low-risk patient as indicative of HIV infection (Gigerenzer, 2013; Kleinman et al., 1998). In addition, test performance may only be characterized in a limited patient population, leading to challenges with generalizability (Whiting et al., 2004).The laboratories that conduct diagnostic testing are some of the most regulated and inspected areas in health care (see Table 2-1). Some of the relevant entities include The Joint Commission and other accreditors, the federal government, and various other organizations, such as the College of American Pathologists (CAP) and the American Society for Clinical Pathology. There are many ways in which quality is assessed. Examples include proficiency testing of clinical laboratory assays and pathologists (e.g., Pap smear proficiency testing), many of which are regulated under the Clinical Laboratory Improvement Amendments, and inter-laboratory comparison programs (e.g., CAP's Q-Probes, Q-Monitors, and Q-Tracks programs).Medical imaging plays a critical role in establishing the diagnoses for innumerable conditions and it is used routinely in nearly every branch of medicine. The advancement of imaging technologies has improved the ability of clinicians to detect, diagnose, and treat conditions while also allowing patients to avoid more invasive procedures (European Society of Radiology, 2010; Gunderman, 2005). For many conditions (e.g., brain tumors), imaging is the only noninvasive diagnostic method available. The appropriate choice of imaging modality depends on the disease, organ, and specific clinical questions to be addressed. Computed tomography (CT) and magnetic resonance imaging (MRI) are first-line methods for assessing conditions of the central and peripheral nervous system, while for musculoskeletal and a variety of other conditions, X-ray and ultrasound are often employed first because of their relatively low cost and ready availability, with CT and MRI being reserved as problem-solving modalities. CT procedures are frequently used to assess and diagnose cancer, circulatory system diseases and conditions, inflammatory diseases, and head and internal organ injuries. A majority of MRI procedures are performed on the spine, brain, and musculoskeletal system, although usage for the breast, prostate, abdominal, and pelvic regions is rising (IMV, 2014).Medical imaging is characterized not just by the increasingly precise anatomic detail it offers but also by an increasing capacity to illuminate biology. For example, magnetic resonance spectroscopic imaging has allowed the assessment of metabolism, and a growing number of other MRI sequences are offering information about functional characteristics, such as blood perfusion or water diffusion. In addition, several new tracers for molecular imaging with PET (typically as PET/CT) have recently been approved for clinical use, and more are undergoing clinical trials, while PET/MRI was recently introduced to the clinical setting. Functional and molecular imaging data may be assessed qualitatively, quantitatively, or both. Although other forms of diagnostic testing can identify a wide array of molecular markers, molecular imaging is unique in its capacity to noninvasively show the locations of molecular processes in patients, and it is expected to play a critical role in advancing precision medicine, particularly for cancers, which often demonstrate both intra- and intertumoral biological heterogeneity (Hricak, 2011).The growing body of medical knowledge, the variety of imaging options available, and the regular increases in the amounts and kinds of data that can be captured with imaging present tremendous challenges for radiologists, as no individual can be expected to achieve competency in all of the imaging modalities. General radiologists continue to be essential in certain clinical settings, but extended training and sub-specialization are often necessary for optimal, clinically relevant image interpretation, as is involvement in multidisciplinary disease management teams. Furthermore, the use of structured reporting templates tailored to specific examinations can help to increase the clarity, thoroughness, and clinical relevance of image interpretation (Schwartz et al., 2011).Like other forms of diagnostic testing, medical imaging has limitations. Some studies have found that between 20 and 50 percent of all advanced imaging results fail to provide information that improves patient outcome, although these studies do not account for the value of negative imaging results in influencing decisions about patient management (Hendee et al., 2010). Imaging may fail to provide useful information because of modality sensitivity and specificity parameters; for example, the spatial resolution of an MRI may not be high enough to detect very small abnormalities. Inadequate patient education and preparation for an imaging test can also lead to suboptimal imaging quality that results in diagnostic error.Perceptual or cognitive errors made by radiologists are a source of diagnostic error (Berlin, 2014; Krupinski et al., 2012). In addition, incomplete or incorrect patient information, as well as insufficient sharing of patient information, may lead to the use of an inadequate imaging protocol, an incorrect interpretation of imaging results, or the selection of an inappropriate imaging test by a referring clinician. Referring clinicians often struggle with selecting the appropriate imaging test, in part because of the large number of available imaging options and gaps in the teaching of radiology in medical schools. Although consensus-based guidelines (e.g., the various appropriateness criteria published by the American College of Radiology [ACR]) are available to help select imaging tests for many conditions, these guidelines are often not followed. The use of clinical decision support systems at the point of care as well as direct consultations with radiologists have been proposed by the ACR as methods for improving imaging test selection (Allen and Thorwarth, 2014).There are several mechanisms for ensuring the quality of medical imaging. The Mammography Quality Standards Act (MQSA)overseen by the Food and Drug Administrationwas the first government-mandated accreditation program for any type of medical facility; it was focused on X-ray imaging for breast cancer. MQSA provides a general framework for ensuring national quality standards in facilities that perform screening mammography (IOM, 2005). MQSA requires all personnel at facilities to meet initial qualifications, to demonstrate continued experience, and to complete continuing education. MQSA addresses protocol selection, image acquisition, interpretation and report generation, and the communication of results and recommendations. In addition, it provides facilities with data on diagnostic performance that can be used for benchmarking, self-monitoring, and improvement. MQSA has decreased the variability in mammography performed across the United States and improved the quality of care (Allen and Thorwarth, 2014). However, the ACR noted that MQSA is complex and specified in great detail, which makes it inflexible, leading to administrative burdens and the need for extensive training of staff for implementation (Allen and Thorwarth, 2014). It also focuses on only one medical imaging modality in one disease area; thus, it does not address newer screening technologies (IOM, 2005). In addition, the Medicare Improvements for Patients and Providers Act (MIPPA)3 requires that private outpatient facilities that perform CT, MRI, breast MRI, nuclear medicine, and PET exams be accredited. The requirements include personnel qualifications, image quality, equipment performance, safety standards, and quality assurance and quality control (ACR, 2015a). There are four CMS-designated accreditation organizations for medical imaging: ACR, the Intersocietal Accreditation Commission, The Joint Commission, and RadSite (CMS, 2015a). MIPPA also mandated that, beginning in 2017, ordering clinicians will be required to consult appropriateness criteria