Medical Teacher

ISSN: 0142-159X (Print) 1466-187X (Online) Journal homepage: http://www.tandfonline.com/loi/imte20

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To cite this article: Robert L. Trowbridge MD. (2008) Twelve tips for teaching avoidance of diagnostic errors, Medical Teacher, 30:5, 496-500, DOI: 10.1080/01421590801965137

To link to this article: http://dx.doi.org/10.1080/01421590801965137

2008; 30: 496–500 MEDICAL TEACHER

TWELVE TIPS

Twelve tips for teaching avoidance of diagnostic errors

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Abstract

Background: Despite an increasing emphasis on patient safety on the part of healthcare systems worldwide, diagnostic error remains common. Errors frequently result in significant clinical consequences and persist despite remarkable advances in diagnostic technology. Most medical students and physician trainees receive little instruction regarding both the root causes of diagnostic errors and how to avoid such errors.

Aims: This installment of the '12 tips' series discusses how to familiarize the learner with the cognitive underpinnings of diagnostic error. It also describes how to teach several approaches to the diagnostic process that may lessen the likelihood of error.

Methods: Specific educational practices are discussed in detail. Emphasis is placed on describing meta-cognitive techniques, promoting the value of the clinical examination, and employing simple diagnostic strategies, including 'diagnostic time-outs' and the practice of 'worst-case scenario' medicine.

Conclusions: Clinical educators may help learners avoid diagnostic errors by employing several of the educational techniques described herein.

Introduction

Spurred by the publication of the Institute of Medicine report 'To Err is Human' in 1999 (1999) the pursuit of improved patient safety has assumed a prominent role in the American healthcare system. Despite the investment of significant resources, however, progress toward a safer system has been slow (Wachter 2004; Pronovost et al. 2006). One particular area with little demonstrable improvement is that of the avoidance of diagnostic error. Indeed, although diagnostic error, and more specifically its causes, has received significant attention in the lay press, (Groopman 2007a, b) there is a relative dearth of medical literature on the subject.

Physicians frequently misdiagnose patients, despite significant improvements in diagnostic technology, including advanced imaging techniques (Shojania et al. 2003, 2005; Graber et al. 2005). The causes of many such diagnostic errors are known and complex constructs have been proposed for the classification of these errors (Croskerry 2002, 2003a, b; Graber et al. 2002; Gordon & Franklin 2003). Most physicians and trainees, however, have little insight into the cognitive and systems-based underpinnings of diagnostic error. They are often additionally unaware of diagnostic techniques that might prevent these errors. The following tips demonstrate how teachers can both familiarize learners with the common causes of diagnostic errors and provide them with simple strategies to avoid these errors.

Tip 1

Explicitly describe heuristics and how they affect clinical reasoning

Most clinicians are only vaguely aware of the existence of heuristics and have little appreciation for the effects, both constructive and detrimental, they have on medical decision-making (Croskerry 2002). By increasing learner familiarity with the most common heuristics and their effect on the diagnostic process, teachers may prompt learners to reflect on the specific effect of heuristics on their own clinical decisions (Croskerry 2000, 2003b; Graber 2003). Common heuristics include (Croskerry 2002, 2003a):

- Availability heuristic: This occurs when physicians make a diagnosis based on what is easily accessible in their minds, rather than what is actually most probable. Diagnoses that are very frequent in a particular setting (i.e. influenza in the winter) or particularly memorable cases (the fascinating 'zebra') can draw physicians toward these particular diagnoses even when the clinical presentation is more consistent with an alternate diagnosis.
- Anchoring heuristic and confirmation bias: Physicians may settle on a diagnosis early in the diagnostic process and subsequently become 'anchored' in that diagnosis. Physicians may also become anchored in a specific symptom or sign. As a result of this anchoring, they may

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ISSN 0142–159X print/ISSN 1466–187X online/08/050496–5 © 2008 Informa UK Ltd.
DOI: 10.1080/01421590801965137

discount clinical information discordant with the original provisional diagnosis and accept only that which supports that diagnosis (confirmation bias).

- Representativeness heuristic: Physicians depend greatly on this cognitive short-cut in which a patient's presentation is compared to a 'typical' case of specific diagnoses. This can be a very useful process and underlies the pattern recognition that is the basis for much of clinical thought. However, this heuristic may fail the clinician when a patient presents with 'atypical' signs or symptoms as the correct diagnosis is discounted because the clinical presentation does not follow the typical pattern for that diagnosis.

