

# Abusive Head Trauma Module in the Child Abuse Pediatrics Curriculum for Physicians (CAP-CuP): Rehma's Story

Katie L. Johnson, MD\*, Caitlin E. Crumm, MD, MS, Emily C. B. Brown, MD, MS

\*Corresponding author: [johnson.katie@mayo.edu](mailto:johnson.katie@mayo.edu)

## Abstract

**Introduction:** Abusive head trauma (AHT) is the leading cause of death from head injuries in children under 2 years and a critically undertaught topic in medical education. **Methods:** We created an interactive module on AHT for medical students, residents, and physicians who treat children. We evaluated the module in three formats: individual, self-paced completion by a multidisciplinary (primarily physician) audience; presentation to a small multidisciplinary (primarily physician) audience at a Child and Adolescent Neurology (CAN) educational conference; and presentation to a large group of first-year medical students as part of a neuropsychology and development course. All versions took 45 minutes. A five-question pre- and postmodule assessment was completed to measure participants' confidence levels and knowledge pertaining to AHT. **Results:** Twenty-four individual, self-paced participants, 10 CAN educational conference attendees, and 62 medical students participated in the AHT module. Among the largest group (medical students), the median confidence level pertaining to AHT demonstrated a modest increase from 3 (interquartile range [IQR]: 2.00-5.00) to 6 (IQR: 6.00-7.75) on a 10-point Likert-type scale. The proportion of medical students answering knowledge questions correctly increased for every question: 27% to 84%, 50% to 90%, 2% to 90%, and 79% to 96%. Among the audiences composed of primarily physicians (i.e., the CAN conference and individual participants), baseline knowledge and confidence scores tended to be higher than the medical students and exhibited increases for every metric. **Discussion:** This interactive module about AHT was associated with increased confidence and knowledge for a variety of medical audiences and delivery formats.

## Keywords

Pediatric Critical Care Medicine, Pediatric Emergency Medicine, Pediatrics, Child Abuse, Case-Based Learning, Games, Multimedia

## Educational Objectives

By the end of this activity, learners will be able to:

1. Define abusive head trauma, including the most common mechanisms and injuries.
2. Describe the frequency and reasons for missed cases of abusive head trauma.
3. Summarize the medical, behavioral, and psychological sequelae of abusive head trauma.

## Introduction

Abusive head trauma (AHT; formerly referred to as Shaken Baby Syndrome) is the most fatal cause of head injuries under the age

of 2 years and the leading cause of death from child abuse under the age of 5 years.<sup>1,2</sup> It may involve shaking, head impact, or both inflicted upon a young child.<sup>3</sup> It can result in physical injuries as well as altered brain function affecting level of alertness, tone, breathing, and movement.<sup>1,3</sup> The majority of victims of abusive head trauma sustain long-term sequelae including developmental, behavioral, and neurological disability.<sup>4</sup> While AHT can be accompanied by visible signs and symptoms, such as bruising or seizures, it can also occur without any external visible indicators. Furthermore, despite widespread consensus within the medical community about the validity of the diagnosis of AHT,<sup>1</sup> there is a small but vocal group of physicians sparking false controversy in legal settings.<sup>5</sup> Thus, it is more important than ever that physicians remain aware of the common signs, symptoms, sentinel injuries, histories, and risk factors that may indicate the need to pursue a workup for AHT.

Signs and symptoms of child abuse are undertaught in medical education.<sup>6-8</sup> Medical students, residents, and physicians in practice have demonstrated both knowledge deficits<sup>7,9</sup> and

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insight into the need for more education in this area.<sup>7,10-12</sup> The American Academy of Pediatrics has provided a set of study materials for child abuse, but these are restricted to subscribing members and have not been updated since 2015.<sup>13</sup>

Previous *MedEdPORTAL* publications on AHT include a simulation case<sup>14</sup> from 2017 and a PedsCase from 2010.<sup>15</sup> Both are designed for use by medical students. The simulation case includes a didactic that summarizes many different forms and mimics of child physical abuse, and does not focus solely on AHT.<sup>14</sup> The PedsCase pairs a case description of AHT with a podcast and multiple-choice questions.<sup>15</sup> The case description uses names for the patient and mother that are traditionally associated with Black race,<sup>15,16</sup> and prior literature has suggested that there are racial disparities in the medical evaluation of AHT.<sup>17</sup> Teaching materials are needed that address and counter implicit biases about child abuse being more likely in Black families.