to order advanced medical imaging procedures, and the act called for a demonstration project evaluating clinician compliance with appropriateness criteria (Timbie et al., 2014). In addition to these mandated activities, societies such as ACR and the Radiological Society of North America (RSNA) provide quality improvement programs and resources (ACR, 2015b; RSNA, 2015).Clinicians may refer to or consult with other clinicians (formally or informally) to seek additional expertise about a patient's health problem. The consult may help to confirm or reject the working diagnosis or may provide information on potential treatment options. If a patient's health problem is outside a clinician's area of expertise, he or she can refer the patient to a clinician who holds more suitable expertise. Clinicians can also recommend that the patient seek a second opinion from another clinician to verify their impressions of an uncertain diagnosis or if they believe that this would be helpful to the patient. Many groups raise awareness that patients can obtain a second opinion on their own (AMA, 1996; CMS, 2015c; PAF, 2012). Diagnostic consultations can also be arranged through the use of integrated practice units or diagnostic management teams (Govern, 2013; Porter, 2010; see Chapter 4).The committee elaborated on several aspects of the diagnostic process which are discussed below, includingdiagnostic uncertaintytimepopulation trendsdiverse populations and health disparitiesmental healthOne of the complexities in the diagnostic process is the inherent uncertainty in diagnosis. As noted in the committee's conceptual model of the diagnostic process, an overarching question throughout the process is whether sufficient information has been collected to make a diagnosis. This does not mean that a diagnosis needs to be absolutely certain in order to initiate treatment. Kassirer concluded that:Absolute certainty in diagnosis is unattainable, no matter how much information we gather, how many observations we make, or how many tests we perform. A diagnosis is a hypothesis about the nature of a patient's illness, one that is derived from observations by the use of inference. As the inferential process unfolds, our confidence as [clinicians] in a given diagnosis is enhanced by the gathering of data that either favor it or argue against competing hypotheses. Our task is not to attain certainty, but rather to reduce the level of diagnostic uncertainty enough to make optimal therapeutic decisions. (Kassirer, 1989, p. 1489)Thus, the probability of disease does not have to be equal to one (diagnostic certainty) in order for treatment to be justified (Pauker and Kassirer, 1980). The decision to begin treatment based on a working diagnosis is informed by: (1) the degree of certainty about the diagnosis; (2) the harms and benefits of treatment; and (3) the harms and benefits of further information-gathering activities, including the impact of delaying treatment.The risks associated with diagnostic testing are important considerations when conducting information-gathering activities in the diagnostic process. While underuse of diagnostic testing has been a long-standing concern, overly aggressive diagnostic strategies have recently been recognized for their risks (Zhi et al., 2013) (see Chapter 3). Overuse of diagnostic testing has been partially attributed to clinicians' fear of missing something important and intolerance of diagnostic uncertainty: I am far more concerned about doing too little than doing too much. It's the scan, the test, the operation that I should have done that sticks with mesometimes for years. . . . By contrast, I can't remember anyone I sent for an unnecessary CT scan or operated on for questionable reasons a decade ago (Gawande, 2015). However, there is growing recognition that overly aggressive diagnostic pursuits are putting patients at greater risk for harm, and they are not improving diagnostic certainty (Kassirer, 1989; Welch, 2015).When considering diagnostic testing options, the harm from the procedure itself needs to be weighed against the potential information that could be gained. For some patients, the risk of invasive diagnostic testing may be inappropriate due to the risk of mortality or morbidity from the test itself (such as cardiac catheterization or invasive biopsies). In addition, the risk for harm needs to take into account the cascade of diagnostic testing and treatment decisions that could stem from a diagnostic test result. Included in these assessments are the potential for false positives and ambiguous or slightly abnormal test results that lead to further diagnostic testing or unnecessary treatment.There are some cases in which treatment is initiated even though there is limited certainty in a working diagnosis. For example, an individual who has been exposed to a tick bite or HIV may be treated with prophylactic antibiotics or antivirals, because the risk of treatment may be felt to be smaller than the risk of harm from tick-borne diseases or HIV infection. Clinicians sometimes employ empiric treatment strategiesor the provision of treatment with a very uncertain diagnosisand use a patient's response to treatment as an information-gathering activity to help arrive at a working diagnosis. However, it is important to note that response rates to treatment can be highly variable, and the failure to respond to treatment does not necessarily reflect that a diagnosis is incorrect. Nor does improvement in the patient's condition necessarily validate that the treatment conferred this benefit and, therefore, that the empirically tested diagnosis was in fact correct. A treatment that is beneficial for some patients might not be beneficial for others with the same condition (Kent and Hayward, 2007), hence the interest in precision medicine, which is hoped to better tailor therapy to maximize efficacy and minimize toxicity (Jameson and Longo, 2015). In addition, there are isolated cases where the morbidity and the mortality of a diagnostic procedure and the likelihood of disease is sufficiently high that significant therapy has been given empirically. Moroff and Pauker (1983) described a decision analysis in which a 90-year-old practicing lawyer with a new 1.5 centimeter lung nodule was deemed to have a sufficiently high risk for mortality from lung biopsy and high likelihood of malignancy that the radiation oncologists felt comfortable treating the patient empirically for suspected lung cancer.Of major importance in the diagnostic process is the element of time. Most diseases evolve over time, and there can be a delay between the onset of disease and the onset of a patient's symptoms; time can also elapse before a patient's symptoms are recognized as a specific diagnosis (Zwaan and Singh, 2015). Some diagnoses can be determined in a very short time frame, while months may elapse before other diagnoses can be made. This is partially due to the growing recognition of the variability and complexity of disease presentation. Similar symptoms may be related to a number of different diagnoses, and symptoms may evolve in different ways as a disease progresses; for example, a disease affecting multiple organs may initially involve symptoms or signs from a single organ. The thousands of different diseases and health conditions do not present in thousands of unique ways; there are only a finite number of symptoms with which a patient may present. At the outset, it can be very difficult to determine which particular diagnosis is indicated by a particular combination of symptoms, especially if symptoms are nonspecific, such as fatigue. Diseases may also present atypically, with an unusual and unexpected constellation of symptoms (Emmett, 1998).Adding to the complexity of the time-dependent nature of the diagnostic process are the numerous settings of care in which diagnosis occurs and the potential involvement of multiple settings of care within a single diagnostic process. Henriksen and Brady noted that this processfor patients, their families, and clinicians