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Defensive medicine and diagnostic testing

Abstract: Defensive medicine often involves the excessive ordering of diagnostic tests. Constantly aware of the risk of malpractice liability, physicians turn to diagnostic tests with the goal of reducing the likelihood of error. Findings reported in literature suggest that medical malpractice contributes significantly to the increased use of diagnostic testing and related costs. It has also been demonstrated that defensive testing not only increases costs but harms patients to a degree that depends on the risk incurred by the test itself, its false-positive and false-negative rates, the benefits and risks of available therapies, and the prior probability of disease. Several solutions have been proposed in the attempt to address this issue, but the physician's competence and training appear to be key factors, data from clinical trials showing that education and feedback for improving test-ordering tendencies have a prolonged effect. Particularly in the field of laboratory medicine, increasing attention is being paid to improving demand management in order to minimize inappropriate testing.

Keywords: defensive medicine; defensive testing; demand management; inappropriate request; liability; patient safety.

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Introduction

The excessive ordering of diagnostic tests is one of the most frequently encountered forms of defensive medicine, a deviation from sound medical practice induced mainly by the fear of liability [1, 2]. In 1994, a review of 16 surveys indicated that 20%–81% of physicians had increased their use of diagnostic tests because of liability concerns [3]. Physicians, aware that malpractice liability can make clinical errors more costly, resort to diagnostic tests that, they hope, will reduce the risk of diagnostic error. Believing that additional testing can protect physicians from liability if clinical errors are made, some diagnostic testing appears to be "defensive", being performed solely to reduce the risk malpractice liability [4]. Inappropriate testing and its relationship with medical specialties was highlighted in a relatively recent survey of physicians in six specialties at high risk of litigation (emergency medicine, general surgery, orthopedic surgery, neurosurgery, obstetrics/gynecology, and radiology) [5]. Fifty-nine percent of respondents reported that they often ordered more diagnostic tests than were medically indicated, the percentage being significantly higher for emergency physicians (70%) than for all other specialists. Similar percentages were found for orthopedic surgeons (62%), general surgeons (55%), gynecologists (54%), and neurosurgeons (50%), and more than half of the specialist physicians participating in the study stated that they resorted to clinically unnecessary computed tomography, magnetic resonance imaging, or radiography. Reportedly, technology was used to "pacify demanding patients, bolster their own-confidence, or create a trail of evidence that they (the specialists) had confirmed or excluded particular disease entities". It can be difficult to disentangle liability-related motivators from other factors influencing clinical decision making, such as the physicians' general desire to meet patients' expectations, consolidate and preserve trust, and avoid conflict [6]. In general, test ordering, a skill that changes over time, is related to several complex variables [7]. For example, interviews conducted to investigate factors contributing to inappropriate preoperative testing highlighted five major factors: 1) traditional practice; 2) the belief that other physicians involved want the tests done; 3) concerns related to medico-legal issues; 4) possible surgical delays or cancellation; and 5) ignorance of evidence and guidelines [8, 9]. However, two of the physicians surveyed expressed the concern that routine preoperative testing can actually increase risk of liability, believing that "if you don't check, you don't know, so you're not liable".

Overall, current evidence suggests that the medical malpractice system contributes significantly to the increased use of diagnostic testing and related costs. The fraction of inappropriate testing is difficult to determine

because there are no direct measures, most data obtained being based on physicians' subjective responses to questionnaires and vignette.

Excessive testing: a question of costs only?

The most common criticism of the practice of excessive test requesting is the unwarranted medical expenditure that it incurs. Moreover, a body of evidence demonstrates that defensive testing not only increases costs but also harms patients, as demonstrated several years ago by DeKay and Asch [4], who reviewed the threshold model developed by Pauker and Kassirer [10] using a simple decision tree with three alternatives (do not treat, test, treat) to ascertain when diagnostic testing provides more benefit than that yielded by treatment or no treatment. This model, provides a powerful conceptual framework for understanding diagnostic-test decisions using the physicians' utilities in addition to the utilities and true clinical needs of the patient. The main outcome of this approach is that the range of prior probabilities of diseases for which diagnostic tests yield the highest expected utility is different from the range found when only patients' utilities are used. When the range of prior probabilities is changed, the risk of patient harm is significantly increased for two reasons. First, invasive tests involve procedural risks that may not be justified in patients with a low prior probability. Second, diagnostic testing in patients with low prior probability increases the rate of false-positive and false-negative results, both of which increase in parallel with the number of tests requested [11, 12].