Tip 2

Promote the use of 'diagnostic timeouts'

Patient safety in the surgical suite has been significantly enhanced through the use of 'time-outs', where the procedure is interrupted to ensure that certain parameters of safe care have been met, including patient identification and surgical site selection (Altpeter et al. 2007). A similar approach can be applied to the diagnostic realm whereas a 'time out' is taken by the diagnostic team to reflect on the current working diagnosis and the evidence supporting that diagnosis. Similar to the practice of having a colleague review a case to allow a 'fresh look', this practice entails reviewing the data available without framing it with the current diagnosis and re-building a differential diagnosis from the ground up. Although this may seem to be a time-consuming exercise, current electronic medical records systems may allow for the rapid review of a significant amount of data in a short period of time. To be effective, however, a conscious effort must be made not to frame the data using the current working diagnosis.

This approach may also be of great value in evaluating patients with 'established' diagnoses. All too often, a patient is labeled as having a particular disorder solely on the basis of miscommunication and 'chart rumor'. Learners should be reminded that health literacy among patients is often lacking and patients may not recall what would seem to be the most basic components of their medical history (Baker 1999; Paasche-Orlow et al. 2005). Prompting learners to be skeptical and take a 'diagnostic time-out' to review the evidence supporting a reportedly established diagnosis can be an effective technique to prevent propagation of a diagnostic error.

Tip 3

Promote the practice of 'worst-case scenario medicine'

Physician trainees may direct the evaluative process toward the least ominous and serious diseases on the differential diagnosis for a particular presentation. Lack of experience and confidence in dealing with life-threatening diseases as well as goodwill toward the patient may all contribute to this phenomenon. Furthermore, many serious disorders, including acute coronary syndrome, pulmonary embolism and necrotizing fasciitis, can be difficult to diagnose. Yet, this tendency can have devastating results if a serious underlying illness is indeed present. Clinical teachers can help learners avoid this trap by encouraging them to practice 'worst-case scenario medicine'. This technique involves immediately invoking the worst possible diagnoses when faced with a particular problem (Croskerry 2000; Sandhu et al. 2006). All patients with chest pain, for example, must have the diagnoses of acute coronary syndrome, pulmonary embolism, pneumothorax, aortic dissection and pericarditis specifically and consciously considered by the clinical learner early in the diagnostic process.

This technique does have the potential to increase inappropriate testing for deadly but rare disorders. When teachers emphasize that considering a diagnosis does not mandate testing for a diagnosis, however, it is not likely to do so. Rather it is likely to result in a greater degree of appropriate diagnostic evaluation for devastating diseases that otherwise may not have been considered.

Tip 4

Promote the use of a systematic approach to common problems

It is well-established that most clinicians have only a small number of disorders in their working differential diagnosis after initially evaluating a patient. As a result, many diagnoses that are possible but not likely are never seriously considered. Although this 'limiting' frequently leads to the correct diagnosis, its practice is subject to a great deal of bias and may contribute significantly to diagnostic error. By promoting a systematic but streamlined approach to common medical problems or syndromes, one allows for the consideration of most potential diagnoses in a short period of time (Coderre et al. 2003). Using this approach, the clinician is forced to consider multiple diagnoses beyond the several that appear most likely on first pass. Although some learners may balk at the prospect, for example, of considering Wegener's Granulomatosis in every single patient with acute kidney injury, a systematic evaluation for many common medical conditions can usually be completed rapidly. Several appropriate examples include:

- using an anatomical approach to chest pain, with learners describing the structures within and proximate to the thorax and working through how each of those structures could be the source of pain;
- using the 'pre-renal/intrinsic renal/post-renal' construct for acute kidney injury.

Tip 5

Ask why

A considerable proportion of medical care revolves around the management of exacerbations of chronic underlying diseases. Patients with acutely decompensated congestive heart failure or chronic obstructive pulmonary disease

(COPD), for example, account for a significant percentage of adult hospitalizations (Adams et al. 2007; Onwuanyi & Taylor 2007). It is tempting for the clinician to limit the diagnostic evaluation to establishing that an 'acute exacerbation' of the underlying disorder is present. Yet, for many patients, the cause of the exacerbation may be as or more important than the underlying disease itself. In patients with unexplained exacerbations of COPD, for example, up to 25% may have concomitant venous thromboembolic disease (Tillie-Leblond et al. 2006).

