

# Study identifies which children do not need CT scans after head trauma

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A substantial percentage of children who get CT scans after apparently minor head trauma do not need them, and as a result are put at increased risk of cancer due to radiation exposure. After analyzing more than 42,000 children with head trauma, a national research team led by two UC Davis emergency department physicians has developed guidelines for doctors who care for children with head trauma aimed at reducing those risks.

Their findings appear in an article published online today and in an upcoming edition of The [Lancet](#).

The collaborative study includes data collected at 25 hospitals from children who were evaluated for the possibility of serious brain injury following trauma to the head. Researchers found that one in five children over the age of 2 and nearly one-quarter of those under 2 who received CT scans following head trauma did not need them because they were at very low risk of having serious brain injuries. In these low-risk children, the risk of developing cancer due to radiation exposure outweighed the risk of serious brain injury.

"When you have a sample size this large, it is easier to get your hands on the truth," said Nathan Kuppermann, professor and chair of emergency medicine, professor of [pediatrics](#) at UC Davis Children's Hospital and lead author of the study. "We think our investigation provides the best available evidence regarding the use of CT scans in children with head trauma, and it indicates that CT use can be safely reduced by eliminating

its application in those children who are at very low risk of serious brain injuries."

As part of the study, Kuppermann and his colleagues developed a set of rules for identifying low-risk patients who would not need a CT. The "prediction rules" for children under 2 and for those 2 and older depend on the presence or absence of various symptoms and circumstances, including the way the injury was sustained, a history of loss of consciousness, neurological status at the time of evaluation and clinical evidence of skull fracture for both age groups. The use of CT in patients who do not fall into the low-risk group identified by the prediction rules will depend on other factors, such as the physician's experience, the severity and number of symptoms, and other factors.

The Centers for Disease Control estimates that 435,000 children under 14 visit emergency rooms every year to be evaluated for traumatic brain injury (TBI). Not all head trauma results in a TBI. The severity of a brain injury may range from mild, causing brief change in mental status or consciousness, to severe, causing permanent symptoms and irreversible damage.

For years, studies have suggested that CT scans were being overused to rule out traumatic brain injuries. However, those studies were considered too small to be sufficiently accurate and not precise enough to be widely applicable to a general population. The sheer size of the current study, and the fact that the investigators created the accurate prediction rules with one large group of children with head trauma and then tested the rules on another large but separate group to demonstrate their validity, allows physicians to have confidence in the results. The researchers emphasized, however, that the rules are not intended to replace clinical judgment.

"We're arming the clinician with the best available evidence so that they

can make the best decisions," said James Holmes, professor of emergency medicine at UC Davis School of Medicine and a co-author of the report. "There certainly are instances when the risks of radiation are worth it, such as in cases of blunt head trauma which result in changes in neurological status or clinical evidence of skull fractures. However, clinicians need reliable data to help them make those judgment calls when it is not clear whether or not a patient needs a CT. Until now, physicians haven't had data based on large and validated research."

The current study comes on the heels of an article published in late August by The New England Journal of Medicine that showed that at least 4 million Americans under age 65 are exposed to high doses of radiation each year from medical imaging tests, with CT scans accounting for almost one half of the total radiation dose. About 10 percent of those get more than the maximum annual exposure allowed for nuclear power plant employees or anyone else who works with radioactive material.

Studies show that exposure to radiation increases the risk of cancer. Radiation exposure to the brain of developing children is of particular concern and must be weighed carefully against the risk of traumatic brain injury that could cause permanent damage or death if not identified early. If the new guidelines are applied appropriately, the use of CT scans nationwide could be significantly reduced.

The effort was made possible by the Pediatric Emergency Care Applied Research Network (PECARN), which enabled the massive collection of data. Supported by the U.S. Department of Health and Human Services' Emergency Medical Services for Children Program, PECARN is the first federally-funded, multi-institutional network for research in pediatric emergency medicine in the nation. The network conducts research into the prevention and management of acute illnesses and injuries in children and youth across the continuum of emergency

medicine and health care.

"Children with medical and traumatic illnesses usually have good outcomes, but you need a lot of children to assess factors and treatments that predict both good and bad outcomes. By studying large numbers of children, in a variety of settings and from diverse populations, the results will more likely be applicable to the general population. That's the power of PECARN," Kuppermann said. "Combined, our network of emergency departments around the country evaluates approximately 1 million children per year."

Along with the UC Davis team, key PECARN researchers in the *Lancet* study included Peter S. Dayan, from New York-Presbyterian Hospital and Columbia University Medical Center in New York; John D. Hoyle, Jr., from Helen DeVos Children's [Hospital](#) in Grand Rapids; Shireen M. Atabaki, from Children's National Medical Center in Washington, D.C.; and Richard Holubkov from the PECARN Data Coordinating Center at the University of Utah.

In order to create the prediction rules, the PECARN investigators studied outcomes in more than 42,000 children with minor initial symptoms and signs of head trauma. CT scans were performed in nearly 15,000 of those patients. Serious brain injuries were diagnosed in 376 children, and 60 children underwent neurosurgery.

Using these data, the researchers developed two prediction rules for identifying mild cases that do not need CT scans. One rule was developed for children under the age of 2 and another for those 2 and over. It was important to study children under 2 separately because they cannot communicate their symptoms or offer information as well as older children, and they are more sensitive to the effects of radiation.

Children under 2 who fell into the low-risk group showed normal mental

status, no scalp swelling, no significant loss of consciousness, no palpable skull fracture, were normal-acting (according to the parent), and had an injury that was sustained in a non-severe way. Severe accidents, which excluded children from the low-risk group, included motor vehicle crashes in which the patient was ejected, and bicycle accidents involving automobiles, in which the patient was not wearing a helmet. Key indicators for children older than 2 who were at low-risk for [brain injury](#) included normal mental status, no loss of consciousness, no vomiting, no signs of fracture of the base of skull, no severe headache, and they did not sustain the injury in a serious accident.

The researchers then validated these rules by applying them to data from a second population of more than 8,600 children. In more than 99.9 percent of the cases, the rules accurately predicted children who were not diagnosed with serious brain injuries and were therefore indeed at low risk..

The researchers also identified and separated [children](#) at intermediate and high risk of serious brain injuries. Those in the high-risk group should receive CT scans, the researchers wrote. The PECARN team is currently working on refining recommendations for the use of CT scans in those at intermediate risk. Until now, emergency room physicians have relied mostly on instincts when deciding whether or not the symptoms of a child with head trauma warrant the use of CT.

"Now we have much better evidence to assist with making decisions regarding CT use," Kuppermann said.

Source: University of California - Davis

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