alikecan often feel like a disjointed journey across confusing terrain, aided or impeded by different agents, with no destination in sight and few landmarks along the way (Henriksen and Brady, 2013, p. ii2).Some diagnoses may be more important to establish immediately than others. These include diagnoses that can lead to significant patient harm if not recognized, diagnosed, and treated early, such as anthrax, aortic dissection, and pulmonary embolism. Sometimes making a timely diagnosis relies on the fast recognition of symptoms outside of the health care setting (e.g., public awareness of stroke symptoms can help improve the speed of receiving medical help and increase the chances of a better recovery) (National Stroke Association, 2015). In these cases, the benefit of treating the disease promptly can greatly exceed the potential harm from unnecessary treatment. Consequently, the threshold for ordering diagnostic testing or for initiating treatment becomes quite low for such health problems (Pauker and Kassirer, 1975, 1980). In other cases, the potential harm from rapidly and unnecessarily treating a diagnosed condition can lead to a more conservative (or higher-threshold) approach in the diagnostic process.Population trends, such as the aging of the population, are adding significant complexity to the diagnostic process and require clinicians to consider such complicating factors in diagnosis as comorbidity, polypharmacy and attendant medication side effects, as well as disease and medication interactions (IOM, 2008, 2013b). Diagnosis can be especially challenging in older patients because classic presentations of disease are less common in older adults (Jarrett et al., 1995). For example, infections such as pneumonia or urinary tract infections often do not present in older patients with fever, cough, and pain but rather with symptoms such as lethargy, incontinence, loss of appetite, or disruption of cognitive function (Mouton et al., 2001). Acute myocardial infarction (MI) may present with fatigue and confusion rather than with typical symptoms such as chest pain or radiating arm pain (Bayer et al., 1986; Qureshi et al., 2000; Rich, 2006). Sensory limitations in older adults, such as hearing and vision impairments, can also contribute to challenges in making diagnoses (Campbell et al., 1999). Physical illnesses often present with a change in cognitive status in older individuals without dementia (Mouton et al., 2001). In older adults with mild to moderate dementia, such illnesses can manifest with worsening cognition. Older patients who have multiple comorbidities, medications, or cognitive and functional impairments are more likely to have atypical disease presentations, which may increase the risk of experiencing diagnostic errors (Gray-Miceli, 2008).Communicating with diverse populations can also contribute to the complexity of the diagnostic process. Language, health literacy, and cultural barriers can affect clinicianpatient encounters and increase the potential for challenges in the diagnostic process (Flores, 2006; IOM, 2003; The Joint Commission, 2007). There are indications that biases influence diagnosis; one well-known example is the differential referral of patients for cardiac catheterization by race and gender (Schulman et al., 1999). In addition, women are more likely than men to experience a missed diagnosis of heart attack, a situation that has been partly attributed to real and perceived gender biases, but which may also be the result of physiologic differences, as women have a higher likelihood of presenting with atypical symptoms, including abdominal pain, shortness of breath, and congestive heart failure (Pope et al., 2000).Mental health diagnoses can be particularly challenging. Mental health diagnoses rely on the Diagnostic and Statistical Manual of Mental Disorders (DSM); each diagnosis in the DSM includes a set of diagnostic criteria that indicate the type and length of symptoms that need to be present, as well as the symptoms, disorders, and conditions that cannot be present, in order to be considered for a particular diagnosis (APA, 2015). Compared to physical diagnoses, many mental health diagnoses rely on patient reports and observation; there are few biological tests that are used in such diagnoses (Pincus, 2014). A key challenge can be distinguishing physical diagnoses from mental health diagnoses; sometimes physical conditions manifest as psychiatric ones, and vice versa (Croskerry, 2003a; Hope et al., 2014; Pincus, 2014; Reeves et al., 2010). In addition, there are concerns about missing psychiatric diagnoses, as well as overtreatment concerns (Bor, 2015; Meyer and Meyer, 2009; Pincus, 2014). For example, clinician biases toward older adults can contribute to missed diagnoses of depression, because it may be perceived that older adults are likely to be depressed, lethargic, or have little interest in interactions. Patients with mental healthrelated symptoms may also be more vulnerable to diagnostic errors, a situation that is attributed partly to clinician biases; for example, clinicians may disregard symptoms in patients with previous diagnoses of mental illness or substance abuse and attribute new physical symptoms to a psychological cause (Croskerry, 2003a). Individuals with health problems that are difficult to diagnose or those who have chronic pain may also be more likely to receive psychiatric diagnoses erroneously.Accurate, timely, and patient-centered diagnosis relies on proficiency in clinical reasoning, which is often regarded as the clinician's quintessential competency. Clinical reasoning is the cognitive process that is necessary to evaluate and manage a patient's medical problems (Barrows, 1980, p. 19). Understanding the clinical reasoning process and the factors that can impact it are important to improving diagnosis, given that clinical reasoning processes contribute to diagnostic errors (Croskerry, 2003a; Graber, 2005). Health care professionals involved in the diagnostic process have an obligation and ethical responsibility to employ clinical reasoning skills: As an expanding body of scholarship further elucidates the causes of medical error, including the considerable extent to which medical errors, particularly in diagnostics, may be attributable to cognitive sources, insufficient progress in systematically evaluating and implementing suggested strategies for improving critical thinking skills and medical judgment is of mounting concern (Stark and Fins, 2014, p. 386). Clinical reasoning occurs within clinicians' minds (facilitated or impeded by the work system) and involves judgment under uncertainty, with a consideration of possible diagnoses that might explain symptoms and signs, the harms and benefits of diagnostic testing and treatment for each of those diagnoses, and patient preferences and values.The current understanding of clinical reasoning is based on the dual process theory, a widely accepted paradigm of decision making. The dual process theory integrates analytical and non-analytical models of decision making (see Box 2-4). Analytical models (slow system 2) involve a conscious, deliberate process guided by critical thinking (Kahneman, 2011). Nonanalytical models (fast system 1) involve unconscious, intuitive, and automatic pattern recognition (Kahneman, 2011).Models of Clinical Reasoning. Fast system 1 (nonanalytical, intuitive) automatic processes require very little working memory capacity. They are often triggered by stimuli or result from overlearned associations or implicitly learned activities.4 Examples of system 1 processes include the ability to recognize human faces (Kanwisher and Yovel, 2006), the diagnosis of Lyme disease from a bull's-eye rash, or decisions based on heuristics (mental shortcuts), intuition, or repeated experiences.In contrast, slow system 2 (reflective, analytical) processing places a heavy load on working memory and involves hypothetical and counterfactual reasoning (Evans and Stanovich, 2013; Stanovich and Toplak, 2012). System 2 processing requires