As shown in Figure 1, a diagnostic test may produce a positive or negative shift of prior probability, thus increasing the reliability of the initial diagnosis. In fact, there are three sets of probabilities: 1) the probabilities of the diagnosis before testing (prior probability), 2) the probabilities that a positive or negative result for a given test can be observed in each disorder diagnosed (conditional probabilities), and 3) the probabilities of the diagnosis after testing (posterior probabilities). The relation among the three sets of probabilities, the so-called Bayes' rule, has been understood for three centuries. However, this formulation has been applied to clinical reasoning only in the past several decades and, in particular, after the seminal papers published by Pauker and Kassirer [10, 13]. These authors introduced the threshold approach to clinical decision making

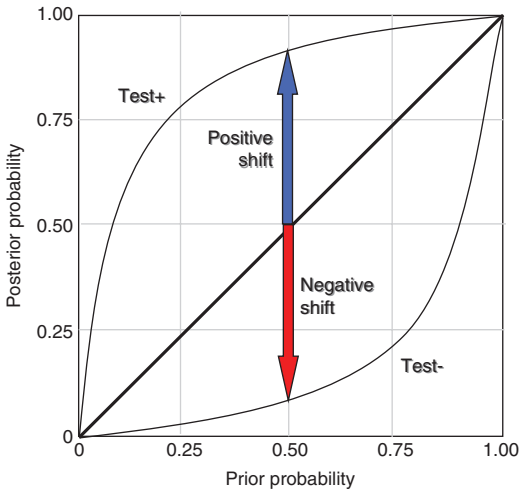

Figure 1 Impact of a positive or negative result of a diagnostic test on the clinical decision making process, based on prior probability.

linking the benefits and risks of testing to the probability of disease. Only tests with great accuracy may improve the diagnostic reasoning and provide a positive benefit to risk ratio, and therefore they should be defined "appropriate". For tests with lower accuracy, the risk for patients may exceed the benefits and, therefore, they should be defined "inappropriate". In addition, when the probability of disease is either very low or very high, it might not be altered by the test results to alter the diagnostic reasoning; in such cases testing not only is superfluous but it adds to the patient's burden of risk and expense. Figure 2 shows the impact of the accuracy and risk of a diagnostic test. The diagram on the lower left illustrates another hypothetical test that is more accurate or safer than the reference test shown at the top. In this case, as the test is more accurate and safer as compared with the reference test should be performed at both lower and higher probabilities than the reference test. By contrast, a test with lower accuracy or greater risk (diagram at the lower right) should be performed only when the disease probabilities lie in a narrow range [10]. In a patient who undergoes inappropriate tests because of the physician's liability concerns, the degree of harm that the test causes depend on: the risk it incurs, its false-positive and false-negative rates, the medical benefits and risks of available therapies, and the prior probability of disease [14]. In addition, the current increase in test volumes has made the management of results more complex, another factor potentially compromising patient safety and quality of care [15]. For example, it has been demonstrated that

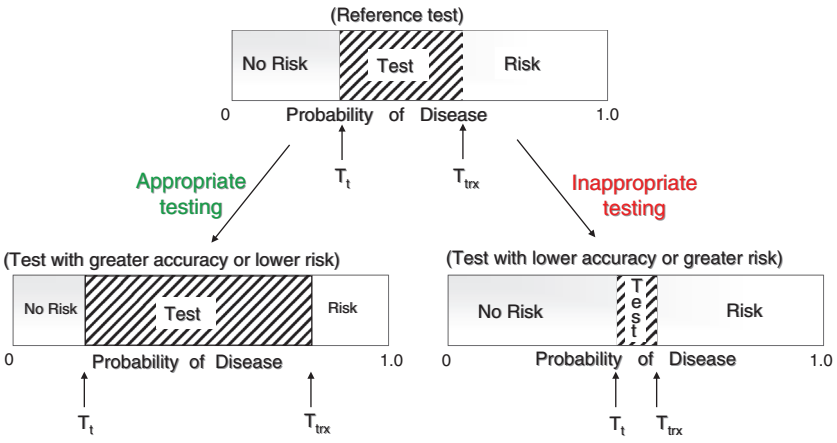

Figure 2 Effects of differences in accuracy and risks of diagnostic tests on clinical thresholds.
T_t, testing threshold, the probability of disease at which there is no difference between the value of withholding treatment/diagnosis and that of performing the test. Ttrx, test-treatment threshold, the probability of a disease at which there is no difference between the value of performing the test and that of diagnosing a disease/administering treatment (from reference [10], modified).

an inadequate follow-up in patients with critical abnormal test results greatly contributes to poor quality and unsafe care [16]. In a study of 4 high-risk categories of abnormal test results [Pap smears, mammographs, prostate-specific antigen (PSA), and International Normalized Ratio], Chen et al. found that one-third of the test results obtained failed to prompt an appropriate follow-up adequately recorded in the patient's chart, and of the cases in which appropriate follow-up was documented, almost half were not performed in a timely manner [17]. In their description of the failure to follow-up the results of laboratory tests and radiologic studies in patients re-referring after discharge, Roy et al. observed that almost half the discharged patients had pending laboratory and radiologic test results and that 9% of these results were potentially clinically actionable. The physicians involved were unaware of almost two-thirds of these potentially actionable results; more than a third of them called for a change in the patient's diagnostic or therapeutic plan, and 12.6% required urgent action [18].