This interactive module on AHT, designed for use by medical students and physicians who treat children, offers an updated review of the literature and expands upon prior work<sup>14,15</sup> by exploring the modern complexities of a tumultuous medicolegal landscape and an equity-focused sociocultural climate. One unique aspect of this module is its exploration of racial disparity in the diagnosis of AHT. It highlights a 1999 study<sup>17</sup> in which the diagnosis of AHT was more likely to be missed in White infants and therefore more likely to be suspected in infants of color. Equity in health care requires medical providers to be mindful of implicit biases and how they may perpetuate discrimination in medical decision-making. Although this data comes from an older study,<sup>17</sup> it is consistent with newer literature that demonstrates overrepresentation of Black and Brown children in child abuse evaluations and the child welfare system.<sup>18,19</sup> In addition, 16 of the 23 module references were published after the most recent *MedEdPORTAL* content on AHT.<sup>14</sup> This module benefits from the design elements of a larger interactive curriculum,<sup>20</sup> minimal equipment and personnel needed for implementation, flexibility of format (i.e., large audience, small group, or self-paced completion), and the use of storytelling<sup>21</sup> to maximize its educational impact. The purpose of this interactive module on AHT was to provide a comprehensive yet succinct review that is accessible, organized, engaging, and versatile to various medical audiences.

## Methods

The AHT module (Appendix A) was created in 2022 with a dual purpose: First, there was a need to update the AHT didactic material in the Mayo Clinic Alix School of Medicine Disruptions in Development course, and second, the author of the module

(Katie Johnson) sought to develop a core curriculum in child abuse pediatrics for physicians. (The Child Abuse Pediatrics Curriculum for Physicians [CAP-CuP]<sup>20</sup>), which would include a module on AHT. Because AHT was a relatively undertaught topic in medical education,<sup>6,10</sup> it was decided that one module could be built to serve both audiences. In other words, this module was built to be suitable for teaching medical students, residents, and physicians in practice about AHT.

The AHT module was created by a child abuse pediatrician (Katie Johnson) who had experience with AHT from a clinical, educational, legal, and research perspective.<sup>22,23</sup> The module was reviewed and edited by two board-certified child abuse pediatricians with similar experience (Caitlin Crumm, Emily Brown), one of whom (Caitlin Crumm) was pursuing additional training in pediatric emergency medicine. The module was built to incorporate elements of the science of learning,<sup>24</sup> including the generation of responses (e.g., multiple choice, true/false, and free response) before the answers were revealed, audiovisual material to vary the cadence of the presentation, and the weaving of a child's story<sup>21</sup> into the material to make it more meaningful. Rehma Sabir was a child who died of AHT while in the care of her babysitter on her first birthday. Rehma's story was shared in three parts, interspersed with information on the epidemiology, clinical presentation, differential diagnosis, recommended workup, and short- and long-term sequelae of AHT. The sharing of Rehma's story in this open-access module was supported by her parents as well as the Cable News Network (CNN), the producer of the special report Justice for Rehma, after purchase of a copyright agreement.

The AHT module was built in PowerPoint and was optimally implemented with the use of a quiz-based polling software, such as Kahoot! or PollEverywhere, though polling software was not required for implementation. Optional Kahoot! links as well as a presenter script were included in the PowerPoint slide notes (Appendix A) as well as the technical guide (Appendix B) to facilitate accessibility, accuracy, and reliability in the presentation of this material. When polling software was not used, participants could use a pen and paper or a personal cell phone or computer to record their answers.

Pilot testing of this module included presentation to large audiences; small groups; and individual, self-paced completion by residents. Large-group presentations included a virtual education conference for pediatric residents at Mayo Clinic (10-15 attendees) and a virtual grand rounds for Mayo Clinic emergency medical services first responders (50-75 attendees), the latter of whom received a modified version that emphasized the first-

responder role. The small-group and self-paced completion of this module was implemented with medical students, residents, and fellows completing the Mayo Clinic child abuse pediatrics elective. Specifically, these learners included fourth-year medical students, a fellow in pediatric hospital medicine, a resident in emergency medicine, and multiple residents in pediatrics, family medicine, and psychiatry. In all pilot tests, qualitative feedback was positive about the accessibility and effectiveness of the material for learners from a variety of training backgrounds.