individuals to generate mental models of what should or should not happen in particular situations, in order to test possible actions or to explore alternative causes of events (Stanovich, 2009). Hypothetical thinking occurs when one reasons about what should occur if some condition held: For example, if this patient has diabetes, then the blood sugar level should exceed 126 mg/dl after an 8-hour fast, or if prescribed a diabetes medication, the sugar level should improve. Counterfactual reasoning occurs when one thinks about what should occur if the situation differed from how it actually is. The deliberate, conscious, and reflective nature of both hypothetical and counterfactual reasoning illustrates the analytical nature of system 2.Heuristicsmental shortcuts or cognitive strategies that are automatically and unconsciously employedare particularly important for decision making (Gigerenzer and Goldstein, 1996). Heuristics can facilitate decision making but can also lead to errors, especially when patients present with atypical symptoms (Cosmides and Tooby, 1996; Gigerenzer, 2000; Kahneman, 2011; Klein, 1998; Lipshitz et al., 2001; McDonald, 1996). When a heuristic fails, it is referred to as a cognitive bias. Cognitive biases, or predispositions to think in a way that leads to failures in judgment, can also be caused by affect and motivation (Kahneman, 2011). Prolonged learning in a regular and predictable environment increases the success-fulness of heuristics, whereas uncertain and unpredictable environments are a chief cause of heuristic failure (Kahneman, 2011; Kahneman and Klein, 2009). There are many heuristics and biases that affect clinical reasoning and decision making (see Table 2-2 for medical and nonmedical examples). Additional examples of heuristics and biases that affect decision making and the potential for diagnostic errors are described below (Croskerry, 2003b):The representativeness heuristic answers the question, how likely is it that this patient has a particular disease? by assessing how typical the patient's symptoms are for that disease. If the symptoms are highly typical (e.g., fever and nausea after contact with an individual from West Africa with Ebola virus), then it is likely the patient will be diagnosed as having that condition (e.g., Ebola virus infection). The representativeness bias refers to the tendency to make decisions based on a typical case, even when this may lead to an incorrect judgment. The representativeness bias helps to explain why an incorrect diagnosis (e.g., a patient diagnosed as not having Ebola virus infection) is made when presenting symptoms are atypical (e.g., no fever or nausea after contact with a person from West Africa).Base-rate neglect describes the tendency to ignore the prevalence of a disease in determining a diagnosis. For example, a clinician may think the diagnosis is acid reflux because it is a prevalent condition, even though it is actually an MI, which can present with similar symptoms (e.g., chest pain), but is less likely.The overconfidence bias reflects the universal tendency to believe that we know more than we do. This bias encourages individuals to diagnose a disease based on incomplete information; too much faith is placed in one's opinion rather than on carefully gathering evidence. This bias is especially likely to develop if clinicians do not have feedback on their diagnostic performance.Psych-out errors describe the increased susceptibility of people with mental illnesses to clinician biases and heuristics due to their mental health conditions. Patients with mental health issues may have new physical symptoms that are not considered seriously because their clinicians attribute them to their mental health issues. Patients with physical symptoms that mimic mental illnesses (hypoxia, delirium, metabolic abnormalities, central nervous infections, and head injuries) may also be susceptible to these errors.In addition to cognitive biases, research suggests that fallacies in reasoning, ethical violations, and financial and nonfinancial conflicts of interest can influence medical decision making (Seshia et al., 2014a,b). These factors, collectively referred to as cognitive biases plus, have been identified as potentially undermining the evidence that informs clinical decision making (Seshia et al., 2014a,b).The interaction between fast system 1 and slow system 2 remains controversial. Some hold that these processes are constantly occurring in parallel and that any conflicts are resolved as they arise. Others have argued that system 1 processes generate an individual's default response and that system 2 processes may or may not intervene and override system 1 processing (Evans and Stanovich, 2013; Kahneman, 2011). When system 2 overrides system 1, this can lead to improved decision making, because engaging in analytical reasoning may correct for inaccuracies. It is important to note that slow system 2 processing does not guarantee correct decision making. For instance, clinicians with an inadequate knowledge base may not have the information necessary to make a correct decision. There are some instances when system 1 processing is correct, and the override from system 2 can contribute to incorrect decision making. However, when system 1 overrides system 2 processing, this can also result in irrational decision making.Intervention by system 2 is likely to occur in novel situations when the task at hand is difficult; when an individual has minimal knowledge or experience (Evans and Stanovich, 2013; Kahneman, 2011); or when an individual deliberately employs strategies to overcome known biases (Croskerry et al., 2013). Monitoring and intervention by system 2 on system 1 is unlikely to catch every failure because it is inefficient and would require sustained vigilance, given that system 1 processing often leads to correct solutions (Kahneman, 2011). Factors that affect working memory can impede the ability of system 2 to monitor and, when necessary, intervene on system 1 processes (Croskerry, 2009b). For example, if clinicians are tired or distracted by elements in the work system, they may fail to recognize when a decison provided by system 1 processing needs to be reconsidered (Croskerry, 2009b).System 1 and system 2 perform optimally in different types of clinical practice settings. System 1 performs best in highly reliable and predictable environments but falls short in uncertain and irregular settings (Kahneman and Klein, 2009; Stanovich, 2009). System 2 performs best in relaxed and unhurried environments.This section applies the dual process theory of clinical reasoning to the diagnostic process (Croskerry, 2009a,b; Norman and Eva, 2010; Pelaccia et al., 2011). Croskerry and colleagues provide a framework for understanding the cognitive activities that occur in clinicians as they iterate through information gathering, information integration and interpretation, and determining a working diagnosis (Croskerry et al., 2013) (see Figure 2-2).When patients present, clinicians gather information and compare that information with their knowledge about various

