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## Tolerance of Uncertainty and the Practice of Emergency Medicine

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Medicine is a science of uncertainty and an art of probability.

—William Osler<sup>1</sup>

Reduction of uncertainty is essential to the practice of medicine, but elimination of uncertainty is impossible.

—Benjamin Djulbegovic and Sander Greenland<sup>2</sup>

Uncertainty is inherent in the practice of medicine. Dermatologists can never be completely certain that a benign-appearing skin lesion is not a skin cancer; radiologists cannot be certain that changes on a chest radiograph are the result of pneumonia. No diagnostic test is 100% accurate, and even with additional testing such as a biopsy or a computed tomography (CT) scan, some degree of uncertainty remains. Until recently, physicians have had little choice but to tolerate uncertainty. Clinical radiography and electrocardiography did not become available until the end of the 19th century, and many other diagnostic tests have become part of routine clinical practice only in the past few decades. Uncertainty has always been a reality, but increased availability of diagnostic options means that the physician's response to uncertainty is now an important factor in clinical care.

In caring for patients with undifferentiated acute symptoms, emergency physicians face uncertainty more frequently and with greater consequence than most other physicians. Since the inception of our specialty, most US emergency physicians have practiced under a fee-for-service reimbursement model with significant litigation risk. This practice environment has distorted incentives for decisionmaking toward overtesting. The shift to value-based or

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capitated payment models is bringing increased attention to emergency department (ED) testing and admission decisions. Electronic health records allow those decisions to be routinely examined at the level of the individual physician. An essential determinant of success in the face of new payment models and increased scrutiny will be the tolerance of uncertainty,<sup>3</sup> which allows us to avoid tests that are unlikely to inform management and that have risks and costs for the patient being tested, cause delayed care for other patients, and add to the societal burden of health care costs. Excess testing also increases the number of false-positive test results, which leads to further testing. In this article, we review sources of uncertainty in emergency medicine, present evidence of wide variance in emergency physician test use, describe the psychological trait underlying tolerance of uncertainty and other factors that influence the physician response to uncertainty, and introduce a strategy for better accommodating uncertainty in the practice of emergency medicine.

There are multiple sources of uncertainty in emergency medicine. Patients come to emergency physicians as unknowns. There is uncertainty in regard to a patient's history, particularly the nature and timing of symptoms preceding the ED visit. There is uncertainty in what we currently understand about the manifestations and causes of disease. There is uncertainty in that diagnostic tests are not perfectly accurate. And there is uncertainty in regard to the benefits and harms of treatments for an individual patient. Research can help improve our understanding of how diseases present, clarify the diagnostic accuracy of tests, and define the potential benefits and harms of a given treatment, but some uncertainty will always remain.

A common emergency physician approach to decisionmaking in the face of uncertainty, particularly in busy practice environments in which physician time is a limiting factor, is a liberal approach to diagnostic testing and hospital admission. This approach manifests itself in protocol-driven triage orders, a tactic that makes sense for many testing decisions (eg, ECGs for chest pain, urinalysis and urine pregnancy testing for women with abdominal symptoms). Such an approach makes less sense for decisions that have greater potential for harm, are more expensive, or have poor specificity. Data from our own practices suggest a large range of test use and admission rates among attending emergency physicians: per-patient rates of advanced imaging among attending physicians range from 40% to 110% (ie, >1 study per patient); hospital admission rates range from 34% to 52%. For the use of head CT for minor head trauma, rates of CT ordering among emergency providers in Alberta, Canada, ranged from 4% to 100%.<sup>4</sup> Within these wide ranges of use, the high testing and hospital admission approach has little or no benefit to patients and can be dangerous.<sup>5-7</sup> Estimates for the total cost of unnecessary care in the United States range from \$760 to \$935 billion,<sup>8</sup> and many of the studies examining the relationship between health spending and outcomes have found a negative relationship.<sup>9,10</sup> Not all of this unnecessary care is driven by emergency physicians, but some of it is.