The AHT module (Appendix A) was evaluated in three different formats: individual, self-paced completion by medical students and physicians from a variety of specialties and institutions, a small multidisciplinary audience at a Child and Adolescent Neurology (CAN) educational conference, and a large group of first-year medical students in the Mayo Clinic Alix School of Medicine in a course on neuropsychology and development (called Disruptions in Development). All versions took about 45 minutes to complete. The individuals completing the module in a self-paced format were from a variety of training levels, specialties, and institutions. They received access to the module from child abuse pediatricians at their institutions who had specifically requested the link after an oral presentation about the CAP-CuP curriculum at a child maltreatment conference (the Ray E. Helfer Society annual meeting in 2024). Most of the participants were pediatric residents, but participants also included family medicine residents, fourth-year medical students, a medicine/pediatrics resident, a pediatric hospital medicine fellow, and a child abuse pediatrician. Submission of learner demographic data by the child abuse pediatricians who had requested the module was voluntary.

For the CAN educational conference and large-group medical student presentation, the optional Kahoot! link for large groups (Appendices A and B) was used. The presenter was a child abuse pediatrician and primary author of the module (Katie Johnson). The CAN audience was hybrid (i.e., some attended in person, and some attended via Zoom) and included child and adolescent neurology residents, child and adolescent neurology attendings, a child psychiatry resident, a medical student, and a nurse. The Disruptions in Development course audience was entirely in person and consisted of all first-year medical students. The following materials were needed:

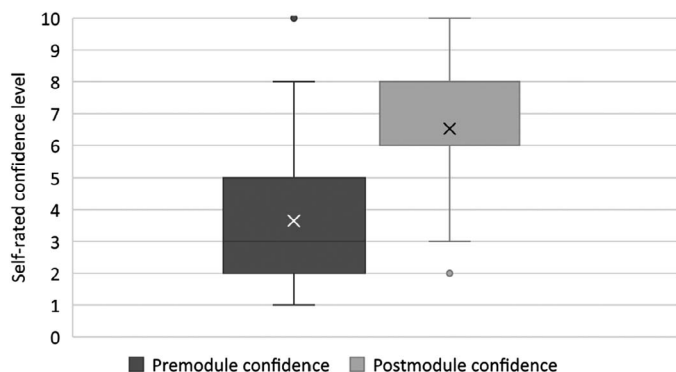
- Presenter: a computer with internet connection, a projector screen, and the ability to share visual and audio content; Zoom capability was needed for the hybrid presentation
- Participants: a cell phone or personal computer with internet connection; Zoom capability was needed for those attending the hybrid presentation remotely

In all delivery formats, the AHT module included a pre- and postmodule assessment consisting of five questions: one evaluating self-rated confidence in recognizing and managing AHT on a 10-point Likert-type scale (1 = *not at all confident*, 10 = *completely confident*), and four evaluating knowledge about AHT (Appendix C). Participation of attendees was voluntary and anonymous. Attendees who opted to participate were not required to respond to every question, and thus, the number of respondents for each question varied. Descriptive statistics were calculated and included the median and interquartile range (IQR) of the confidence-level question (question 1) and the proportion of correct responses to the multiple-choice and true/false questions (questions 2-5). These metrics were calculated separately for each presentation format and also pooled for the two multidisciplinary audiences composed of primarily physicians (i.e., the CAN audience and individual participants). This project was approved by the Mayo Clinic Institutional Review Board and Education Research Committee.

## Results

A total of 24 multidisciplinary participants completed the individual self-paced module, 10 multidisciplinary participants attended the CAN educational conference, and 62 first-year medical students attended the Disruptions in Development course presentation. For the live presentations, total attendee numbers were not available. It is the author's observation that most (if not all) of the attendees participated in the game-based module. Among the largest group (the first-year medical students), the median confidence level pertaining to AHT demonstrated a modest increase from 3 (IQR: 2.00-5.00) to 6 (IQR: 6.00-7.75; [Figure 1](#)). The proportion of medical students answering knowledge questions correctly increased for every question, as follows: 27% (14 of 52) to 84% (43 of 51), 50% (26 of 52) to 90% (46 of 51), 2% (1 of 52) to 90% (44 of 49), and 79% (41 of 52) to 96% (47 of 49; [Figure 2](#)).

