55 Initial Experience Using Artificial Intelligence for the Assessment of Pediatric Burn Depth

James H. Holmes, IV, MD, FACS, Herb A. Phelan, III, MD, MSCS, Jeffrey W. Shupp, MD, J. Michael DiMaio, MD, Jeffrey E. Carter, MD

Atrium Health Wake Forest Baptist, Winston-Salem, North Carolina; LSUHSC-New Orleans Department of Surgery, New Orleans, Louisiana; MedStar Washington Hospital Center, Washington DC, District of Columbia; Baylor Scott and White, Dallas, Texas; University Medical Center- New Orleans, New Orleans, Louisiana

Introduction: Estimation of burn depth, and hence severity, is critical for burn management. Burn depth estimates vary widely, and these inaccuracies can be compounded in pediatric burns. A reliable, objective, non-invasive device for the accurate assessment of burn depth is needed. A non-invasive imaging technology, using multispectral imaging (MSI) combined with a machine learning algorithm (MLA), is being developed as a tool for burn depth assessment. The results of the initial multi-center study using this artificial intelligence (AI) technology in pediatric burns are presented.
Methods: The MSI device was used to image subjects < 18y of age with thermal burns < 50% TBSA. It captured a set of images measuring the reflectance of visible and near-IR light, within a 23x23 cm field-of-view. Images were collected from up to 2 separate burned regions within 72 hours of injury that were then serially imaged for up to 7d post-injury. Burns that the investigator believed would heal spontaneously (superficial or superficial partial-thickness) were managed per institutional standard of care (SOC) and assessed at 21d post-injury for complete healing. Burns that the investigator felt would not heal by 21d post-injury (deep partial-thickness or full-thickness) were excised and grafted per institutional SOC, with multiple biopsies being taken prior to excision.
Regions of non-healing burn within every MSI image were identified by a panel of 3 burn surgeons. To accurately identify these non-healing regions, the panel of surgeons was given access to 1 of 2 clinical reference standards: a) the 21-day healing assessments for burns allowed to heal spontaneously; or b) pathology reports detailing histologic analyses from the biopsies.
This information was then used to develop a type of MLA called a convolutional neural network (CNN) that could automatically identify the regions of non-healing burn within an image. From these data, an ensemble of 8 separate CNN algorithms was used to automatically identify non-healing burn tissue. Training and test accuracies of the ensemble CNN were calculated using cross-validation at the level of the subject.
Results: Twenty-four (24) pediatric burn patients were enrolled, with 26 burned areas being serially imaged. The age range of the subjects was 7 months - 17y, with a mean age of 5.7y. Subjects had a mean burn size of 8.0 ± 4.2% TBSA, and 70% of the subjects were male. The AI performance results showed an accuracy of 88.2 ± 3.7%, sensitivity of 80.0 ± 14.6%, specificity of 88.0% ± 3.7%, and an area under the curve (AUC) of 0.92.
Conclusions: Our study demonstrates an improvement in the accuracy of burn depth assessment over the traditional exam, which could lead to improved burn care.

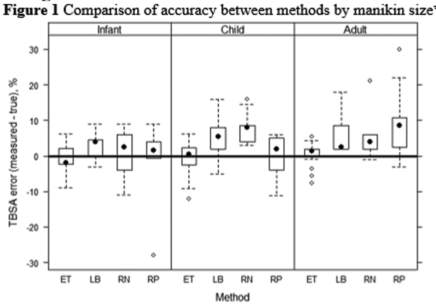
56 Evaluation of a Smartphone Application as a Method for Calculating Total Body Surface Area Burned

Cindy D. Colson, MSN, RN, Emily A. Alberto, MD, Zachary P. Milestone, BA, Nikita Batra, BS, Tyler Salvadore, BS, Hadi Fooladi, MS, Kevin Cleary, PhD, Rima Izem, PhD, Randall S. Burd, MD, PhD

Children's National Hospital, Bowie, Maryland; Children's National Hospital, Washington, District of Columbia; Children's National Hospital, Washington, District of Columbia; Children's National Hospital, Washington, District of Columbia; Children's National Hospital, Washington, District of Columbia; Children's National Hospital, Washington, District of Columbia; Children's National Hospital, Washington, District of Columbia; Children's National Hospital, Washington, District of Columbia; Children's National Hospital, Washington, District of Columbia

Introduction: Current methods of burn estimation can lead to incorrect estimates of the total body surface area burned, especially among injured children. Inaccurate estimation of burn size can impact initial management, including unnecessary transfer to burn centers and fluid overload during resuscitation. To address these challenges, we developed a smartphone application that calculates the total body surface area of a burn using a body-part by body-part approach. The aims of this study were to assess the accuracy of the smartphone application and compare its performance to three established methods of burn size estimation (Lund-Browder Chart, Rule of Nines, Rule of Palms).
Methods: Twenty-four healthcare providers used each method to estimate burn sizes on moulaged manikins. The manikins represented different ages (infant, child, adult) with different total body surface area burns (small < 20%, medium 20-49%, large >49%). We calculated the accuracy of each method as the difference between the user-estimated and actual total body surface area. We used multivariable modeling to control for manikin size and method.
Results: Among all age groups and burn sizes, the smartphone application had the greatest accuracy for burn size estimation (-0.01%, SD 3.59%) followed by the Rule of Palms (3.92%, SD 10.71%), the Lund-Browder Chart (4.42%, SD 5.52%), and the Rule of Nines (5.05%, SD 6.87%).
Conclusions: The smartphone application may improve the estimation of total body surface area burned compared to existing methods.

Figure 1 Comparison of accuracy between methods by manikin size*



*Box plots representing the medians and interquartile ranges of the data presented in Table 1.

TBSA= total body surface area; ET= Smartphone Application; LB= Lund-Browder chart; RN= Rule of Nines; RP= Rule of Palms