Teachers, when faced with a patient with what appears to be a routine exacerbation of a well-established underlying disorder, may prevent the learners from overlooking such concomitant diagnoses simply by asking 'Why did this happen?'. The teacher can continue with the 'Why?' questions until a specific discrete explanation for the acute worsening is proposed, if not established. Although learners may resist turning a 'simple' case into a difficult one, this approach reinforces the importance of examining all cases in detail. Learners may additionally quickly adopt this approach when it allows them to make a diagnosis that had been overlooked by their peers, such as the environmental trigger to a patient with recurrent asthma exacerbations.

Tip 6

Teach and emphasize the value of the clinical exam

Advances in diagnostic technology have led to an outsized emphasis on laboratory and radiology testing as a means of establishing diagnoses (LaCombe 1997; Bordage 1995; Feddock 2007). Yet, the clinical examination, inclusive of the history and physical, remains crucial to the evaluation of most patients, including those with disorders as disparate as pulmonary embolism, stroke and acute cholecystitis (Hampton et al. 1975; Chunilal et al. 2003; Trowbridge et al. 2003). Although many clinical decision support models have been developed to guide the inexperienced clinician, even the most widely utilized of these models incorporate some degree of 'clinical gestalt' (van Belle et al. 2006; Wells 2006). In addition, such models may have difficulty in explaining the robust performance of experienced clinicians.

In emphasizing the clinical exam and demonstrating its value at the bedside, the clinical teacher may decrease reliance on a single test and encourage learners to incorporate all available information into their diagnostic decision-making. This process forces the learner to consider all data, including advanced laboratory and imaging techniques, as a component of a comprehensive evaluation and not as stand alone tests. This serves to decrease diagnostic error by multiple means, including by decreasing the likelihood of premature closure (where a diagnosis is 'established' early on in the diagnostic process, often as the result of a test result, and all subsequent diagnostic efforts cease) and limiting 'unpacking' error (where alternate diagnostic possibilities are not considered because a clinical presentation or test result are considered specific for a particular diagnosis) (Croskerry 2002).

Potential means of accomplishing this include:

- Teaching at the bedside. It has been clearly established that both patients and learners enjoy bedside teaching (Lehmann et al. 1997; Thibault 1997; Ramani 2003; Ramani et al. 2003) and involving the patient in the diagnostic process has the potential to decrease miscommunication and error.
- Modeling the diagnostic process. Observing an experienced clinician proceed through the diagnostic process can have a significant impact on how learners approach a diagnostic challenge.
- Incorporating 'The Rational Clinical Examination' series from the *Journal of the American Medical Association* into rounds. This series describes evidence supporting the clinical exam while also clearly and concisely describing how to perform specific components of the exam (Simel & Rennie 1997).

Tip 7

Teach Bayesian theory as a way to direct the clinical evaluation and avoid premature closure

As described above, learners may over-rely on diagnostic testing to establish or refute a particular diagnosis. By employing Bayesian reasoning with the explicit use of pre-test and post-test probabilities, the teacher may demonstrate the danger of pre-mature closure. Pretest probabilities are available in the literature for a large number of clinical presentations and likelihood ratios for numerous tests are also readily accessible (Richardson et al. 2003). By walking the team through the diagnostic evaluation for a suspected problem after a series of tests, the danger of premature closure and unpacking error can be clearly demonstrated in mathematical terms that are easily comprehended (Kurzenhauser & Hoffrage 2002).

For example, in a patient with a low clinical likelihood of pulmonary embolism, one could assign a pretest probability of 9% (1990). If a CT scan is performed and reveals a pulmonary embolism, a common reaction may be to consider the diagnosis of PE to be established and halt the diagnostic process. This, however, could represent a diagnostic error as the likelihood of PE in this case remains unclear with a post-test probability of only 66%. (i.e. the combination of a pretest probability of 9% and a test with a positive likelihood ratio of 20 yields a post-test probability of 66%) (1990; Stein et al. 2006). By explicitly demonstrating to the learners this Bayesian process and demonstrating sometimes surprisingly high or low post-test probabilities, the teacher may prompt the learner to avoid premature closure and continue the diagnostic evaluation when appropriate.

Tip 8

Acknowledge how the patient makes the clinician feel

Although physicians may wish to think of themselves as dispassionate scientists when applying the diagnostic process, physicians are significantly affected by emotional bias

(Croskerry 2000). Physicians may ignore data that portends an ominous diagnosis in patients with whom they identify personally or for whom they have a particular affection. Physicians may also discount data in patients they find annoying or difficult and in those who are frequent consumers of medical care for 'trivial' problems (Croskerry 2007). Patients with psychiatric disease may be particularly vulnerable to this form of diagnostic error. Finally, physicians may simply be distracted for personal reasons and may commit diagnostic errors because of a lack of focus.

