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Controversies

A conceptual model of emergency physician decision making for head computed tomography in mild head injury ☆

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ABSTRACT

The use of computed tomographic scanning in blunt head trauma has increased dramatically in recent years without an accompanying rise in the prevalence of injury or hospital admission for serious conditions. Because computed tomography is neither harmless nor inexpensive, researchers have attempted to optimize utilization, largely through research that describes which clinical variables predict intracranial injury, and use this information to develop clinical decision instruments. Although such techniques may be useful when the benefits and harms of each strategy (neuroimaging vs observation) are quantifiable and amenable to comparison, the exact magnitude of these benefits and harms remains unknown in this clinical scenario. We believe that most clinical decision instrument development efforts are misguided insofar as they ignore critical, nonclinical factors influencing the decision to image. In this article, we propose a conceptual model to illustrate how clinical and nonclinical factors influence emergency physicians making this decision. We posit that elements unrelated to standard clinical factors, such as personality of the physician, fear of litigation and of missed diagnoses, patient expectations, and compensation method, may have equal or greater impact on actual decision making than traditional clinical factors. We believe that 3 particular factors deserve special consideration for further research: fear of error/malpractice, financial incentives, and patient engagement. Acknowledgement and study of these factors will be essential if we are to understand how emergency physicians truly make these decisions and how test-ordering behavior can be modified.

1. Introduction

Noncontrast head computed tomographic (CT) scan is the most commonly ordered test to assess patients with mild head injury (MHI) [1-3]. Every year, there are an estimated 22 million emergency department (ED) visits in the United States for injury-related conditions during which more than 1 million head CTs are ordered (1 per 330 US population), representing substantial health care expenditures and exposure to ionizing radiation [2,4,5]. Despite serious concerns about these adverse effects [6-8], CT use in the ED continues to rise dramatically [4,5,9-11]. Less than 6% of imaged patients have clinically important intracranial injuries, and less than 1% require neurosurgical intervention [2,3]. The decision to order a head CT for patients with MHI is particularly difficult because the actual magnitude of the harms (increased risk of malignancy, false-positive findings) or benefit (discovery of treatable intracranial injury) is not truly known in aggregate, let alone for each individual patient. Nonetheless, emergency physicians (EPs) must make this decision almost every shift. Many factors—clinical and nonclinical—influence the EP's decision to order a head CT. Current understanding and research efforts focus almost exclusively on the clinical factors underlying this decision, with little attention paid to the myriad and important nonclinical factors [1,2,12-18]. Although some emergency researchers have explored psychological, nonclinical factors affecting clinical decision making [19], this work has generally been done by social scientists [20,21].

Conceptual models are theoretical frameworks that have been used extensively in behavioral health science [22] and, to some degree, in emergency medicine [23-25], to better understand health service use. A greater understanding of why EPs order head CTs for MHI could lead to more effective interventions aimed at changing physician behavior and reducing the rate of unnecessary neuroimaging.

We will present a conceptual model integrating both clinical and nonclinical variables to illustrate how they interact and lead to the final decision to order or not order a head CT. These variables can be divided into 3 categories: (*a*) patient factors, (*b*) systems factors, and (*c*) physician factors. The accompanying figure depicts how the

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patient and physician factors combine, in the greater context of the health care environment, to result in a decision. The traditional factors invoked in the classical model of clinical medicine are outlined with a yellow(gray), rectangular dashed line. The vertical black dashed line depicts situations whereby the decision to order a head CT has bypassed the physician.

2. Patient factors

Classical models of decision making in emergency medicine presume that patient factors are the primary determinant of CT testing. Patient factors fall into 3 main categories: clinical variables, discharge circumstances, and patient or surrogate's wishes—which we refer to henceforth as "patient's wishes" with the understanding that we are including surrogates (eg, parents of young children, family caregivers) in this term. In the classical model, EPs collect information on clinical variables on which they base their decision to order a CT. These models assume that the EP is weighing some combination of patient age, mechanism of injury, medications (particularly anticoagulants), medical and social history, symptoms, and physical examination findings, to make a decision. Under this model, EPs would synthesize these variables and estimate the likelihood that the benefits of CT outweigh the harms.

Patients' varying beliefs and accompanying wishes regarding the harms and benefits of radiologic imaging and patients' discharge circumstances often wield influence on this decision yet have garnered little attention in the MHI research domain. With respect to the former, a patient may request neuroimaging because he has greater faith in technology than human judgment [19]. Conversely, he may request a head CT not be done due to accurate or inflated perceptions of harm. Evaluating the discharge circumstances of the patient (ie, living situation, access to follow-up care, and presence of a reliable caregiver) will help determine whether proposed "watchful waiting" will truly be watchful and whether the patient has ready access to care in the event of neurologic deterioration. A patient who has reliable supervision, postdischarge, might be managed without imaging, whereas immediate imaging might be appropriate in a similar patient with less favorable discharge circumstances.