diseases. This can include comparing a patient's signs and symptoms with clinicians' mental models of diseases (or information about diseases that is stored in memory as exemplars, prototypes, or illness scripts; see Box 2-4). This initial pattern matching is an instance of fast system 1 processing. If a sufficiently unique match occurs, then a diagnosis may be made without involvement of slow system 2.However, some symptoms or signs may not be recognized or they may trigger mental models for several diseases at once. When this happens, slow system 2 processing may be engaged, and the clinician will continue to gather, integrate, and interpret potentially relevant information until a working diagnosis is generated and communicated to the patient. When this process triggers pattern matches for several mental models of disease, a differential diagnosis is developed. At this point, the diagnostic process shifts to slow system 2 analytical reasoning. Based on their knowledge base, clinicians then use deductive reasoning: If this patient has disease A, what clinical history and physical examination findings might be expected, and does the patient have them? This process is repeated for each condition in the differential diagnosis and may be augmented by additional sources of information, such as diagnostic testing, further history gathering or physical examination, or referral or consultation. The cognitive process of reassessing the probability assigned to each potential diagnosis involves inductive reasoning,5 or going from observed signs and symptoms to the likelihood of each disease to determine which hypothesis is most likely (Goodman, 1999). This can help refine and narrow the differential diagnosis. Further information gathering activities or treatment could provide greater certainty regarding a working diagnosis or suggest that alternative diagnoses be considered. Throughout this process, clinicians need to communicate with patients about the working diagnosis and the degree of certainty involved.Task complexity and expertise affect which cognitive system is dominantly employed in the diagnostic process. System 1 processing is more likely to be used when patients present with typical signs and symptoms of disease. However, system 2 processing is likely to intervene in situations marked by novelty and difficulty, when patients present with atypical signs and symptoms, or when clinicians lack expertise (Croskerry, 2009b; Evans and Stanovich, 2013). Novice clinicians and medical students are more likely to rely on analytical reasoning throughout the diagnostic process compared to experienced clinicians (Croskerry, 2009b; Elstein and Schwartz, 2002; Kassirer, 2010; Norman, 2005). Expert clinicians possess better developed mental models of diseases, which support more reliable pattern matching (system 1 processes) (Croskerry, 2009b). As a clinician accumulates experience, the repetition of system 2 processing can expand pattern matching possibilities by building and storing in memory mental models for additional diseases that can be triggered by patient signs and symptoms. The ability to create and develop mental models through repetition explains why expert clinicians are more likely to rely on pattern recognition when making diagnoses than are novicescontinuous engagement with disease conditions allows the expert to develop more reliable mental models of diseaseby retaining more exemplars, creating more nuanced prototypes, or developing more detailed illness scripts.The way in which information is processed through system 1 and system 2 informs a clinician's subsequent diagnostic performance. Figure 2-3 illustrates the concept of calibration, or the process of a clinician becoming aware of his or her diagnostic abilities and limitations through feedback. Feedback mechanismsboth in educational settings (see Chapter 4) and in learning health care systems (see Chapter 6)allow clinicians to compare their patients' ultimate diagnoses with the diagnoses that they provided to those patients. Calibration enables clinicians to assess their diagnostic accuracy and improve their future performance.Work system factors influence diagnostic reasoning, including diagnostic team members and tasks, technologies and tools, organizational characteristics, the physical environment, and the external environment. For example, Chapter 6 describes how the physical environment, including lighting, noise, and layout, can influence clinical reasoning. Chapter 5 discusses how health IT can improve or degrade clinical reasoning, depending on the usability of health IT (including clinical decision support), its integration into clinical workflow, and other factors. Box 2-5 describes how certain individual characteristics of diagnostic team members can affect clinical reasoning.Individual Characteristics That Influence Clinical Reasoning. As described above, the diagnostic process involves initial information gathering that leads to a working diagnosis. The process of ruling in or ruling out a diagnosis involves probabilistic reasoning as findings are integrated and interpreted. Probabilistic (or Bayesian) reasoning provides a formal method to avoid some cognitive biases when integrating and interpreting information. For instance, when patients present with typical symptoms but the disease is rare (e.g., the classic triad of headache, sweating, and rapid heart rate for pheochromocytoma), base rate neglect and the representativeness bias may lead clinicians to overestimate the likelihood of pheochromocytoma among patients presenting with high blood pressure. Using Bayesian reasoning and formally revising probabilities of the various diseases under consideration helps clinicians avoid these errors. Clinicians can then decide whether to pursue additional information gathering or treatment based on an accurate estimate of the likelihood of disease, the harms and benefits of treatment, and patient preferences (Kassirer et al., 2010; Pauker and Kassirer, 1980).Probabilistic reasoning is most often considered in the context of diagnostic testing, but the presence or absence of specific signs and symptoms can also help to rule in or rule out diseases. The likelihood of a positive finding (the presence of signs or symptoms or a positive test) when disease is present is referred to as sensitivity. The likelihood of a negative finding (the absence of symptoms, signs, or a negative test) when a disease is absent is referred to as specificity. If a sign, symptom, or test is always positive in the presence of a particular disease (100 percent sensitivity), then the absence of that symptom, sign, or test rules out disease (e.g., absence of pain or stiffness means the patient does not have polymyalgia rheumatica). If a sign, symptom, or test is always negative in the absence of a particular disease (100 percent specificity), then the presence of that symptom, sign, or test rules in disease (e.g., all patients with KayserFleischer rings have Wilson's disease; all patients with Koplik's spots have measles).However, nearly all signs, symptoms, or test results are neither 100 percent sensitive or specific. For example, studies suggest exceptions for findings such as KayserFleischer rings with other causes of liver disease (Frommer et al., 1977; Lipman and Deutsch, 1990) or Koplik's spots with parvovirus B19 or echovirus (Suringa et al., 1970) and even for Reed-Sternburg cells for Hodgkin's lymphoma (Azar, 1975).Bayes' theorem provides a framework for clinicians to revise the probability of disease, given disease prevalence, as well as the presence or absence of clinical findings or positive or negative test results (Grimes and Schulz, 2005; Griner et al., 1981; Kassirer et al., 2010; Pauker and Kassirer, 1980). Bayesian calculators are available to facilitate these probability revision analyses (Simel and Rennie, 2008). Box 2-6 works through two examples of probabilistic reasoning. While most clinicians will not formally calculate probabilities, the logical principles behind Bayesian reasoning can help clinicians consider the trade-offs involved in further information gathering, decisions about treatment, or evaluating clinically ambiguous cases (Kassirer et al., 2010). The committee's recommendation on improving diagnostic competencies includes a focus on diagnostic test ordering and subsequent decision making, which relies on the principles of probabilistic reasoning.Examples of Probabilistic (Bayesian) Reasoning. Advances in biology and medicine have led to improvements in prevention, diagnosis, and treatment, with a deluge of innovations in diagnostic testing (IOM, 2000, 2013a; Korf and Rehm, 2013; Lee and Levy, 2012). The rising complexity and volume of these advances, coupled with clinician time constraints and cognitive limitations, have outstripped human capacity to apply this new knowledge (IOM, 2011a, 2013a; Marois and Ivanoff, 2005; Miller, 1956; Ostbye et al., 2005; Tombu et al., 2011; Yarnall et al., 2003). The