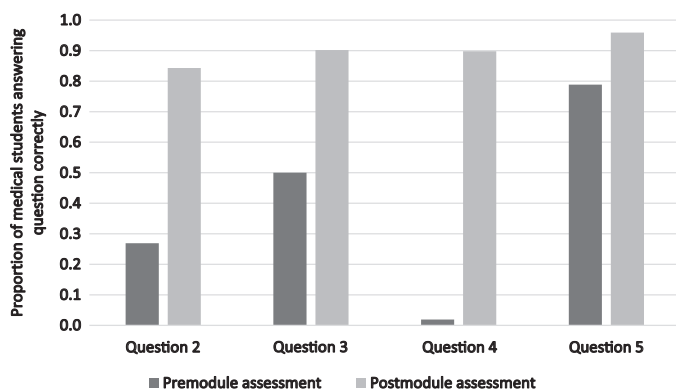
Among the multidisciplinary audiences composed primarily of physicians (i.e., the CAN education conference and individual participants), the baseline confidence and knowledge scores tended to be higher, but the percentage of correct responses still increased for every question. Specifically, the multidisciplinary CAN group—which included two CAN residents, one CAN attending, one psychiatry resident, one medical student, one nurse, and four attendees who did not provide demographic data—had a median confidence level of 5 (IQR: 5.00-6.50) in the premodule assessment and 7 (IQR: 7.00-8.00) in the postmodule assessment. The percentages of correct responses to each



**Figure 1.** Medical students' self-rated confidence level in recognizing and managing abusive head trauma in the pre- versus postmodule assessments. The median confidence level increased from 3 (interquartile range [IQR]: 2.00-5.00) to 6 (IQR: 6.00-7.75). The mean (X) increased from 3.6 to 6.5. The whiskers extend to a maximum of one IQR below the 1st quartile and one IQR above the 3rd quartile, with outliers beyond these ranges indicated by dots.

knowledge question before and after the module were as follows: 57% (4 of 7) to 100% (7 of 7), 71% (5 of 7) to 100% (7 of 7), 25% (2 of 8) to 86% (6 of 7), and 63% (5 of 8) to 100% (7 of 7). The individual participants completing the self-paced module—which included 10 pediatric residents, three family medicine residents, three fourth-year medical students, one medicine/pediatrics resident, one pediatric hospital medicine fellow, one child abuse pediatrician, and five for which no demographic data was available—had a median confidence level of 6 (IQR: 5.00-6.00) in the premodule assessment and 7 (IQR: 5.75-8.00) in the postmodule assessment. The percentages of correct responses to each knowledge question before and after the module were as follows: 70% (16 of 23) to 90% (18 of 20), 83% (19 of 23) to 95% (19 of 20), 30% (7 of 23) to 100% (20 of 20), and 70% (16 of 23) to 100% (20 of 20).

The data for the latter two groups, which were both multidisciplinary and composed primarily of physicians, were



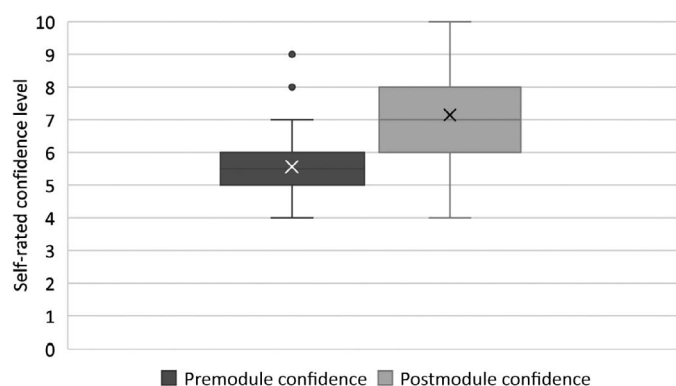
**Figure 2.** Performance of medical students on knowledge-based questions in pre- versus postmodule assessments.

pooled for comparison to the first-year medical student group. This pooling yielded a premodule confidence level of 6 (IQR: 5.00-6.00) and a postmodule confidence level of 7 (IQR: 6.00-8.00; Figure 3). The percentage of correct responses in the pooled data set before and after the module were as follows: 67% (20 of 30) to 93% (25 of 27), 80% (24 of 30) to 96% (26 of 27), 29% (9 of 31) to 96% (26 of 27), and 68% (21 of 31) to 100% (27 of 27; Figure 4).

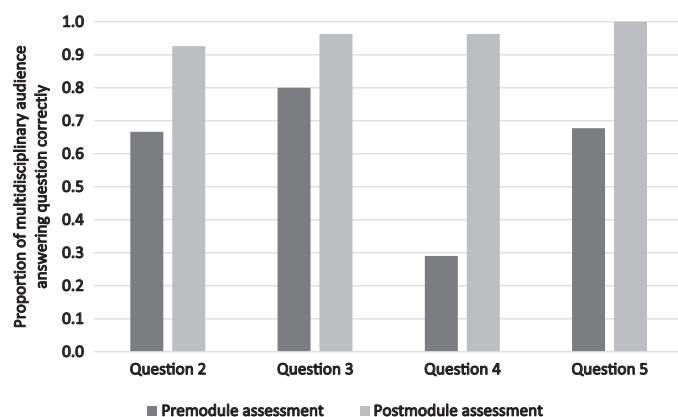
The greatest improvement for all audiences was observed for question 4, which asked participants to identify the percentage of AHT diagnoses missed by the first physician they see. The answer to this question was presented in the context of a slide about racial disparities (i.e., physicians are more likely to miss the diagnosis of AHT in White infants, and therefore more likely to suspect the diagnosis in infants of color).<sup>17</sup>

