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SPECIAL REPORT

Decision-support systems in patient diagnosis and treatment

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The encyclopedic knowledge of the experienced clinician is an obvious advantage when facing a difficult diagnostic problem. The depth and breadth of their knowledge can be replicated by a computer database, or large decision-support systems, which can be accessed by the student or inexperienced clinician. The software may prompt them to consider alternative diagnoses and further tests that may distinguish between competing hypotheses. Systems like these can aid the physician, but they lack the understanding, empathy and compassion of the good doctor and therefore cannot substitute for the physician's diagnosis. Microdecision-support systems perform a more limited, specialized function, such as the interpretation of electroencephalogram tracings and as differential blood-count analyzers. They are usually associated with particular devices.

Clinicians make important diagnoses and treatment recommendations every day, often without the benefit and reassurance of absolute certainty. There are many complex factors, such as the financial costs of further tests, their practical benefit and accuracy, as well as current accepted opinion and research evidence, which play a part in the diagnostic decision.

Is diagnostic error common?

Accurate information regarding the prevalence of inadvertent diagnostic error is difficult to determine given the litigious nature of some patients and the unwillingness of clinicians to expose themselves to professional censure. The possibility of medical diagnostic error must always be considered. Negligence is associated with a large proportion of diagnostic mishaps (75% in the study by Leape [1]). It is the most vulnerable patients, those requiring multiple interventions, and those who remain in hospital for the longest duration that are the most likely to bear the brunt of serious injury as a result of medical mistakes [2]. When a patient attends a clinician with symptoms and seeking a diagnosis, the clinician will take into account the general prevalence of a disease in forming a provisional diagnosis. Using further detailed information derived from the patient's symptoms, a meticulous patient examination and further diagnostic tests, the clinician reduces the initial uncertainty to obtain a definitive diagnosis. Errors can occur in assessing the initial likelihood of a disease in the provisional diagnosis, since the unusual is much more memorable than the mundane. In addition, the inexperienced clinician may order additional tests to confirm a diagnosis rather than to discriminate between equally likely results, or else misinterpret the results of a test.

How can we improve our diagnostic ability?

Given the severe adverse effects that can result from diagnostic error, a more rational, quantitative approach is required. Authoritative decision-support systems are increasingly available based on best practice. These should not aim to undermine the responsibility of the clinician, but rather provide a useful interaction. Using decision-support systems, clinicians can be provided with expert diagnosis and recommendations to aid clinical decision making and thus avoid errors.

Kawamoto and colleagues undertook a systematic review of trials that aimed to identify those features that were more likely to result in the successful adoption of these expert systems and improve clinical practice [3]. A total of 70 studies, involving approximately 6000 clinicians and 130,000 patients, were included in the final analysis. They found that improved clinical practice resulted if the automated technology was blended with the clinician's work pattern and was available at the time when the decision was being made, if it provided a recommendation rather than an assessment and if a computer was used to generate the decision support. Of the systems possessing all four features, 94% significantly improved clinical practice. Decision-support systems that require the clinician to collect further data and perform complex calculations to assess the risk of a disease, and which resulted in no diagnostic or treatment recommendations to the clinician, would be quickly discarded.

Keywords: decision support systems, DXplain®, Iliad, medical diagnostic error

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What large-scale diagnostic-support systems are available?

Diagnostic-support systems can introduce students to the diagnosis and management of rarer diseases, which they may not encounter during training. Even with the more common diseases, they may be prompted to consider alternative or related diagnoses. One such system, Iliad, developed by the University of Utah Department of Medical Informatics, UT, USA, is primarily used to train students in internal medical diagnosis and advise cost-effective work-up strategies by using simulated case presentations [4]. The system can correct a student's tendency to overlook a particular diagnosis, will improve the interpretation of diagnostic test data and prevent students from making premature, unjustified diagnostic conclusions [5]. DXplain®, a web-based clinical diagnostic decision-support system, developed at the Laboratory of Computer Science at the Massachusetts General Hospital, MA, USA, has the purpose of providing a ranked list of diseases that are associated with particular clinical findings. The diagnostic interpretation by the program is explained.

The diagnostic performance of DXplain and Iliad systems were compared and neither was found to score better than the other on all performance measures [6]. Even in situations where decision-support tools have been found to not substantially improve the quality of primary patient care, the diagnostic performance of less experienced physicians may have been improved [7].

Conclusion

Decision-support systems have the potential to train medical students and inexperienced doctors to generate a differential diagnosis and use resources effectively to arrive at the correct diagnosis. They find their optimal application in the clinic with the patient, at the point of use. However, these systems may be regarded as extensions of electronic learning or simulated clinical environments, with which students may already be familiar. Clinical scenarios that allow the student to investigate and manage a virtual patient are becoming common educational practice. The construction of appropriate cases can be burdensome, but teachers may find decision-support systems helpful in ensuring that all possible choices and outcomes are presented.

Future perspective

Decision-support systems can be divided into large-scale systems, which attempt to diagnose large areas of medicine, and microsystems, which perform a more specialized, niche role, for example the interpretation of electroencephalogram tracings and automated differential blood-count analyzers. In the next 5–10 years, the authors foresee a greater use of these microdecision-support systems, especially when they are associated with a particular automated device. The large-scale systems may be associated with increased costs; a longer physician's consultation, the costs of additional computer hardware, software and any upgrades associated with continued modification of the information-intensive environment. Whether the increased costs are associated with significant improvements in patient, student and clinician benefit will determine the future success of the large-scale systems.

Executive summary

Is diagnostic error common?

- The possibility of diagnostic error must always be considered.
- Errors may occur in assessing the likelihood of disease or in requesting inappropriate additional tests.

How can we improve our diagnostic ability?

- Decision-support systems provide recommendations to aid clinical diagnosis.
- Large-scale decision-support systems need to be integrated into the hospital patient information and laboratory data systems.

What large-scale diagnostic support systems are available?

- Iliad (developed by the University of Utah, Department of Medical Informatics, UT, USA).
- DXplain® (developed by the Laboratory of Computer Science at the Massachusetts General Hospital, MA, USA).
- Other systems.

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