A number of factors have been identified that may influence physician decisionmaking in the face of uncertainty. The most fundamental of these is our own personalities. Although there are likely numerous personality traits that influence clinical decisionmaking, the trait of particular interest here is ambiguity tolerance-intolerance, a construct that was developed as part of examinations of ethnocentric and authoritarian personalities in children, but has

since been studied in medical students and physicians. A 16-item scale developed by Budner<sup>11</sup> provides a formal assessment of this construct. An example item statement with which one might agree or disagree is, “An expert who doesn’t come up with a definite answer probably doesn’t know too much.” (Agreement with this statement suggests a low tolerance for uncertainty.) Although the trait uses the term *ambiguity*, we will return to the word *uncertainty*; for the purposes of this article, we consider tolerance of ambiguity and tolerance of uncertainty the same concepts. Within the context of medical care, we interpret tolerance of uncertainty as a description of the approach to decisions about diagnostic testing and treatment, not a description of the patient assessment. Emergency physicians should always take a careful history, perform a thorough directed physical examination, and review relevant medical records; having tolerance of uncertainty does not give one license to skip the rigorous collection of relevant data to inform medical decisionmaking. Available data suggest that medical students who are men, those who are white, and those who are younger when they begin medical school all tend to have less tolerance of uncertainty.<sup>12</sup> Tolerance of uncertainty also varies according to the prospective specialty of the student, with students pursuing surgery residency having lower tolerance of uncertainty than those in the other specialties studied.<sup>12</sup> Variance in tolerance for uncertainty by medical specialty may be appropriate, but some tolerance of uncertainty is probably a virtue regardless of medical specialty because low tolerance for uncertainty has been linked to increased test ordering, failure to follow evidence-based guidelines, and fear of medical malpractice.<sup>13</sup>

Proposals have been made to use tolerance for uncertainty as a criterion during the medical student selection process or teach it in medical school.<sup>14-17</sup> But whether tolerance for uncertainty can be taught is a mostly unanswered question. A single study of an educational curriculum to increase tolerance of ambiguity provided to residents as part of a 4-week outpatient family medicine rotation had a sustained effect on the perceived threat of ambiguity but little or no effect on other outcomes.<sup>18</sup> We were also unable to find studies assessing tolerance for uncertainty among emergency physicians. A pragmatist might believe that individuals who choose emergency medicine as a career have a high tolerance for uncertainty in order to be able to conduct the work. However, a psychologist might argue the opposite, that physicians choose emergency medicine as a way of getting control of their intolerance of uncertainty. Regardless, a greater tolerance for uncertainty might lead to lower rates of test ordering and greater career satisfaction, but this is not known. Regardless of one’s personality type, we think all emergency physicians can benefit from contemplating their strengths and weaknesses vis-à-vis tolerance of uncertainty. We might not be able to change who we are, but we can at least be aware.

A number of other factors interact with our personalities to influence emergency physician decisionmaking. One challenge is a cognitive one: we tend to give excess weight to the benefits of diagnosis and intervention while underemphasizing potential harms.<sup>19</sup> One reason for this is that the adverse consequences from overtesting and hospitalization generally occur on a much longer timeline than the consequences of a missed diagnosis. A CT scan may increase a patient’s lifetime risk of cancer, but if cancer develops, it may not show up for 20 years or more. In contrast, when we miss a consequential diagnosis, we are usually immediately informed of the error through informal or formal pathways such as the morbidity and mortality conference. Even if the discussion about a missed diagnosis covers

the potential harms of overtesting, the take-home message is usually that one should have been more careful and ordered the test. A second explanation for why physicians fail to give consideration to potential harms is the black swan theory,<sup>20</sup> which posits that people have difficulty conceptualizing the importance of low-probability but consequential events. For example, because contrast-induced anaphylaxis is rare, emergency physicians may simply ignore this risk when making clinical decisions in regard to contrast studies. Ideally, however, this risk would be given some weight. In addition to physical harms, emergency physicians should also consider emotional harms to the patient as well as the opportunity costs to patients waiting to be treated and to society from the unnecessary use of expensive health care resources.<sup>21</sup> Of course, either testing or not testing could generate emotional harm, but evidence indicates that physician conversations with patients are as effective as or more effective than testing in reducing anxiety.<sup>22,23</sup>