Potential solutions

Although several variables affect so-called "non evidence-based test ordering", defensive medicine plays a key role [7]. Since test ordering is related to several complex variables no magic bullet is available to reduce inappropriate test requests. Most of the solutions proposed to address the issue of defensive testing (e.g., traditional tort reforms, alternative dispute resolution) attempt to limit liability by reducing the incidence of malpractice suits, and the amount of ensuing award [3]. However, the education of physicians appears to be a key factor in achieving the necessary improvement. Most clinical trials have shown education and feedback have a sustained effect on improvement in test-ordering tendencies [7]. In particular, clinicians should be aware that defensive testing not only leads to unjustified costs (for which they should be accountable) but may also harm patients by changing the risk/benefit ratio. In addition, increased volumes of diagnostic tests increase the complexity of the data management process and paradoxically, may increase the risk of medical liability. The suggestion "if you don't check, you don't know, so you're not liable" certainly does not spring from an evidence-based approach, but it contains a degree of truth, particularly if completed by the following phrase "but if you check, you have to follow-up on the result".

Particularly in the field of laboratory medicine, increasing attention is being paid to improving upon demand management by defining as "inappropriate" a request that is made outside agreed guidance [19, 20]. It is widely accepted that demand management is an important component of clinical laboratory activity and should be considered not only a tool for cost containment but also a duty of care [21]. A systematic approach to demand management should be based on available evidence and on efforts to evaluate the outcomes associated with diagnostic tests [22]. Current evidence of the potentially harmful nature of diagnostic errors should prompt further efforts to improve upon the appropriateness of diagnostic test requesting, follow-up and interpretation to assure patient safety.

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References

1. Hershey N. The defensive practice of medicine: myth or reality. Milbank Mem Fund Q 1972;50:69–98.
2. Klingman D, Localio AR, Sugarman J, Wagner JL, Polishuk PT, Wolfe L, et al. Measuring defensive medicine using clinical scenario surveys. J Health Polit Policy Law 1996;21:185–217.
3. Defensive Medicine and Medical Malpractice. Washington, DC: Office of Technology Assessment, 1994.
4. DeKay ML, Asch DA. Is the defensive use of diagnostic tests good for patients, or bad? Med Decis Making 1998;18:19–28.
5. Studdert DM, Mello MM, Sage WM, DesRoches CM, Peugh J, Zapert K, et al. Defensive medicine among high-risk specialist physicians in a volatile malpractice environment. J Am Med Assoc 2005;293:2609–17.
6. Bradley CP. Factors which influence the decision whether or not to prescribe: the dilemma facing general practitioners. Br J Gen Pract 1992;42:454–8.
7. Sood R, Sood A, Ghosh AK. Non-evidence-based variables affecting physicians' test-ordering tendencies: a systematic review. Neth J Med 2007;65:167–77.
8. Brown SR, Brown J. Why do physicians order unnecessary preoperative tests? A qualitative study? Fam Med 2011;43:338–43.
9. Rovner DR. Laboratory testing may not glitter like gold. Med Dec Making 1998;18:32–3.
10. Pauker SG, Kassirer JP. The threshold approach to clinical decision making. N Engl J Med 1980;302:1109–17.
11. Lippi G, Plebani M. False myths and legends in laboratory diagnostics. Clin Chem Lab Med 2013;51:2087–97.
12. Lippi G, Cervellin G, Plebani M. The ten commandments of laboratory testing for emergency physicians. Clin Chem Lab Med 2014;52:183–7.
13. Pauker SG, Kassirer JP. Decision analysis. N Engl J Med 1987;316:250–8.
14. Owens DK. Defensive diagnostic testing – a case of stolen utility? Med Decis Making 1998;18:33–4.
15. Poon EG, Gandhi TK, Sequist TD, Murff HJ, Karson AS, Bates DW. "I wish I had seen this test result earlier!" Arch Int Med 2004;164:2223–8.
16. Gandhi TK, Kachalia A, Thomas EJ, Puopolo AL, Yoon C, Brennan TA, et al. Missed and delayed diagnoses in the ambulatory setting: a study of malpractice claims. Ann Intern Med 2006;145:488–96.
17. Chen ET, Eder M, Elder NC, Hickner J. Crossing the finish line: follow-up of abnormal test results in a multisite community health center. J Natl Med Assoc 2010; 102:720–5.
18. Roy CL, Poon EG, Karson AS, Ladak-Merchant Z, Johnson RE, Maviglia SM, et al. Patient safety concerns arising from test results that return after hospital discharge. Ann Intern Med 2005;143:121–8.
19. Fryer A, Smellie WS. Managing demand for laboratory tests: a laboratory toolkit. J Clin Pathol 2013;66:62–72.
20. Janssens PM, Wasser G. Managing laboratory test ordering through test frequency filtering. Clin Chem Lab Med 2013;51:1207–15.
21. Fryer AA, Hanna FW. Managing demand for pathology tests: financial imperative or duty of care? Ann Clin Biochem 2009;46:435–7.
22. Plebani M, Panteghini M. Promoting clinical and laboratory interaction by harmonization. Clin Chim Acta 2013 Oct 9, [Epub ahead of print]. DOI: 10.1016/j.cca.2013.09.051.