

This statement was created in 2012 by the Pediatric Subcommittee of the Governor's EMS and Trauma Advisory Committee (GETAC) and reflects the opinion of GETAC.

Computed tomography (CT) has proven to be a remarkable tool for improving the diagnostic accuracy of the clinician treating children with illness or injury. Its utility has seen a significant increase over the past two decades despite no proportional increases in severity of illness or injury [1,2,3]. However, the increasing use of CT has potentially adverse effects on the growing child susceptible to radiation induced malignancy (increased dose per unit area), including the development of fatal malignancy in an estimated 500 patients for every 600,000 abdominal and head CT studies performed in children under 15 years of age [4]. With over 175, 000 children and young adults, one recent cohort study revealed a three-fold increase in the risk of brain tumors and leukemia following a cumulative absorbed dose to the head or bone marrow of 50-60 mGy (roughly 2-3 CT studies to the head/bone marrow using current scanner settings). Estimated, this would equate to one case of leukemia and one case of brain tumor for every 10,000 CT studies performed on children 10 years and younger occurring in the first decade of life following the first CT study [5].

Although CT imaging may not be avoidable, the amount of radiation delivered can be reduced without detrimentally affecting study results. Development of low-dose, pediatric specific protocols has been advocated by the American Academy of Pediatrics and the American Pediatric Surgical Association in statement papers that support adherence to the principle of using radiation "As Low as Reasonably Achievable" (ALARA) for CT imaging. Easy to follow protocols are readily available. The Alliance of Radiation Safety in Pediatric Imaging (<http://www.pedrad.org/associations/5346/ig/>) offers an on-line resource for healthcare professionals and technologists with step by step guide to developing low-dose protocols. Providers and institutions that care for children should evaluate their CT scanners and institute protocols to reduce radiation emissions.

The design of protocols and guidelines in the evaluation of the pediatric patient has evolved as diagnostic modalities have developed. What was once perceived as a unique goal-centered clinical evaluation of the pediatric patient fraught with risk has become a diagnostic imaging gold mine for the clinician to evaluate for the presence of illness or traumatic injury. Many of these protocols are based on adult literature and experience because the cohort of pediatric trauma patients in many studies are small [6]. Facility trauma designation has also been tied to the adherence to trauma protocols; many of which include evaluation from the top of the head to the upper thigh via CT. These protocols often do not take into account the overlap of radiation that occurs as separate studies are ordered, the severity of trauma, the need for reduced radiation for the pediatric patient, or age based injury patterns [7]. For example, the incidence of pediatric cervical spine injuries is approximately one-third that of adults [8].

Clinical decision rules derived from evidence based best practice can assist the clinician in determining the need for radiographic imaging of the pediatric patient with illness or injury [9]. Stratification of the severity of the patient and identification of risk associated with clinical and/or laboratory predictors can improve diagnostic accuracy and help minimize the need for evaluation via CT. For example, clinical decision rules can minimize the need for CT in the evaluation of children with suspected appendicitis. Utilization of clinical and laboratory scoring tools can define those at both high and low risk for appendicitis, thus limiting more extensive radiographic evaluation to those with equivocal findings [10,11, 12, 13]. Moreover, ultrasound, a safer modality for radiographic evaluation has been utilized with high sensitivity and specificity for detecting appendicitis in children, thus obviating the need for ionizing radiation from CT studies and can be a more cost effective strategy [14]. A thorough history and physical examination combined with the appropriate clinical decision rules should dictate the necessity of the correct imaging modalities warranted in pediatric patients cared for in emergent care settings.

The transfer of the traumatic pediatric patient from a rural or referral hospital to a level I trauma center has been proven to reduce mortality in the severely injured patient. As CT studies have become highly utilized as the primary diagnostic tool in the evaluation of the traumatic patient, repeat imaging among institutions is a major source of overutilization and exposes patients to unnecessary cost and radiation while not significantly altering outcomes. CT studies formed prior to transfer to a level I trauma center lead to a variety of quality of care issues including duplication of studies, increased cost, increased radiation exposure, possible increased radioactive dye exposure with contrast-induced nephropathy, increased length of stay, and increased mortality and morbidity [15]. Retrospective studies have noted that repetition of CT studies after transfer to a trauma center vary by body part imaged with repeat frequencies between 4% and 90% [16, 17, 18]. Multiple institution-specific factors have been identified as reasons for repeating CT studies with incompatibility of Computerized Disc (CD) or lack of availability of digital images having the highest frequency [19]. Importing outside images to PACs appears to reduce the rate of repeat imaging at the transfer of care between institutions. Studies have shown up to a 17% decrease in subsequent 24 hour imaging utilization for patients whose CD imports were successful to the PACs system. Receiving institutions can avoid repeating scans. Moreover, in the current era of electronic exchange of information, regionalized trauma systems can adopt more efficient and reliable means of electronic transmission of medical records and images. Advances in these areas have potential to reduce morbidity and mortality by expediting transfers, reducing radiation and intravenous contrast exposure, and improving healthcare costs. The current standard of scanning CDs into PACs systems could ultimately transition to cloud-based technology.

This committee therefore recommends the following:

1. All CT scans on children should be performed using “pediatric” dose-reduction protocols. Pediatric protocols are available through The Alliance for Radiation Safety in Pediatric Imaging.
<http://www.pedrad.org/associations/5346/ig/>

2. Avoidance of the use of protocols which automatically result in the performance of multiple CT studies (i.e. head, cervical spine, chest, and abdomen and pelvis) in pediatric trauma patients.
3. Imaging modalities that do not use ionization radiation, such as ultrasound, should be used when feasible.
4. Understanding and linking guidelines of care that utilize evidence based practice strategies will help minimize the use of unnecessary testing.
5. Avoidance of further CT imaging once the decision to transfer to definitive care is made, unless the accepting institution specifically requests a scan prior to transfer. If CT imaging is performed prior to transfer, the images should be included in the transfer documentation on disc or some other form of reviewable file. The final radiology report should be forwarded to the receiving facility as soon as possible. Acquisition of radiographic testing, or delaying testing should be balanced against the risk of delaying critical care for stabilization of the ill or injured pediatric patient.
6. Accepting institutions should avoid repeating scans. Consider access to a cloud-based digital image translator.

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The Pediatric Subcommittee of the Governor’s EMS and Trauma Advisory Committee June 2012 (Members: Deb Brown, RN, BSN, MHA; Britton M. Devillier, MD, MPH; Bonnie Hartstein, MD; Charles Jaquith, LP; Juan Juarez, Jr., MD; Julie Lewis, RN; Janet D. Pointer, RN; Jorge Sainz, MD; Sally Snow, RN; William V. Walker, RN, LP; Chairman: Charles G Macias MD, MPH); The Center for Clinical Effectiveness at Baylor College of Medicine/Texas Children’s Hospital; Robert Orth MD; Jane Guerrero