A second cognitive error that can influence decisionmaking is incorrect assumptions about patient preferences.<sup>24-26</sup> The literature on pediatrician antibiotic prescribing reveals that physicians often incorrectly assume parents want antibiotics for their children.<sup>27</sup> Emergency physicians probably make similar incorrect assumptions favoring more intensive testing and treatment. Among an unselected population of ED patients presented with a hypothetical scenario of hospital admission for serial troponin levels, 25% of patients stated they were willing to accept a high risk of adverse outcomes, defined as a rate of 5% or higher, to avoid further testing.<sup>28</sup> Similarly, among ED patients with chest pain, hospitalization was judged to be necessary only when the risk of acute coronary syndrome was at least 6.5%. In contrast, physicians place the risk threshold for admission at or below 1%.<sup>29,30</sup> These discrepancies suggest that physicians and patients often see the world differently, and we need to avoid assuming that we know the risk tolerance of our patients.<sup>31,32</sup> A related incorrect assumption sometimes made by physicians is that patients want a “unilateral directive approach” in which the physician makes the decisions.<sup>33</sup> This is true for some patients, but the majority of ED patients wish to have some involvement in medical decisions, especially in the case of more serious medical problems.<sup>34,35</sup>

Our ability to manage uncertainty is also influenced by our training. Medical training has traditionally emphasized declarative knowledge conveying assurance over acknowledging and managing uncertainty. The use of multiple-choice tests as the basis for medical education and licensure likely reduces critical thinking<sup>36</sup> and reinforces the idea that there is a single correct answer for any given clinical scenario, a perspective that is both inconsistent with reality and antithetical to the tolerance of uncertainty. Part of the solution to this is to increase awareness of the importance of critical thinking and, specifically, to teach medical trainees to examine how their cognitive biases can contribute to diagnostic errors and patient harm.<sup>37</sup> Rather than expecting medical students to memorize a long list of concepts and “facts,” educators should spend more time emphasizing the importance of critical inquiry and discussing strategies for weighing the risks, benefits, and alternatives to various diagnostic and treatment options, as well as teaching students how to understand and factor in an individual patient’s preferences, values, and goals.<sup>31</sup> Presumably, this would better prepare physicians for wrestling with uncertainty when it inevitably arises. Medical training also often cultivates a hierarchic approach, with the physician being the confident, all-knowing leader, despite that strong hierarchies increase medical errors and physician

overconfidence decreases patient trust.<sup>24,38</sup> Training of emergency physicians also often follows a “rule out the worst-case scenario” approach to clinical decisionmaking, which tends to be more resource intensive than a hypothetico-deductive approach in which the physician makes and tests a series of diagnostic hypotheses.<sup>39</sup> Consideration of the worst-case scenario likely ought to remain a central part of how emergency physicians approach a case because this approach reflects our primary responsibility. But the differential diagnosis should be used to help physicians think about a variety of serious conditions, not imply that testing is required for each of them.

Practice setting, culture, and policies also influence how we manage uncertainty. For many clinical conditions, a period of observation is a safe and cost-effective diagnostic tool (“tincture of time”). ED crowding and pressure to make decisions quickly to minimize ED length of stay make this approach less feasible. Expectations of referring, consulting, and admitting physicians can also put pressure on us to answer questions that sometimes don’t have to be answered. We might be comfortable admitting a patient without a definitive explanation for his or her symptoms, but the admitting physician might not. Physicians should also be aware of the concept of decision fatigue, the decline in the quality of decisions that occurs after a sustained period of decisionmaking. The literature on decision fatigue indicates that when fatigue sets in, people tend to resort to more conservative behaviors. Although the most widely publicized study of decision fatigue described the decline in parole offers for inmates during the course of the day,<sup>40</sup> this phenomenon has also been described for antibiotic prescribing (more during the course of a day),<sup>41</sup> influenza vaccinations and cancer screening orders (fewer),<sup>42,43</sup> hand hygiene compliance (less),<sup>44</sup> and adenoma detection during colonoscopies (less).<sup>45</sup> In emergency medicine, decision fatigue may manifest itself as lower thresholds for diagnostic testing and admission. Strategies to protect against or allow recovery from decision fatigue may serve to preserve tolerance of uncertainty during the course of a shift.