Institute of Medicine report Best Care Lower Cost: The Path to Continuously Learning Health Care in America concluded that diagnostic and treatment options are expanding and changing at an accelerating rate, placing new stresses on clinicians and patients, as well as potentially impacting the effectiveness and efficiency of care delivery (IOM, 2013a, p. 10). The sheer number of potential diagnoses illustrates this complexity: There are thousands of diseases and related health conditions categorized in the National Library of Medicine's medical subjects headings system and around 13,000 in International Classification of Diseases, 9th Edition, with new conditions and diseases added every year (Medicaid.gov, 2015).With the rapidly increasing number of published scientific articles on health (see Figure 2-4), health care professionals have difficulty keeping up with the breadth and depth of knowledge in their specialties. For example, to remain up to date, primary care clinicians would need to read for an estimated 627.5 hours per month (Alper et al., 2004). McGlynn and colleagues (2003) found that Americans receive only about half of recommended care, including recommended diagnostic processes. Thus, clinicians need approaches to ensure they know the evidence base and are well-equipped to deliver care that reflects the most up-to-date information. One of the ways that this is accomplished is through team-based care; by moving from individuals to teams of health care professionals, patients can benefit from a broader set of resources and expertise to support care (Gittell et al., 2010) (see Chapter 4). In addition, systematic reviews and clinical practice guidelines (CPGs) help synthesize available information in order to inform clinical practice decision making (IOM, 2011a,b).CPGs came into prominence partly in response to studies that found excessive variation in diagnostic and treatment-related care practices, indicating that inappropriate care was occurring (Chassin et al., 1987; IOM, 1990; Kosecoff et al., 1987; Lin et al., 2008; Song et al., 2010). CPGs are defined as statements that include recommendations intended to optimize patient care that are informed by a systematic review of the evidence and an assessment of the benefits and harms of alternative care options (IOM, 2011a, p. 4). CPGs can include diagnostic criteria for specific conditions as well as approaches to information gathering, such as conducting a clinical history and interview, the physical exam, diagnostic testing, and consultations.CPGs translate knowledge into clinical care decisions, and adherence to evidence-based guideline recommendations can improve health care quality and patient outcomes (Bhatt et al., 2004; IOM, 2011a; Peterson et al., 2006). However, there have been a number of challenges to the development and use of CPGs in clinical practice (IOM, 2011a, 2013a,b; Kahn et al., 2014; Timmermans and Mauck, 2005). Two of the primary challenges are the inadequacy of the evidence base supporting CPGs and determining the applicability of guidelines for individual patients (IOM, 2011a, 2013b). For example, individual patient preferences for possible health outcomes may vary, and with the growing prevalence of chronic disease, patients often have comorbidities or competing causes of mortality that need to be considered. CPGs may not factor in these patient-specific variables (Boyd et al., 2005; Mulley et al., 2012; Tinetti et al., 2004). In addition, the majority of scientific evidence about any diagnostic test typically is focused on test accuracy and not on the impact of the test on patient outcomes (Brozek et al., 2009; Trikalinos et al., 2009). This makes it difficult to develop guidelines that inform clinicians about the role of diagnostic tests within the diagnostic process and about how these tests can influence the path of care and health outcomes for a patient (Gopalakrishna et al., 2014; Hsu et al., 2011). Furthermore, diagnosis is generally not a primary focus of CPGs; diagnostic testing guidelines typically account for a minority of recommendations and often have lower levels of evidence supporting them than treatment-related CPGs (Tricoci et al., 2009). The adoption of available clinical practice guideline recommendations into practice remains suboptimal due to concerns about the trustworthiness of the guidelines as well as the existence of varying and conflicting guidelines (Ferket et al., 2011; Han et al., 2011; IOM, 2011a; Lenzer et al., 2013; Pronovost, 2013).Health care professional societies have also begun to develop appropriate use or appropriateness criteria as a way of synthesizing the available scientific literature and expert opinion to inform patient-specific decision making (Fitch et al., 2001). With the growth of diagnostic testing and substantial geographic variation in the utilization of these tools (due in part to the limitations in the evidence base supporting their use), health care professional societies have developed appropriate use criteria aimed at better matching patients to specific health care interventions (Allen and Thorwarth, 2014; Patel et al., 2005).Checklists are another approach that has been implemented to improve the safety of care by, for example, preventing health careacquired infections or errors in surgical care. Checklists have also been proposed to improve the diagnostic process (Ely et al., 2011; Schiff and Leape, 2012; Sibbald et al., 2013). 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New York: Russell Sage Foundation; 2007. Welch HG. Less medicine more health: 7 assumptions that drive too much medical care. Boston, MA: Beacon Press; 2015. WHO (World Health Organization). International classification of diseases (ICD). Geneva: World Health Organization; 2012. Whiting P, Rutjes AWS, Reltsma JB, Glas AS, Bossuyt PMM, Kleljnen J. Sources of variation and bias in studies of diagnostic accuracy. Annals of Internal Medicine. 2004;140(3):189202. [PubMed: 14757617]Zwaan L, Thijs A, Wagner C, van der Wal G, Timmermans DR. Design of a study on suboptimal cognitive acts in the diagnostic process, the effect on patient outcomes and the influence of workload, fatigue and experience of physician. BMC Health Services Research. 2009;9:65. [PMC free article: PMC2680398] [PubMed: 19383168]1In this report, the committee employs the terminology the diagnostic process to convey diagnosis as a process.2The committee uses the term diagnostic testing to be inclusive of all types of testing, including medical imaging, anatomic pathology, and laboratory medicine, as well as other types of testing, such as mental health assessments, vision and hearing testing, and neurocognitive testing.3Public Law 110-275 (July 15, 2008).4The term system 1 is an oversimplification because it is unlikely there is a single cognitive or neural system responsible for all system 1 cognitive processes.5Inductive reasoning involves probabilistic reasoning (see the following section). Health & Medicine Medicine diagnosis, the process of determining the nature of a disease or disorder and distinguishing it from other possible conditions. The term comes from the Greek gnosis, meaning knowledge.The diagnostic process is the method by which health professionals select one disease over another, identifying one as the most likely cause of a persons symptoms. Symptoms that appear early in the course of a disease are often more vague and undifferentiated than those that arise as the disease progresses, making this the most difficult time to make an accurate diagnosis. Reaching an accurate conclusion depends on the timing and the sequence of the symptoms, past medical history and risk factors for certain diseases, and a recent exposure to disease. The physician, in making a diagnosis, also relies on various other clues such as physical signs, nonverbal signals of distress, and the results of selected laboratory and radiological and other imaging tests. From the large number of facts obtained, a list of possible diagnoses can be determined, which are referred to as