

The “NUTS” Statistic: Applying an EBM Disease Model to Defensive Medicine

Abstract:

Background: Physicians believe that malpractice concerns result in unnecessary testing, and many emergency physicians state that avoiding malpractice is a contributing factor to ordering medically unnecessary tests. Unfortunately, defensive medicine does not come without possible harm to patients who may be subject to non-beneficial, downstream testing, procedures, and hospitalizations.

Discussion: We submit a novel statistic, "NUTS" or “Number of Unnecessary Tests to avoid one Suit." We calculated a NUTS of 4,737 for troponin testing in ED patients with suspected myocardial infarction, meaning a clinician will need to order 4,737 medically unnecessary troponin tests to avoid one missed myocardial infarction lawsuit.

Conclusions: The NUTS framework offers us an evidence-based lens to examine defensive medicine less superstitiously and more based on currently available data.

Introduction

“But, if a lawyer were to review your chart, how would you defend that decision?”

We have all been asked this question by our supervising attendings during residency training, perpetuating the next generation of defensive medical practitioners.

Ninety percent of all physicians believe that malpractice concerns result in unnecessary testing.¹ Sixty-five percent of emergency physicians stated that avoiding malpractice was “almost always” or “often” a contributing factor to ordering medically unnecessary advanced imaging.² Defensive medicine occurs when “doctors order tests, procedures, or visits, or avoid high-risk patients or procedures, primarily (but not necessarily solely) to reduce their exposure to malpractice liability.”³ Unfortunately, defensive medicine does not come without possible harm to patients, who may be subject to complications of non-beneficial downstream testing,^{4,5} procedures, and hospitalizations.⁶ Subsequent overtesting and overtreatment⁵ may contribute to rising healthcare costs⁷ and increased length of stay,⁸ without added value.⁹ What if we were to apply an evidence-based disease model to the practice of defensive medicine? This framework would allow us to think about the utility (and harms) of defensive medicine beyond anecdotes and individual fears passed down to us through oral tradition.

Evidence-based medicine is the “conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients.”¹⁰ When we practice evidence-based medicine, we recommend an intervention to patients based on the likelihood of benefit versus harm of that particular intervention. Statistically, the evidence of benefit and harm for a specific intervention can be summarized with Number Needed to Treat (NNT) and Number Needed to Harm (NNH) - the number of patients that are needed to be given a particular therapy to benefit or harm one patient.

The “Malpractice Claim Disease”

One-third to half of all physicians have been named in a lawsuit.^{11,12} In one large national emergency physician group, one in 11 was named in a claim over 4.5 years.¹³ A 2017 survey of over 4000 physicians across 25+ specialties found that 45% have the threat of malpractice on their mind “always” or “most of the time”; 34% admitted that the threat of malpractice influences their actions “always” or “most of the time.”¹² Emergency medicine ranks as high as the 3rd most frequently sued specialty.¹¹ Although only 2% of cases across all specialties result in a judge/jury verdict against the physician, lawsuits cost physicians time, money, and emotional energy.¹²

Let's consider “being named in a lawsuit” a disease. Physicians may decide to order certain tests or interventions primarily to avoid this “disease,” and these tests and interventions will, therefore, be “medically unnecessary.” So with that in mind, let's now estimate the number of medically unnecessary tests that a physician needs to order to avoid one lawsuit. Let's call this statistic, “Number of Unnecessary Tests to avoid one Suit” or “NUTS.” Next, we will present a sample calculation of how to calculate “NUTS” using troponin testing for suspected myocardial infarction (MI) as an example. While we present this one example, we believe the “NUTS” framework can similarly be applied to other scenarios which may lend themselves to defensive testing.

Sample Estimate: NUTS for troponin testing in suspected myocardial infarction

Myocardial infarction is one of the leading diagnoses in malpractice claims and a persistent source of litigious fear for emergency physicians.¹⁴ The fear may be well-founded as a study

of malpractice claims found missed MI to be the most commonly alleged, missed diagnosis being most associated with both mortality and the highest proportion (53%) of closed claims payments.¹⁵ The average indemnity for missed MI may be as high as \$600k.¹⁶ Consequently, emergency clinicians may liberally use troponin testing to identify MI in patients who present to the emergency department (ED) with chest pain. How many of these patients will need troponin testing solely to avoid one lawsuit for missed MI?