We suggest strategies that individual physicians (Table 1) and physician groups, departments, or professional societies (Table 2) can undertake to strengthen the tolerance of uncertainty in emergency medicine decisionmaking. Individual steps are by no means required for all encounters, but may prove particularly useful in situations in which the value of a test or admission is unclear. These steps are rooted in shared decisionmaking<sup>46,47</sup> but informed by the considerations listed earlier in regard to the role of uncertainty in emergency care.

## CONCLUSION

Emergency medicine is changing. Diagnostic and treatment options continue to expand. Fee-for-service payment structures are being replaced with payment mechanisms that make health care providers accountable for costs. With these changes comes pressure to reduce testing and hospitalizations. In response to these changes and to optimize care, emergency physicians will benefit from a greater awareness of their own tolerance of uncertainty and from cultivating the ability to discuss uncertainty with their patients. Doing so has the potential to make our patients safer, better informed, and more satisfied, thus increasing the value of emergency care.

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**Table 1.** Strategy for an individual physician to integrate uncertainty into emergency medicine decisionmaking.

Step	Justification and Considerations
Identify and acknowledge uncertainty	<p>Almost all cases contain some area of uncertainty in regard to optimal diagnostic approach or treatment. Identifying and acknowledging this can help you accept uncertainty as part of the practice of emergency medicine. In some cases, discussing this explicitly with patients can help normalize uncertainty and help patients consider treatment options.</p>
Explain options	<p>In cases for which there is substantial uncertainty, serious potential consequences, more than one option available, and adequate time to do so, presenting options to the patient is appropriate.            Observation may be considered a diagnostic strategy.            Limitations of more intensive testing or treatment should be described.            Clinical decisions aids and narratives appropriate to the patient's literacy and numeracy can be helpful.</p>
Assess risk tolerance	<p>Assessing a patient's values and preferences may help to determine the approach that is most appropriate for him or her. Consider asking patients what they think is wrong, what they think their risk of a serious condition is, and whether they think they need a specific test (ideas, concerns, and expectations).</p>
Reassure the patient	<p>For low-risk patients, empathic care may reduce anxiety more than additional testing. Counseling and reassurance should be accompanied by a description of how a missed diagnosis might subsequently manifest and by clear return precautions.</p>

**Table 2.** Physician group, department, and professional-society-level processes and procedures to support physician tolerance of uncertainty.

Domain	Justification and Considerations
Quality improvement/peer review	<p>Include cases in morbidity and mortality conferences with adverse outcomes or unnecessary admissions caused by overtesting.</p> <p>Administrators advocate and support physicians who tolerate uncertainty when decisionmaking is challenged by consultants and admitting physicians (eg, formal endorsement of Choosing Wisely recommendations by department/hospital leadership and risk management).</p> <p>Promote a culture in which ED decisions are not criticized retrospectively according to information that becomes available after the ED visit.</p>
Patient care metrics	<p>Assess adequacy of shared decisionmaking as part of patient satisfaction surveys.</p> <p>Use audit and feedback physician resources, particularly for advanced imaging and admissions, including Choosing Wisely measures.</p> <p>Eliminate ED returns as an adverse event metric, or qualify this metric according to whether the decisionmaking for the initial visit was within the standard of care.</p>
Work flows	<p>Support alternative care pathways for patients who would likely benefit from observation rather than additional testing.</p> <p>Facilitate efficient physician access to evidence-based clinical decision support.</p> <p>Use joint education of physician and nursing staff in regard to thresholds for testing and admission to reduce occurrences of inconsistent and discrepant patient communication on these issues.</p>
Professional societies	<p>Emergency medicine organizations advocate didactic sessions and training on tolerance of uncertainty.</p> <p>Participate in an annual conference about preventing overdiagnosis.</p> <p>Prioritize additional research on acceptable risk thresholds for both patients and physicians.</p> <p>Disseminate guidelines that identify clinical scenarios in which there are multiple acceptable approaches because of uncertain risks/benefits.</p> <p>Work with lawyers and judges to better define the liability of physicians who miss a diagnosis as a result of a decision not to perform a diagnostic test that, at the time, was considered to have a very low likelihood of having a positive result.</p>