REVIEW

How Expert Clinicians Intuitively Recognize a Medical Diagnosis

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ABSTRACT

Research has shown that expert clinicians make a medical diagnosis through a process of hypothesis generation and verification. Experts begin the diagnostic process by generating a list of diagnostic hypotheses using intuitive, nonanalytic reasoning. Analytic reasoning then allows the clinician to test and verify or reject each hypothesis, leading to a diagnostic conclusion. In this article, we focus on the initial step of hypothesis generation and review how expert clinicians use experiential knowledge to intuitively recognize a medical diagnosis.

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A medical diagnosis, such as acute myocardial infarction, often is defined by rules or criteria that are codified by panels of experts.[1,2] At the outset of making a diagnosis, however, those rules could not be further from the mind of a clinician. Rules are used for analyzing and verifying a diagnosis, but the initial diagnostic step used by expert clinicians is not rule based. The ability of expert clinicians to recognize a possible diagnosis is intuitive, nonanalytic reasoning.[3,4]

More than 4 decades ago, a number of researchers independently deconstructed the diagnostic process and found that expert clinicians use the same process of hypothesis generation and verification that is generally used for reasoning by beginning medical students.[5-8] The skill of master diagnosticians was not due to a distinctive reasoning process, but instead depended on a clinician's ability to access knowledge from past experience to generate short lists of possible diagnoses. Elstein et al[5] and Barrows et al[7] noted that expert clinicians developed 3 to 5 hypotheses within seconds to minutes of starting a diagnostic inquiry.

Barrows et al[7] showed that early hypothesis generation was critical to the accuracy of the eventual diagnosis. If the clinician thought of the correct diagnosis within 5 minutes, eventual accuracy was 98%; if not, accuracy decreased to 25%.[7] In a subsequent study of primary care physicians, the correct diagnosis occurred to the clinician on the basis of only the chief symptom in 78% of cases.[9] A study of emergency physicians showed that clinicians generated 25% of the diagnostic hypotheses before even meeting the patient and 75% of the hypotheses within the first 5 minutes of the clinical encounter.[10] The cognitive psychologist Herbert Simon described this astonishing human ability by stating: "the situation has provided a cue; this cue has given the expert access to information stored in memory, and the information provides the answer. Intuition is nothing more and nothing less than recognition."[11]

DIAGNOSTIC CATEGORIES

Generating diagnostic hypotheses is a categorization process. Psychologists describe how various decision-makers form categories and how they place new objects into those categories. According to psychologist Douglas Medin, "a category is a partitioning or class to which some assertion or set of assertions might apply."[12] A diagnostic category is useful because it allows the clinician to make inferences and predictions about patients assigned to the diagnostic category.

When placing a patient with specific signs and symptoms into a category (eg, myocardial infarction), experts with prior experience can immediately recognize that acute myocardial infarction is a diagnostic possibility because the patient resembles a prior patient with acute myocardial infarction. This ability to place a patient in a diagnostic category is similar to the general ability to place a common object such as a bird, dog, or chair into a category. People can recognize a variety of birds, ranging from a robin to a penguin, because they have seen a variety of birds before and have placed them in memory under the category of birds. Likewise, expert clinicians can recognize a broad range of patients with acute myocardial infarction because they have seen a variety of patients with acute myocardial infarction before and have placed them in long-term memory under the category of acute myocardial infarction.

Diagnostic possibilities are not always immediately recognizable, requiring the clinician to connect the clinical cues, like piecing together a jigsaw puzzle. To help this process, clinicians are taught to take a patient's history and organize it into a narrative.[13-16] A narrative is a way of organizing a story by adding context and detail, and assigning priority and weight to elements of the narrative. When an expert clinician retells the story, the patient's words become the doctor's words. "I'm short of breath" becomes "dyspnea," and "I broke out in a sweat" becomes "diaphoresis." The experienced clinician will add semantic qualifiers, which are meaningful adjectives such as "acute" or "chronic," and "episodic" or "continuous" to fully describe a clinical presentation.[17] Humans are natural storytellers, and often the diagnosis is more recognizable when the patient's story is organized as a coherent narrative.

Abstracting the meaning from the patient's history and re-representing the patient's findings as a succinct summary or problem statement is another opportunity to recognize that the patient belongs to a diagnostic category. In ill-defined, complex cases, pattern recognition may not be sufficient, and experts will adapt by relying more on analytic reasoning based on causal or conceptual knowledge. Clinicians may consult other specialists, bringing additional experiential and conceptual knowledge to bear to solve difficult cases.[18,19]

HOW KNOWLEDGE OF PAST EXPERIENCE IS STRUCTURED

If the ability to recognize a diagnosis is less dependent on a distinctive reasoning process and more dependent on knowledge of past experience, it is important to understand how memories of past experiences are stored and retrieved. Investigators have promoted a number of theories to explain how we structure experiential knowledge.[20-27] Knowledge is remembered in context, and experiential knowledge gained from direct experience is structured differently than formalized biomedical knowledge gained from abstract (eg, book) learning. Experiential knowledge is remembered as instances of past experience, often referred to in the psychology literature as "exemplars": prior experiences that have been categorized and stored in memory.[22] Assigning an experience to a category gives it meaning, a process called "instantiation." With experience, a category will contain a number of exemplars that are stored in a nearly limitless long-term memory and are automatically retrievable.

Each clinical encounter is represented in long-term memory in a unique and idiosyncratic fashion, attending to key features of the presentation that hold meaning specific to that clinician. This representation may contain both the relevant features of the disease and other features unique to this specific person. Because each clinician has unique patient experiences, the exemplars available to each clinician is a product of his or her unique experiences and not generalizable among clinicians.

When encountering a patient with chest pain, an expert may recognize that the patient is a variant within the category of acute myocardial infarction (eg, posterior myocardial infarction or non−ST elevation myocardial infarction) or is a variant of myocardial infarction mimics (eg, type A aortic dissection or pericarditis) based on pattern recognition and the degree of association with existing exemplars in each category. As learners become experts, exemplars can be compared and contrasted to help the learner remember how different disease categories have overlapping and distinguishing features.[28]

Patient presentations vary. Some patients have many disease features, and some have only a few. Exemplars help us handle the variation of disease presentation and allow us to recognize patients who lack all of the typical features of a disease.

Common presentations are repeatedly encountered, resulting in more numerous exemplars that are recalled more readily. This gives the expert an intuitive sense of the base rates of features within a category.[24] Experienced clinicians know intuitively that patients with acute myocardial infarction frequently present with chest pressure radiating to

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CLINICAL SIGNIFICANCE

- Expert clinicians use intuitive, nonanalytic reasoning to generate approximately 3 to 5 diagnostic hypotheses early during a diagnostic encounter.

- Prior experience, structured in long-term memory as exemplars, enables clinicians to automatically and effortlessly recognize diagnostic hypotheses.

- Research is pointing to ways that learners can make the most of experience to optimize the way they use experiential knowledge to generate diagnostic possibilities.

- Research provides guidance for educators and clinicians on what works and what does not work for improving the diagnostic process.