Basic Definitions and Assumptions

NNT α Number of troponin tests needed to avoid one lawsuit = $1/ARR$

ARR = Absolute Risk Reduction of 1 troponin rule-out on the risk of 1 lawsuit

= (Risk of lawsuit WITHOUT troponin test) – (Risk of lawsuit WITH troponin test)

Before we venture any further, we have to acknowledge the significant limitations of the NUTS estimation as every input includes multiple assumptions.

Let's assume, annually:

There are approximately 1,535 ED malpractice claims annually.¹

6.5% of ED claims are for a diagnosis of MI.^A

Therefore there are approximately 100 claims against ED physicians for MI annually.

Next, let's assume there are 5,200,000 ED chest pain visits annually.¹⁷

¹ Data used with permission of The Risk Management Foundation of the Harvard Medical Institutions Incorporated all rights reserved. The Strategies' Comparative Benchmarking (CBS) database contains approximately 30% of all US claims. CBS database queried all cases from 2008-2019 in which the responsible service was "emergency", the allegation was "missed diagnosis", and the final diagnosis was "myocardial infarction" for a total of 332 claims. We then averaged this figure over 11 years and extrapolated to account for the additional 70% of claims not included in the CBS database.

Then, 100 ED suits for missed MI / 5,200,000 ED chest pain visits = 0.0019% absolute risk of lawsuit for missed MI per ED chest pain visit.

Assume that one could perform a 100% sensitive “perfect one-troponin rule-out” that will identify MI in all patients for whom one may have a suspicion. In other words, the absolute risk of a suit per chest pain visit is 0% if you perform a perfect one-troponin rule-out.

ARR = (Risk of suit WITHOUT troponin) – (Risk of suit WITH troponin) = 0.0019% – 0.0%
=

0.0019% ARR for ordering perfect troponin rule-out in one chest pain visit.

1/ARR = 1/0.000019= 52,632 perfect troponin rule-outs to prevent 1 missed MI lawsuit.

In other words, 52,632 perfect, one-troponin rule-outs *in total* are required to prevent 1 missed MI lawsuit.

Not every one of these troponin tests may qualify as unnecessary. Many of these are not sent primarily to avoid the malpractice disease but to objectively rule out MI in patients presenting with significantly high pre-test probability. Therefore, we need to make one final assumption:

9.0% of troponin tests are “medically unnecessary.”

By design, a troponin result is required for the HEART decision tool¹⁸ to identify patients with an acceptably low rate of major adverse cardiac events (MACE). However, a recent study (n=4,979)¹⁹ found that 9% of patients with HEAR score of 0 to 1 would not need troponin testing to achieve an acceptable MACE rate (< 1%); therefore, 9.0% of troponin tests are “medically unnecessary.”

NUTS can now be calculated:

$$\text{NUTS} = 52,632 \text{ total troponin rule-outs to prevent 1 lawsuit} \times 0.09 \text{ (9.0\% medically unnecessary troponin rule-outs)} = 4,737 \text{ medically unnecessary troponin rule-outs to prevent 1 missed MI lawsuit.}$$

Discussion

We calculated a NUTS of 4,737 for troponin testing in suspected MI, meaning a clinician will need to order 4,737 medically unnecessary troponin tests to avoid one missed MI lawsuit.

Such non-judicious troponin testing has consequences. Troponin assays are becoming more sensitive and less specific which ironically creates additional diagnostic uncertainty.²⁰

Eighty-four percent (95% CI 80% to 87%) of patients with suspected acute coronary syndrome had elevated high-sensitivity troponin levels without a diagnosis of acute coronary occlusion.²¹ “False-positive” troponin elevations may represent myocardial injury associated with conditions unrelated to acute coronary occlusion such as end-stage renal disease, sepsis, stroke, and pulmonary embolism.²² Furthermore, advanced age simply increases the likelihood of false-positives, which may be as high as 93% in geriatric patients who are often tested despite presenting with non-specific complaints.²³ Although false-positive troponin tests do indicate some degree of myocardial injury that may portend poor *long-term* prognosis,²⁴ patients with initial troponin elevations will often dwell in the ED awaiting serial troponin testing or inpatient telemetry beds, contributing to the growing problem of ED overcrowding and its associated patient safety risks.²⁵ Subsequently, some of these patients may be subjected to the risks⁶ and costs²⁶ of hospitalization and urgent cardiac catheterization²⁷ (e.g. periprocedural stroke²⁸) without any benefit. As with any intervention,

before determining testing and treatment thresholds, one should responsibly weigh the potential harms of that intervention including those related to downstream testing.²⁹

