Development of Reliable and Validated Tools to Evaluate Technical Resuscitation Skills in a Pediatric Simulation Setting: Resuscitation and Emergency Simulation Checklist for Assessment in Pediatrics

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Objectives To develop a reliable and validated tool to evaluate technical resuscitation skills in a pediatric simulation setting.

Study design Four Resuscitation and Emergency Simulation Checklist for Assessment in Pediatrics (RESCAPE) evaluation tools were created, following international guidelines: intraosseous needle insertion, bag mask ventilation, endotracheal intubation, and cardiac massage. We applied a modified Delphi methodology evaluation to binary rating items. Reliability was assessed comparing the ratings of 2 observers (1 in real time and 1 after a video-recorded review). The tools were assessed for content, construct, and criterion validity, and for sensitivity to change.

Results Inter-rater reliability, evaluated with Cohen kappa coefficients, was perfect or near-perfect (>0.8) for 92.5% of items and each Cronbach alpha coefficient was ≥0.91. Principal component analyses showed that all 4 tools were unidimensional. Significant increases in median scores with increasing levels of medical expertise were demonstrated for RESCAPE-intraosseous needle insertion ($P = .0002$), RESCAPE-bag mask ventilation ($P = .0002$), RESCAPE-endotracheal intubation ($P = .0001$), and RESCAPE-cardiac massage ($P = .0037$). Significantly increased median scores over time were also demonstrated during a simulation-based educational program.

Conclusions RESCAPE tools are reliable and validated tools for the evaluation of technical resuscitation skills in pediatric settings during simulation-based educational programs. They might also be used for medical practice performance evaluations. *(J Pediatr 2017;188:252-7).*

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Several reviews have highlighted the educational benefits of simulation in pediatrics.[1-3] However, the number of studies reporting the validation of assessment tools remains limited.[4] This may be problematic, as the development of educational simulation programs necessitates reliable assessment tools.[1,5,6] Well-validated tools could be used both to assess learner knowledge, skills, and/or behavioral abilities and/or to evaluate the effectiveness of simulation training in improving these areas,[6] particularly in comparisons with other training methodologies.

We identified 4 acute care skills that represent the foundation of pediatric resuscitation: intraosseous needle insertion (IO), bag mask ventilation (BMV), endotracheal intubation (ETI), and cardiac massage (CM). These skills must be mastered by any pediatric medical staff member working in a hospital setting. Critical, real-life situations in which these skills are actually used are quite rare, and simulation has now been widely adopted as an alternative learning method. We created 4 Resuscitation and Emergency Simulation Checklist for Assessment in Pediatrics (RESCAPE) tools to evaluate the technical aspects of IO

BMV	Bag mask ventilation
CM	Cardiac massage
ETI	Endotracheal intubation
IO	Intraosseous needle insertion
RESCAPE	Resuscitation and Emergency Simulation Checklist for Assessment in Pediatrics

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(RESCAPE-IO), BMV (RESCAPE-BMV), ETI (RESCAPE-ETI), and CM (RESCAPE-CM). The aim of this study was to assess the reliability, validity, and sensitivity to change of these tools.

Methods

International recommendations[7,8] and manufacturers' recommendations for an intraosseous infusion mechanical system and a manual trocar served as the basis for creation of the 4 tools. Drafting of the individual tool items was performed by a team of experts in pediatric emergency medicine and pediatric critical care medicine from the University Hospitals of Nice and Nancy, France. Each item included in the tool had to meet the following criteria: (1) have a true impact on the technical skill; (2) be simple, clear, and the most objective measure possible; and (3) be evaluable by a single observer standing next to the subject being assessed, without interfering in the participant's activities.

An independent panel of 14 pediatric intensivists or pediatric anesthetists practicing in the French University Hospitals of Nice and Nancy were contacted by e-mail. A modified Delphi methodology was used to select the best items. Experts rated each item on a Likert-type scale ranging from 1 to 9. The item was retained if a high level of agreement was reached, with at least 80% of the experts scoring it at 7 or above.