## Discussion

This versatile, interactive module about AHT was associated with increased confidence and knowledge for a variety of medical audiences and various delivery formats, including self-paced completion by residents, small-group participation by multidisciplinary attendees at a CAN educational conference, and large-group participation by first-year medical students. All presentation formats covered a succinct, comprehensive, interactive, and case-based presentation about AHT in under 45 minutes. This module may serve as an effective precursor to either the simulation<sup>14</sup> or the PedsCase<sup>15</sup> previously published in *MedEdPORTAL*. Given its timely incorporation of medicolegal and health equity perspectives on AHT, it may enhance the debrief following either of these teaching tools.



**Figure 3.** Multidisciplinary (primarily physician) confidence levels in recognizing and managing abusive head trauma in the pre- versus postmodule assessments. The median confidence level increased from 6 (interquartile range [IQR]: 5.00-6.00) to 7 (IQR: 6.00-8.00). The mean (X) increased from 5.6 to 7.2. The whiskers extend to a maximum of one IQR below the 1st quartile and one IQR above the 3rd quartile, with outliers beyond these ranges indicated by dots.



**Figure 4.** Multidisciplinary (primarily physician) performance on knowledge-based questions in pre- versus postmodule assessments.

Lessons learned from this project included how to navigate copyright permissions with a cable news network including both primary and third-party permissions for use of audiovisual material in an open-access, Creative Commons-licensed educational product. In the earliest version of this module, Rehma's story was shared in one 9-minute segment at the beginning of the module. Because of the need to remove certain segments of the video with copyright-protected third-party content, the video was divided into three segments, and the decision was made to intersperse these segments throughout the presentation. This turned out to be a favorable format for keeping the audience engaged by varying the presentation style between a live presenter and audiovisual media. In addition, the opportunity to connect with Rehma Sabir's father prior to implementation of this module served as a reminder that the support of families when using patient stories in education cannot be overstated.

Limitations of this project include its heterogeneity in audience specialty, training background, and delivery format, although this could be viewed as a strength of the module's versatility as well. While the physician audiences provided some secondary data ( $n = 34$ ), the heterogeneity of the audience and limitations in demographic data rendered by voluntary submission and anonymous participation made it difficult to draw meaningful conclusions about the effectiveness of the module. Nevertheless, we observed that this mixed physician group had higher baseline confidence levels and knowledge scores than the first-year medical students, and similar increases in confidence and knowledge for each question, suggesting reliability in effect. This project is limited in its evaluation method, which included short-term recall and self-rated confidence. These are both relatively

weak forms of evaluation, leaving the long-term clinical impact of this module unknown. Nevertheless, we used science of learning principles<sup>24</sup> woven together with a poignant patient story<sup>21</sup> to support meaningful, enduring learning.

Next steps for this module may include wider implementation and testing with various medical audiences, such as emergency medicine providers, pediatricians, pediatric intensivists, and advanced practice practitioners. All of these groups are stakeholders who may have the opportunity to recognize, appropriately manage, and testify regarding AHT in the best interest of safeguarding children.

## Appendices

- A. Abusive Head Trauma Module.pptx
- B. Abusive Head Trauma - Technical Guide and Script.docx
- C. Abusive Head Trauma - Assessment.docx

*All appendices are peer reviewed as integral parts of the Original Publication.*

**Katie L. Johnson, MD:** Assistant Professor, Department of Pediatrics, Mayo Clinic; ORCID: <https://orcid.org/0000-0002-6388-489X>

**Caitlin E. Crumm, MD, MS:** Assistant Professor, Division of Pediatric Emergency Medicine, Seattle Children's Hospital

**Emily C. B. Brown, MD, MS:** Assistant Professor, Department of Pediatrics, University of Washington School of Medicine

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## Ethical Approval

The Mayo Clinic Institutional Review Board and Education Research Committee reviewed this project.

## Disclaimer

The views expressed in the publication are the authors' own and not an official position of the institutions for which they work.



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