From a practical standpoint, we believe the NUTS framework offers benefits to both providers and healthcare systems. Tests with high NUTS will by definition be less efficient in protecting against lawsuits. Thus, providers may be less inclined to order unnecessary tests with high NUTS. Similarly, the NUTS framework may guide hospitals and agencies as they balance the cost of testing against the potential costs of lawsuits. From a purely financial standpoint, the aggregate cost of an expensive test with a high NUTS may outweigh the cost of a lawsuit. In such cases, hospital systems could enact guidelines aimed at limiting defensive medicine.

Limitations

We recognize that the NUTS framework is simplified and an imprecise calculation, relying on numerous assumptions and estimates that are limited by the quantity and quality of the underlying evidence. For example, the assumption that all ED chest pain visits involve troponin testing will result in the NUTS being inflated to some degree. On the other hand, ED patients can present with symptoms other than chest pain and undergo troponin testing; this will deflate the NUTS. Conversely, not all patients with malpractice claims related to missed MI may present to the ED with chest pain; this too will deflate the NUTS. In addition, the estimate that 9.0% of troponins ordered are “medically unnecessary” comes from one single-center study and may not be generalizable.¹⁹ We admit that practice patterns may differ based on factors including level of experience,³⁰ healthcare systems,²¹ and medicolegal risk and its tolerance.³¹ However, we use the 9% factor from Smith et al¹⁹ as the HEART score is the one of the most established and widely used clinical decision tools for predicting 30-day

risk of MACE.¹⁸ Further validation studies in larger, more diverse populations may determine a more refined MACE rate in patients with HEAR score of 0-1, and the NUTS estimate can be adjusted accordingly to be more applicable.

In regards to defensive medicine, the evidence has unique limitations. These include lack of nationally representative samples (e.g. studies from a single or several insurers), reliance on proprietary data from malpractice insurers and therefore inability to reproduce results, under-reporting of malpractice events to the legally mandated National Practitioner Data Bank, lack of data specific to emergency medicine physicians, and use of data pulled from non-concurrent years for a single estimation. Specifically, in our sample calculation, the estimate of 100 claims for missed MI annually is very rough, limited by imprecise existing data. We chose not to use data from the National Practitioner Data Bank as this data is limited to closed claims with payments made from individual providers.¹⁵ Instead, we report data supplied by CRICO Strategies as we believe this data provides the closest estimate of total claims.

Additionally, we acknowledge that the NUTS framework does not address all factors that may account for why a provider may send a “medically unnecessary test.” In particular, cost is not addressed in our provided framework for NUTS. Both cost of the test as well as cost of a potential lawsuit may undoubtedly factor into a provider's decision to order a specific test. For example, an inexpensive test in the face of a potential costly lawsuit may push a provider, consciously or subconsciously, to order the test. We exclude the cost factor for the simplicity of the calculation, but this element could be added to the NUTS calculation if so desired. Lastly, a medically unnecessary test may be ordered for reasons other than litigation fear. For

example, providers may “shotgun” tests based on the chief complaint before assessment of pretest probability and whether the test is truly necessary or not.

Unfortunately, the paucity of data on malpractice claims and lawsuits in emergency medicine limits our current scope to only a sample estimation of NUTS for troponin testing. Given these significant limitations, we acknowledge the low certainty in this specific NUTS.

Nevertheless, we believe the framework outlined for NUTS provides a useful example as to how to potentially apply this novel statistic. As additional data becomes available, we are hopeful that the NUTS framework may be applied with greater precision to additional interventions.

Conclusion

Balancing our exposure to litigation with ordering unnecessary, potentially harmful tests is an unfortunate reality of our healthcare system that may feel at odds with the mission of medicine.³² If we perform a test simply to mitigate potential malpractice exposure, are we practicing contrary to the oath to “do no harm?” It is easy for defensive medicine to feel exhausting rather than protective. Will that extra testing protect you? The NUTS framework offers an evidence-based lens to examine defensive medicine less superstitiously and more based on currently available data. In the face of so much uncertainty and paucity of data, the most sustainable and practical thing to do is to stay true to our mission and do right by your patient. Establishing trust, providing reassurance, and addressing patient concerns are all ways in which a clinician can reduce unnecessary testing.³³

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