At the end of the process, the RESCAPE-IO scale contained 19 items, the RESCAPE-BMV and -ETI scales contained 20 items each, and the RESCAPE-CM scale contained 21 items. The resulting tools were constructed to be as concise as possible, with items written in chronological order, such that the assessment could be conducted in the same time that the skill was completed. Items were rated either 0 (not or poorly performed), 1 (correctly performed), or not applicable (depending on the technique chosen, or the age of the child).

One bilingual professional translated the 4 tools into English. Another bilingual professional back-translated the 4 tools into French to assure that the sense was correctly captured in translation. A consensus about translation to English was reached during a meeting with those involved in the initial design of the tools. Face validity in English was not studied given that our study population was French. The English-language tools are appended to this article (**Figures 1-4**; available at www.jpeds.com).

This study was conducted in the Pediatric University Hospitals of Nice and Nancy from September 2013 to August 2014. The study design is presented in **Figure 5**.[9]

Sixty-five participants were asked, via e-mail, to participate in the study. All agreed and gave signed, informed consent. None of the participants was a member of either of the 2 expert panels described above. Each participant filled in a questionnaire concerning their sociodemographic characteristics, position in medical training, and technical experience regarding the various resuscitation skills being evaluated. This study was deemed to be exempt from ethical approval by the institutional clinical trials review board, "CPP V Sud Mediterannée."

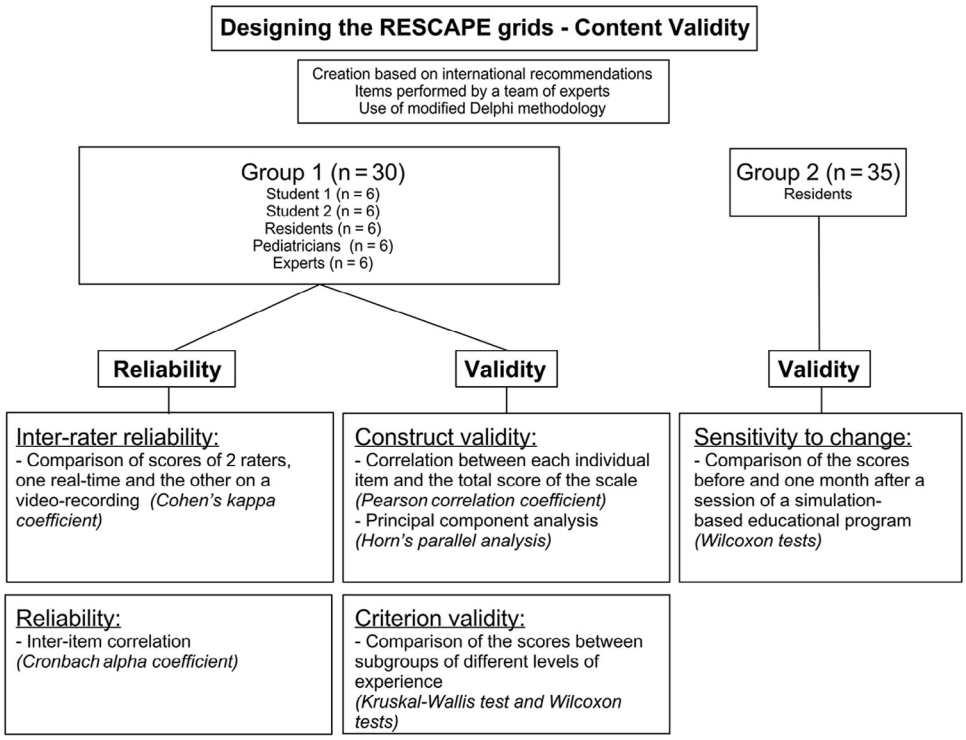

Figure 5. Study design. Flowchart showing the different steps of the study.