the differential diagnosis. The physician organizes the list with the most likely diagnosis given first. Additional information is identified, and appropriate tests are selected that will narrow the list or confirm one of the possible diseases. Traditionally, diagnosis has been defined as the art of identifying a disease from its signs and symptoms. Formerly, few diagnostic tests were available to assist the physician, who depended on medical history, observation, and examination. In the 20th century there occurred numerous technological advances in medicine, which resulted in the development of a wide variety of diagnostic tests and new techniques to image tissues. These developments significantly improved the ability of doctors to make accurate diagnoses. In the 5th century bce, at the time of the Greek physician Hippocrates, there arose significant interest in medicine and personal hygiene. The Greeks recognized the salubrious effects of bathing, fresh air, a good diet, and exercise. The ancient Romans also recognized the influence of these factors on health and even made significant advances in supplying and purifying water and in improving sanitation. Today, a balanced diet, clean air and water, and exercise continue to be emphasized as important factors for maintaining health. The ancient Greeks also introduced the notion that illness resulted from an imbalance between the four humours of the body: blood, phlegm, yellow bile, and black bile. They emphasized the value of observation, including bodily signs and excretions. However, the focus was more on predicting the outcome of an illness (i.e., prognosis) and less on its diagnosis. A physicians reputation depended on accurate prognostic skills, predicting who would recover and who would die or how long an illness would last. Hippocrates is credited with establishing the ethical basis of the physicians behaviour, and graduating physicians still recite the Hippocratic oath. His writings document the value of objectively evaluating all aspects of the patients symptoms, diet, sleep patterns, and habits. No finding was considered insignificant, and physicians were encouraged to employ all their sensessight, hearing, smell, taste, and touchin making a diagnosis. These principles hold just as true today. A Visit with the Word Doctor: Medical Vocabulary Quiz Galen of Pergamum (129 cec. 216) is considered the most influential physician after Hippocrates because of his extensive studies in anatomy and physiology. His voluminous writings rendered him the ultimate authority in these fields until the 16th century. As the first experimental neurologist, he described the cranial nerves and the sympathetic nervous system. He observed the structural differences between arteries and veins. One of his most important demonstrations was that the arteries carry blood, not air, as had been taught for 400 years. However, many of his views contained fallacies, which remained unchallenged for centuries. His description of the heart and its chambers and valves, in which he contended that blood passes from the right to the left ventricle by means of invisible pores in the interventricular septum, delayed the discovery of blood circulation for 14 centuries. The true nature of the circulation of blood was not recognized until the early 17th century, when English physician William Harvey published his findings in Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus (1628; Anatomical Exercise on the Motion of the Heart and Blood in Animals, or simply De Motu Cordis). One of the greatest advances in diagnosis was the invention of the compound microscope toward the end of the 16th century by the Dutch optician Hans Jansen and his son Zacharias. In the early 17th century, Italian philosopher, astronomer, and mathematician Galileo constructed a microscope and a telescope. The utility of microscopes in the biological sciences and for diagnostic purposes was initially realized in the late 17th century, when Dutch microscopist Antonie van Leeuwenhoek became the first person to see protozoa and bacteria and the first to describe red blood cells (erythrocytes). He also demonstrated the capillary anastomosis (network) between arteries and veins that proved Harveys studies of circulation to be correct. Another advance in diagnostic medicine occurred when the mercury thermometer, invented in 1714 by German physicist Daniel Fahrenheit, came into general use as a clinical tool in the mid-19th century. It was initially 25.4 cm (10 inches) long and took five minutes to register a temperature. The modern clinical thermometer was introduced by English physician Sir Thomas Clifford Allbutt in 1866. The thermometer was popularized by German physician Karl August Wunderlich, who thought, incorrectly, that every disease had its own characteristic fever pattern. stethoscopeModern stethoscopes are made of rubber tubing and are binaural, transmitting sounds from a patient's chest to both ears of the physician.Another significant medical advance, which greatly improved the ability to diagnose diseases of the chest and heart, was the invention of the stethoscope in 1816 by French physician Ren-Thophile-Hyacinthe Lannec. Before this, the lungs and heart were examined by applying the ear to the chest wall. Lannecs original stethoscope design consisted of a wooden cylinder and was monoaural, transmitting sound to only one ear. This device allowed Lannec to diagnose diseases such as tuberculosis at an earlier stage than was previously possible. His wooden stethoscope was replaced at the end of the 19th century by models using rubber tubing; later, binaural stethoscopes, which transmit sound to both ears, came into use. Rubber binaural devices are widely used today. Another significant diagnostic aid that was developed in the 19th century was the ophthalmoscope, an instrument for inspecting the interior of the eye. The ophthalmoscope was developed in 1850 by German scientist and philosopher Hermann von Helmholtz, who was best known for his knowledge of physics and mathematics. The ophthalmoscope consists of a strong light that can be directed into the eye by a small mirror or prism. The light reflects off the retina and back through a small hole, through which the examiner sees a nonstereoscopic magnified image of the structures at the back of the eye. With this device the retina and its blood vessels can be readily examined. The inner eye can provide information not only about diseases of the eye but also about those pertaining to cardiovascular abnormalities and complications of diabetes mellitus. Perhaps the greatest modern anatomic diagnostic tool is the X-ray, discovered in 1895 by the German physicist Wilhelm Conrad Rntgen. Rntgen found that opaque objects exposed to ionizing radiation could be visualized on a screen coated with fluorescent material, which he demonstrated by producing a photographic image of the bones of the human hand. Since then, knowledge about X-rays, sometimes called roentgen rays, and about various forms of radiation have been applied to the development of computerized axial tomography (CAT), magnetic resonance imaging (MRI), and other imaging techniques that are extremely useful modern diagnostic tools. William OslerWilliam Osler, at the bedside of a patient, while professor of medicine at Johns Hopkins, 18881904.The training of physicians also has undergone significant change since the time of the ancient Greek physicians. For many centuries, and particularly between the late Middle Ages and the end of the 19th century, physicians were trained through lectures and rarely were taught at the patients bedside. This practice was altered by Canadian physician Sir William Osler during his time as professor of medicine at Johns Hopkins University Medical School in Baltimore, Md., U.S. One of the most renowned physicians of the early 20th century, he introduced the practice of instructing students at the bedside of the patient. He emphasized the importance of taking an accurate medical history, providing a thorough examination, and