A means of teaching avoiding this form of error is to examine consciously one's reaction to a patient and explicitly acknowledge these feelings (Croskerry 2002, 2003b, 2007). This can be difficult to do for both the learner and the teacher, but modeling this behavior ('I admit I don't have the greatest rapport with this patient and I need to examine my decision-making to be sure my conflict with him is not affecting my clinical judgment') may be particularly effective. Specifically asking learners how they feel about a particular patient and how those feelings may be affecting their judgment can also be effective.

Tip 9

Encourage learners to find clinical data that doesn't fit with a provisional diagnosis; ask 'What can't we explain?'

Premature closure, as described above, and search satisfying (where no further diagnostic measures are pursued once a diagnosis is found) can be common causes of diagnostic error (Croskerry 2002; Graber et al. 2005) Indeed, Occam's Razor, the concept that the simplest explanation tends to be the best, is a commonly invoked diagnostic rule. Although Occam's Razor is a useful rule-of-thumb, many patients suffer from more than one diagnosis or have rare or complex diseases. One means of teaching the avoidance of the diagnostic traps of premature closure and search satisfying is to encourage learners to examine closely the available data for any findings that the 'established' diagnosis cannot explain (Croskerry 2003b). Learners may resist this process, however, viewing it as unnecessary and time-consuming. Yet engendering a degree of skepticism in learners towards 'established' diagnoses and promoting a comprehensive approach to the patient can help avoid these particularly common forms of diagnostic error.

Tip 10

Embrace zebras

Another common truism in clinical medicine states that 'if you hear hoofbeats, think horses, not zebras'. A variation on Occam's Razor, this guideline stresses that common disorders occur commonly and that one can waste a great deal of time and effort considering the rare diagnosis. Unfortunately, this maxim may be adopted in the extreme such that only the most common causes of a presenting complaint are considered at all. It is not uncommon, for example, for the differential diagnosis in a patient with dyspnea to be limited to pulmonary edema, pneumonia, obstructive lung disease and pulmonary embolism. Although these diagnoses are the cause of dyspnea in a substantial percentage of patients, concentrating on them alone to the exclusion of others results in a truncated clinical process and may contribute to delays and errors when less common disorders are present. By encouraging learners to 'embrace zebras' and at least consider (although not necessarily test for) less common disorders, learners may be substantially more likely to recognize them when they are indeed present. In the patient with dyspnea, for example, actively considering less common diagnoses such as hypersensitivity pneumonitis and primary pulmonary hypertension may render the learner more likely to recognize the presentation of these disorders.

Tip 11

Encourage learners to slow down

Proper diagnostic decision-making takes time, a resource that is all too scarce in the productivity-driven model of many modern healthcare systems. Trainees may additionally be particularly burdened by time constraints given the inefficiency common to inexperienced clinicians. Yet encouraging learners to slow down in their decision-making and take the time to consider the many facets of a particular case may significantly decrease errors. Although learners may be resistant to slowing down ('We've got to move on, we have seven more patients to see'), explaining the economy of 'doing it right the first time' may increase acceptance of this technique.

Tip 12

Admit one's own mistakes

All experienced and reflective clinicians can recall many cases in which they made a diagnostic error. In many cases, these errors were made for a multitude of reasons, including a failed heuristic, personal problems impinging on work performance, or the lack of consideration of a less common diagnosis. Explicitly discussing these cases with the learners can have a powerful impact on the learners' capacity for self-reflection and evaluation of their own diagnostic skills. Many learners low in the educational hierarchy may not appreciate the fallibility of the diagnostic skills of their 'superiors' and may be looking forward to the day when they become master diagnosticians and no longer doubt their diagnostic skills. As most experienced clinicians realize, however, this represents a naïve view of the art of medical diagnosis and disavowing this false anticipated confidence can have a profound effect on the naïve learner. This approach can also produce benefits beyond just reducing diagnostic errors (by producing an appropriate learning climate, for example). Unfortunately, admitting one's fallibility and limitations in the competitive environment of the academic medical center can be difficult.

Conclusion

The practice of clinical medicine is difficult and requires a wide range of aptitudes. As a result, and in part secondary to the vagaries of clinical medicine, errors in diagnosis are both widespread and difficult to avoid. Yet, though the use of a variety of techniques, the clinical teacher may help the inexperienced clinician adopt an approach to the patient that minimizes this exposure. These approaches may also encourage learners to embrace the uncertainty of clinical medicine and to enjoy rather than dread the diagnostic process.

Notes on contributor

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