3. Systems factors

The classical model, focused on patient clinical variables, gives little weight to the many nonclinical systems factors involved in this decision. These include local clinical culture, departmental clinical protocols, compensation method, mid-level-ordered tests, availability of CT, national guidelines, regional variation, and medicolegal climate. Often, a "typical work-up" exists for patients presenting to a particular ED with a given chief complaint. This local culture is usually dictated by key opinion leaders within a department [26,27]. Additional cultural factors related to receiving blame for missed injuries, for example, "morbidity and mortality rounds," may encourage EPs to order a CT scan for fear of having their "miss" being exposed to their peers. These cultural factors will interact with certain physician factors discussed below, including the risk tolerance of the EP.

National guidelines may also influence an EP's decision to order neuroimaging. For example, the American College of Emergency Physicians publishes guidelines regarding the management of mild traumatic brain injury [3], which EPs can consult when making this decision. Departments may also have specific clinical protocols guiding the management of certain patients with MHI. For example, in Italy, some departments routinely order an initial and interval head CT (at 24 hours) on all elderly, anticoagulated patients presenting with MHI [28].

The compensation method under which the EP works can potentially affect their testing threshold if there exists a financial incentive to increase or decrease the intensity of care delivered to a patient [29]. These potential financial incentives are discussed further below.

Furthermore, in EDs with midlevel providers (physician assistants, nurse practitioners, and residents in training), attending physicians may feel inclined to acquiesce to the plan of a midlevel provider who has already ordered a head CT, and in EDs with extensive triage protocols, CTs may be ordered without the physician's knowledge (see vertical dashed line, Fig.).

In certain practice environments, the limited availability of a CT scanner and necessary personnel (CT technologist, radiologist) can affect the decision to order a head CT, especially overnight and in smaller, rural EDs [30]. However, with the widespread proliferation of CT scanners, this is likely to be an increasingly rare factor contributing to the decision in the United States [11]. As CT scanners have become more common and image acquisition more rapid, the barriers to CT scanning have fallen substantially, which has contributed to a 330% increase in CT scanning in the ED from 1996 to 2007 [9].

Finally, systems factors at the macrolevel, such as the medicolegal climate in a particular area, may affect an EPs perception of medical liability and, in turn, affect his tendency to practice "defensive medicine." Looking across 50 states, it was found that, for every 10% increase in malpractice payments, imaging rates increased by 2.2%, the greatest increase of any physician service [31]. State-based limitations on noneconomic damages, such as California's Medical Injury Compensation Reform Act, have been implemented in an effort to curb increasing malpractice costs and could conceivably alter an EP's perception of medicolegal risk leading to a less defensive practice style [32].

Regional variation in health care resource utilization in the United States has been well known for quite some time [33]; there exists substantial regional variation in imaging rates not accounted for by differences in patient characteristics [34-36]. The location of an EP's practice influences the decision to order a CT even after controlling for differences in patient population and injury severity [37].

4. Physician factors

Notwithstanding situations where imaging is independently ordered by nonphysicians or via protocol, both patient and systems factors exert their influence through the EP because he is ultimately the one responsible for ordering the test.

Many physician factors influence this decision, including training and past clinical experience, perception of harms of CT, fear of error, fear of malpractice, personality, financial incentives, and consultant input.

Emergency physicians have varying beliefs regarding the utility of CT imaging determined by their clinical training and experience. Certain EPs feel that advanced imaging is overused leading to increased radiation exposure, false-positive results, and unnecessary health care resource utilization [1,2,5,14,15]. Emergency physicians who trained in the era before the proliferation of CT scanners may feel more confident excluding significant intracranial injury on clinical grounds alone. Conversely, other EPs may rely heavily on imaging results to manage patients with MHI. Physicians have varying perceptions of the risks of radiation associated with CT [38-40], partly because our current understanding of the risks of CT-induced malignancy is based primarily on studies of atomic bomb survivors in postwar Japan and radiation workers in the nuclear industry [6-8]. The applicability of these studies is debated.

A crucial, nonclinical factor involved in this decision is the personality of the EP caring for the patient.

Many personality traits influence this process in complex psychosocial ways [19]. One key trait is the EP's tolerance for risk and uncertainty, which is inversely proportional to their fear of error and fear of malpractice. These 2 fears are critical factors that produce strong incentives to order neuroimaging.