closely observing the patients behaviour to gather clues for a diagnosis before resorting to laboratory testing. Also found in: Dictionary, Thesaurus, Acronyms, Encyclopedia, Wikipedia. [diag-nosis] 1. determination of the nature of a cause of a disease.2. a concise technical description of the cause, nature, or manifestations of a condition, situation, or problem. adj., adj diagnostic.clinical diagnosis diagnosis based on signs, symptoms, and laboratory findings during life.differential diagnosis the determination of which one of several diseases may be producing the symptoms.medical diagnosis diagnosis based on information from sources such as findings from a physical examination, interview with the patient or family or both, medical history of the patient and family, and clinical findings as reported by laboratory tests and radiologic studies.nursing diagnosis see nursing diagnosis.physical diagnosis diagnosis based on information obtained by inspection, palpation, percussion, and auscultation.diagnosis-Related Groups (DRG) a system of classification or grouping of patients according to medical diagnosis for purposes of paying hospitalization costs. In 1983, amendments to Social Security contained a prospective payment plan for most Medicare inpatient services in the United States. The payment plan was intended to control rising health care costs by paying a fixed amount per patient. The program of DRG reimbursement was based on the premise that similar medical diagnoses would generate similar costs for hospitalization. Therefore, all patients admitted for a surgical procedure such as hernia repair would be charged the same amount regardless of actual cost to the hospital. If a patient's hospital bill should total less than the amount paid by Medicare, the hospital is allowed to keep the difference. If, however, a patient's bill is more than that reimbursed by Medicare for a specific diagnosis, the hospital must absorb the difference in cost. See also appendix of Diagnosis-Related Groups.Miller-Keane Encyclopedia and Dictionary of Medicine, Nursing, and Allied Health, Seventh Edition. 2003 by Saunders, an imprint of Elsevier, Inc. All rights reserved. (d'ag-n'sis), The determination of the nature of a disease, injury, or congenital defect. [G. diagnsis, a deciding] Farlex Partner Medical Dictionary Farlex 2012 (dg-nss)n. pl. diagnoses (-sz) 1. Medicine a. The act or process of identifying or determining the nature and cause of a disease or injury through evaluation of patient history, examination, and review of laboratory data.b. The opinion derived from such an evaluation.2. a. A critical analysis of the nature of something.b. The conclusion reached by such analysis.3. Biology A brief description of the distinguishing characteristics of an organism, as for taxonomic classification.The American Heritage Medical Dictionary Copyright 2007, 2004 by Houghton Mifflin Company. Published by Houghton Mifflin Company. All rights reserved. The process of identifying a disease based on a persons signs and symptoms, which may be gleaned from a simple physical examination or require ancillary testing, lab work, imaging studies, etc.Segen's Medical Dictionary. 2012 Farlex, Inc. All rights reserved. Decision-making The process of determining, through examination and analysis, the nature of a Pt's illness; the process of identifying a disease by signs and symptoms; the label for a particular condition. See Computer-assisted diagnosis, Differential diagnosis, Deferred diagnosis, Definitive diagnosis, Direct diagnosis, Electrodiagnosis, Indirect diagnosis, Leading diagnosis, Misdiagnosis, Primary diagnosis, Secondary diagnosis, Wastebasket diagnosis, Working diagnosis. McGraw-Hill Concise Dictionary of Modern Medicine. 2002 by The McGraw-Hill Companies, Inc. (d-g-n'sis) The determination of the nature of a disease, injury, or congenital defect. See also: nursing diagnosis[G. diagnsis, a deciding]Medical Dictionary for the Health Professions and Nursing Farlex 2012 The art and science of identifying the disease causing a particular set of clinical signs and symptoms. Differential diagnosis is the selection of one from a list of diseases that present in a similar way. From the Greek dia , through, and gnoskein , to perceive.Collins Dictionary of Medicine Robert M. Youngson 2004, 2005 a statement that distinguishes the particular TAXON in question from other similar taxa, in terms of the most important characters. identification of a particular pathological or physiological condition deduced from characteristic symptoms, or the procedure to achieve such an identification. Collins Dictionary of Biology, 3rd ed. W. G. Hale, V. A. Saunders, J. P. Margham 20051. Term that indicates the disease (e.g. pulmonary tuberculosis) or the refractive error (e.g. compound myopic astigmatism) that a person has. 2. The art of determining a disease or visual anomaly based on the signs, symptoms and tests.Millodot: Dictionary of Optometry and Visual Science, 7th edition. 2009 Butterworth-Heinemann(Dx) (d-g-n'sis) The determination of the nature of a disease, injury, or congenital defect. [G. diagnsis, a deciding]Medical Dictionary for the Dental Professions Farlex 2012Q. How is the diagnosis of autism made? My friend has a child who is suspected to have autism. I wanted to find out more about making the diagnosis of autism.A. Diagnosing autism is not an easy task, especially when there are several other conditions that might confuse the clinician with this disorder or spectrum of disorders. The child usually has several symptoms that suggest an autistic disorder, such as impaired social behavior. Several diagnostic instruments (tests) are available. Two are commonly used in autism research: the Autism Diagnostic Interview-Revised (ADI-R) is a semistructured parent interview, and the Autism Diagnostic Observation Schedule (ADOS) uses observation and interaction with the child. The Childhood Autism Rating Scale (CARS) is used widely in clinical environments to assess severity of autism based on observation of children. A pediatrician commonly performs a preliminary investigation by taking developmental history and physically examining the child.. If warranted, diagnosis and evaluations are conducted with help from ASD specialists, observing and assessing cognitive, communication, family, and other factorsQ. Is the diagnosis correct? I have been diagnosed bipolar and was previously diagnosed with depression and ADHD how I know the diagnosis is correct this time?A. a psychologist/psychiatrist should also have the possibility with a questionary to detect if you have bipolar disorder and/or adhd. i have both and live with it since i am a child. i had my first "out-of-control"-crisis with 29 years. in the meantime i am 46 (in two days) and i still live! i had also many times the wish to make suicide, but this is the worst solution. do you live alone? do you have a dog? do you have a job? what are your talents? what do you love to do in life? write it down and look what you could put on a focus. what are the things you do daily that allows you to stop thinking of all your trouble? write it down. to make a puzzle? play chess with your neighbor? to chat online? you only can collect what could help you in such cases to keep the bad thoughts you have away from yourself. there is always at least one good solution. i give you here some ideas. never give up! thank youQ. Who was the first person to be diagnosed with ADHD? Here is a question which I find very difficult to get an answer. Who was the first person to be diagnosed with ADHD? Take it easy to answer me my new friend. Thanks in advance.More discussions about diagnosisThis content is provided by iMedix and is subject to iMedix Terms. The Questions and Answers are not endorsed or recommended and are made available by patients, not doctors. Want to thank TFD for its existence? Tell a friend about us, add a link to this page, or visit the webmaster's page for free fun content. Link to this page:

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