A Picture Says a Thousand Words: How Visual Diagnostic Decision Support Improves Diagnosis and Quality of Care

Medical errors and startlingly high levels of misdiagnosis have taken a toll on the public's view of our health care system. The human costs, mistrust in the system, and economic impact is considerable. According to recent studies, nearly 20% of diagnoses are incorrect. Why such levels? The nature of medical school training, financially driven time pressures put on doctors, a fragmented system, and ever-increasing medical data are part of the problem. There is simply too much to know and certainly too much for any primary care doctor to possibly memorize.

Why is it then that diagnostic decision support is rarely used? For all the hand wringing and conversations around improving quality of care, this technology is often discussed but rarely implemented. Doctors cite complexity, cost, workflow difficulties, and outright skepticism that clinical decision support works.

What can change this? The missing element in clinical decision support that counters all of these claims comes down to pictures. This may seem simplistic, but visual diagnostic decision support addresses the non-analytical, instantaneous perceptual moment occurring when the doctor examines the patient and then recognizes or does not. Visual diagnostic decision support can help tremendously, considering that half of all diseases have a skin or pattern clue, and 10–20% of a general practitioner's diagnosis is visually based. Yet generalist practitioners receive minimal training in how to recognize these clues.

The Challenges of Diagnosis

Medical errors around physician orders and drug reactions grab headlines, but the more serious and underlying concern is misdiagnosis. The attention away from diagnosis-as-error is due to the systemic and cultural complexities of reporting and collecting data on diagnostic errors. Yet diagnostic error leads to incorrect treatment, failure to use an indicated diagnostic test, misinterpretation of test results, and failure to act on abnormal results. Cognitive errors may result in poor quality of care, patient safety risks, increased costs, and in some cases, malpractice litigation.

In their medical education, physicians are provided a highly structured method in which to think, and they habituate this methodology throughout their training and subsequent practice. Medical education stresses memorization of basic science and clinical facts; this means that students must focus on prototypical "classic cases" rather than learning all the variants. As the medical student moves from the classroom to residency apprenticeship years, training shifts to "practice-based" learning from unique clinic or hospital patient cases. These residents soon realize that most patients do not neatly present as the textbook suggests. Thus, the life-long learning of the physician begins. Expertise is bred from experience; expertise evolves from interaction with thousands of patients, learning from the twists and turns of each individual "case," synthesizing and remembering the vast array of symptom and examination patterns over a career. Our patients hope we have this expertise and assume if we are early in our careers we have developed a methodology to think about, recognize, and diagnose their problem regardless of how much experience we actually have. Yet a great number of patients will appear in our offices with patterns we have never seen in practice or read in texts. If you practice family, internal, pediatric, or emergency medicine, you are expected to recognize the pattern and make diagnoses that span all of the medical specialties. Given the immense variation of disease, it is clear that the frequent variants of the common as well as the rare diagnoses might be difficult for these non-specialty physicians to recognize, even after 20 years of practice, never mind the first 5 or 10.

There are hundreds – if not thousands – of skin, eye, and oral clues of diseases. When physicians are faced with making a diagnosis from skin or pattern-recognition-based clues, they readily admit they are insufficiently trained to recognize visual clues. This

challenge is compounded every day in fast-paced clinics, emergency rooms, and hospitals, where generalists are forced to make quick decisions, often with incomplete data and a dearth of experience in evaluating the subtleties of disease characteristics.

Many practitioners falsely believe that search engines are an answer. But you cannot search by a diagnosis if you do not know the diagnosis, and there is the matter of accuracy. In a study by Tang, et al, Google-aided diagnoses were accurate 58% of the time. This rate is poor and would never be acceptable for pilot cockpit data, nor should it be for medicine.

Diagnostic decision support systems, though rarely used, allow physicians to enter their patient symptoms and other medical factors, such as laboratory results, to build a text-based listing of diagnostic possibilities. All of the diagnostic systems to date limit the dynamic nature of medical diagnosis and do not allow for the incorporation of perceptual and visual data into clinical thinking. Many physicians do not know how to describe with words the visual clues and patterns they observe, and extensive words on a page or screen make it difficult to recognize patterns of disease. Furthermore, the findings in the physical examination are essential elements for diagnostic acuity.

Building Better Efficacy: The Value of Visuals

Accurate diagnostics involves the synthesis of complex, often ambiguous data and clinical judgment by the physician. Experienced physicians have an extensive knowledge base that matches up the features of the case at hand with one or more patterns. These decisions for rare diseases and variants are highly accurate when made by experts, but generalists lack that knowledge base, especially with regard to the intricacies of visual clues.

One of the greatest areas of information-need in medicine is a visual approach for pattern recognition. Developed from this need is a visual diagnostic decision support system (VDDSS), organized to match the way a physician thinks about signs, symptoms, and diagnoses. It allows rapid visual and iconic search entry of visual patient clues and presents multiple images and graphics of each disease alternative, demonstrating how each might look at different stages and in people of different ages and ethnicities.

The difference between perception and cognition is a key differentiator between VDDSS and non-visual diagnostic decision support systems. In contrast to prior efforts in diagnostic decision support, the VDDSS's database interface and information strategy facilitate rapid comparisons and visual differential-diagnosis generation. Many internal diseases present with visual clues that can be used as a leveraging tool when making a diagnosis. These objective clues and signs of internal disease often go unrecognized and uninterpreted by primary care clinicians, resulting in delayed diagnosis and reduced quality of care.

VDDSS's utilization of search technology that requires data entry of patient problems and patient factors provides a way to both narrow the scope of search results and simultaneously sort through a multitude of images to show not just the most common visual, but an image that is closest to the morphology entered by the user.

Databases can catalog variation much more easily than the human brain can. Combined with a purposefully designed visual display, image variants can be displayed to assist the user in recognition. The human brain has remarkable innate abilities to pattern-match between like images, but until now our human-computer interfaces in medicine have not been optimized to facilitate simultaneous pattern matching and differential-diagnosis generation.

By entering and selecting a patient's findings as a combination of text and images, clinicians can build a customized pictorial differential diagnosis in seconds, drawn from thousands of medical photographs and revealing the variation in presentation between – as well as within – diseases.

In conclusion, VDDSS solutions bring decision support to new levels of efficacy. The unusual variants of the common as well as the rare diagnoses are often difficult for the non-specialist to recognize because of broad training necessarily focused on prototypical "classic cases" across a wide area of medicine. Information tools that allow physicians to enter patient factors and perceptual and visual data provide powerful benefits for

achieving more in-depth knowledge and, therefore, diagnostic acuity. Visuals and data allow diagnosticians the best of both worlds: a superior technologic synthesis of complex data along with the physician's clinical judgment.

About the Author

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