

# Applications of Justification and Optimization in Medical Imaging: Examples of Clinical Guidance for Computed Tomography Use in Emergency Medicine

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Availability, reliability, and technical improvements have led to continued expansion of computed tomography (CT) imaging. During a CT scan, there is substantially more exposure to ionizing radiation than with conventional radiography. This has led to questions and critical conclusions about whether the continuous growth of CT scans should be subjected to review and potentially restraints or, at a minimum, closer investigation. This is particularly pertinent to populations in emergency departments, such as children and patients who receive repeated CT scans for benign diagnoses. During the last several decades, among national medical specialty organizations, the American College of Emergency Physicians and the American College of Radiology have each formed membership working groups to consider value, access, and expedience and to promote broad acceptance of CT protocols and procedures within their disciplines. Those efforts have had positive effects on the use criteria for CT by other physician groups, health insurance carriers, regulators, and legislators. [Ann Emerg Med. 2014;63:25-32.]

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## INTRODUCTION

### Background

In the 2009 article “Ionizing Radiation Exposure of the Population of the United States,”<sup>1</sup> it was reported that from the early 1980s to 2006 the average effective dose per individual from medical procedures increased 6-fold (from 0.53 mSv/year in 1987 [National Council on Radiation Protection and Measurements<sup>2</sup>] to 3.00 mSv/year in 2006). Approximately half of the collective effective dose from medical imaging in 2006 was from computed tomography (CT) and more than one fourth from nuclear medicine procedures. The increase in CT dose has involved nearly every sector of medicine, and the sustained increase in use in emergency medicine has been reported, recognizing that this is a result of multiple factors, including the proven diagnostic efficacy of CT, defensive medicine, and patient/consultant demands.<sup>3</sup> Of the approximately 80 million CT scans performed in the United States each year, about a third are in the emergency setting.<sup>1,2,4</sup> Concerns have been expressed that high use of CT in emergency medicine may include scans that have questionable indications and therefore should be avoided.<sup>5-12</sup> In August 2011, The Joint Commission published Sentinel Event Alert

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Issue 47, “Radiation Risks of Diagnostic Imaging,” which further affirms the significance of this issue to patient safety.<sup>1,3</sup>

For many patients in the emergency setting, immediate diagnosis or the exclusion of a critical condition depends on prompt clinical performance and interpretation of radiologic imaging procedures. The choice of diagnostic procedures has relied on advances in radiology from basic radiographs and fluoroscopic examinations to current imaging procedures with CT, ultrasonography, magnetic resonance imaging (MRI), and radionuclide imaging. A significant change has been the rapidly increasing use of CT. The availability of CT scanners to emergency departments (EDs) (sometimes even sited in the ED) and their unparalleled ability to provide rapid high-quality tomographic images to resolve urgent care questions make them an increasingly dominant element of emergency radiologic imaging and patient diagnosis.

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During the last several decades, among national medical specialty organizations, the American College of Emergency Physicians (ACEP) and the American College of Radiology have each formed membership working groups to consider value, access, and expedience and to promote broad acceptance of CT protocols and procedures within their disciplines.<sup>14-16</sup> Those efforts have had positive effects on the use criteria for CT by other physician groups, health insurance carriers, regulators, and legislators.

Because diagnostic radiology procedures are performed on referral to radiology departments by physicians and other health care providers from many disciplines, the American College of Radiology has engaged the participation of other medical specialty groups to work with radiologists on imaging quality and safety initiatives, including clinical guidelines and technical standards, and appropriateness criteria. ACEP also develops clinical guidelines that relate to the Emergency Medical Treatment and Labor Act (EMTALA), according to reports from its clinical policy subcommittee and peer-reviewed medical literature. Many of these evidence-based policy statements and references are intended for and used by physicians and health care systems that need information for emergency protocols.

The choice of imaging procedures is made by emergency physicians who may not have access to previous patient records or pertinent patient history when patients present with impaired level of consciousness or acute life-threatening emergencies. Therefore, the emergency physician must decide which imaging procedures are most appropriate in light of multiple factors. The choice of imaging procedure also potentially depends on the needs and preferences of consultants such as surgeons or hospitalists and to locally available imaging equipment and interpretive expertise. The requirements of the EMTALA law on diagnosis strategies including use of imaging also influence use. Examples are presented of clinical guidelines issued by ACEP and appropriateness criteria from the American College of Radiology for CT applications in emergency medicine.

## **NATIONAL COUNCIL ON RADIATION PROTECTION AND MEASUREMENTS ASSESSMENT OF CT USE IN EMERGENCY MEDICINE**

As a result of the rapid growth of CT use and nationwide concern about medical radiation exposure, the National Council on Radiation Protection and Measurements undertook a program to investigate the issues of CT in the ED, with input from a wide range of stakeholders. The first step in the program was conducting a workshop on ensuring appropriate use of computed tomography in emergency medicine, which was held in Bethesda, MD. In addition to ACEP and the American College of Radiology, the workshop was cosponsored by the American Association of Physicians in Medicine, the American Society of Emergency Radiology, the Centers for Disease Control and Prevention, Landauer, Inc., the Society for Academic Emergency Medicine, the US Environmental Protection Agency, and the World Health

Organization. The workshop was attended by 26 speakers plus observers representing emergency medicine, diagnostic radiology, medical physics, and government regulatory agencies. A summary of the workshop was published by Linton et al.<sup>17</sup>

The topics discussed and conclusions reached in the workshop included the following:

1. ACEP, the American College of Radiology, and other medical organizations should continue to develop clinical guidelines, appropriateness criteria, and decision support (eg, computerized emergency physician order entry). This information should be evidence based, collaborative, and consensus driven. The incorporation of costs, including use of resources and potential health risks, should be patient centered and ideally immediately available to emergency physicians and acute care consultants at the point of care. The goal is to assist in determining what imaging procedure is most appropriate for and available to the individual emergency patient. Where sufficient evidence-based medicine does not exist, evidence should be developed through nationally funded research as a component of consensus-based guidelines.
2. Many patients presenting to EDs have undergone trauma or have disease circumstances that require immediate attention and treatment. The need for expeditious treatment may require a more rapid diagnostic evaluation that limits checking of patient history and records. For some patients, review of medical records, including recent diagnostic images, may affect the choice of a current imaging procedure. For patients with confusion, significant altered mental status, coma, or an inability to communicate, such as a very young child, the emergency physician must choose imaging on the basis of what modality is the fastest, safest, and most likely to affect immediate care according to limited information. Oftentimes this includes CT imaging.
3. When possible, emergency physicians should reach general agreement with the radiologists and consulting physicians in their institution on common scenarios involving imaging procedures, such as acute abdominal pain, possibly pulmonary thromboembolism, or trauma, especially to the cervical spine. In addition, case-specific consultation when possible allows the radiologist to suggest the optimal procedure and to perform it in a timely manner with a patient-specific protocol.
4. Joint development of and training in pathways and skills to reduce the need for CT imaging when possible and safe, such as the use of radiography, ultrasonography (including clinician-performed, emergency, point-of-care ultrasonography), and MRI, should be supported and expanded.
5. The radiologist is responsible for supervising the performance of any appropriate requested procedure and for the conduct of a diagnostic-quality examination with a protocol optimized to manage the dose to the patient to be commensurate with the medical purpose. The radiologist should be available to collaborate with clinicians and when appropriate mitigate requests for multiple or repetitive procedures without specific justification by the responsible medical team. Whenever possible, patients transferred for care from outside facilities

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