MedDbriefer: A Debriefing Research Platform and Tool to Support Peer-led Simulation-based Training in Healthcare

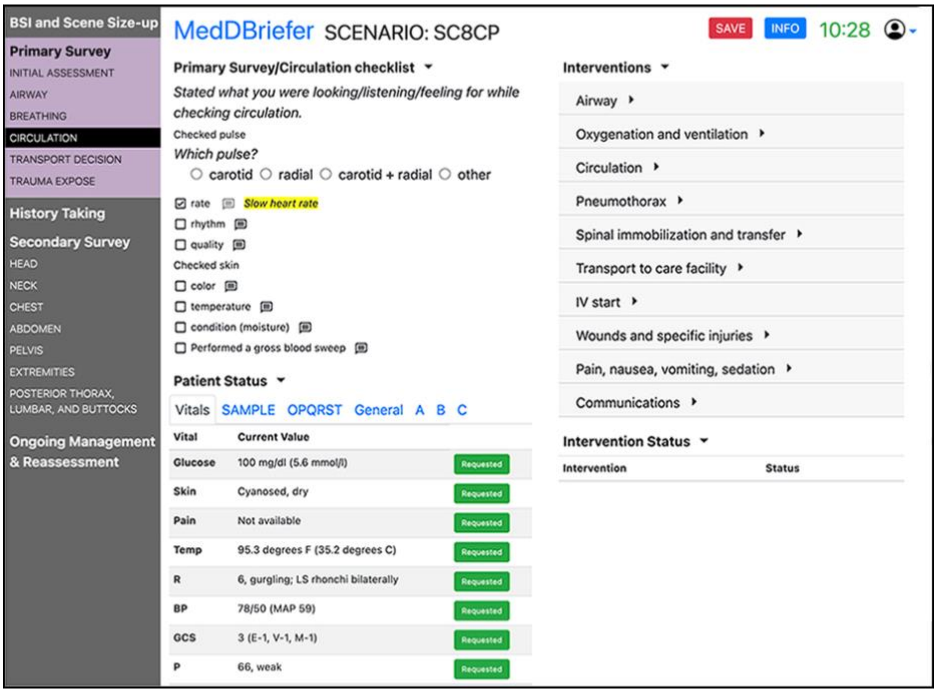
Sandra Katz, Patricia Albacete, Pamela Jordan, and Scott Silliman
Learning Research and Development Center, University of Pittsburgh, Pittsburgh PA, USA
katz@pitt.edu, palbacet@pitt.edu, pjordan@pitt.edu, ssilliman@pitt.edu
Tiffany Yang, Pediatrics, Children's Hospital of Pittsburgh
tiffanysyang@gmail.com

Abstract: MedDbriefer allows paramedic students to engage in simulated prehospital emergency care scenarios and receive an automated debriefing on their performance. It is a web-based tool that runs on a tablet. Although debriefing is purported to be one of simulation-based training's most critical components, there is little empirical research to guide human and automated debriefing. We implemented two approaches to debriefing in MedDbriefer and are conducting a randomized controlled trial to compare their effectiveness.

Introduction

Across the healthcare professions, students who struggle to acquire clinical reasoning and psychomotor skills rarely get enough simulation-based training (SBT) practice during course labs. Experienced SBT facilitators are in short supply. Many are themselves active practitioners (physicians, nurses, paramedics, etc.), which limits the time that they can devote to teaching. To address this problem, we are developing MedDbriefer, a web-based simulation tool that runs on a tablet. When fully implemented, it will allow one or more paramedic students to practice realistic prehospital emergency care scenarios and receive a debriefing on their performance (Katz et al., 2022). While one student treats a simulated patient as the leader of an emergency medical service (EMS) team, a peer uses the tablet's checklists to record the team leader's actions. (See Figure 1.) The system then analyzes

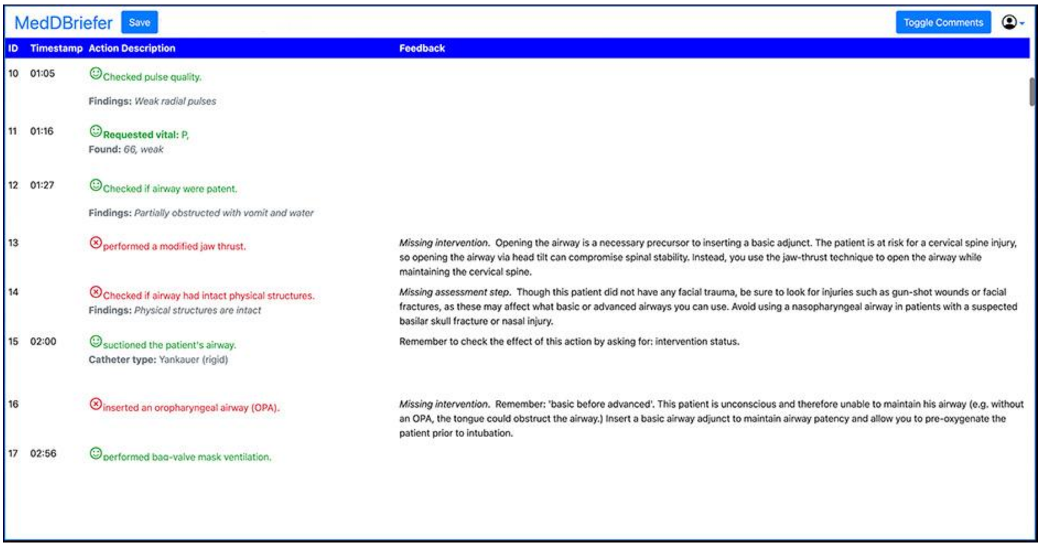
Figure 1: MedDbriefer's Observer Interface



the event log and generates a debriefing. If successful, MedDbriefer could help to reduce the shortage of EMS providers (e.g., Amiry & Maguire, 2021) and, ultimately, support training across the healthcare professions.

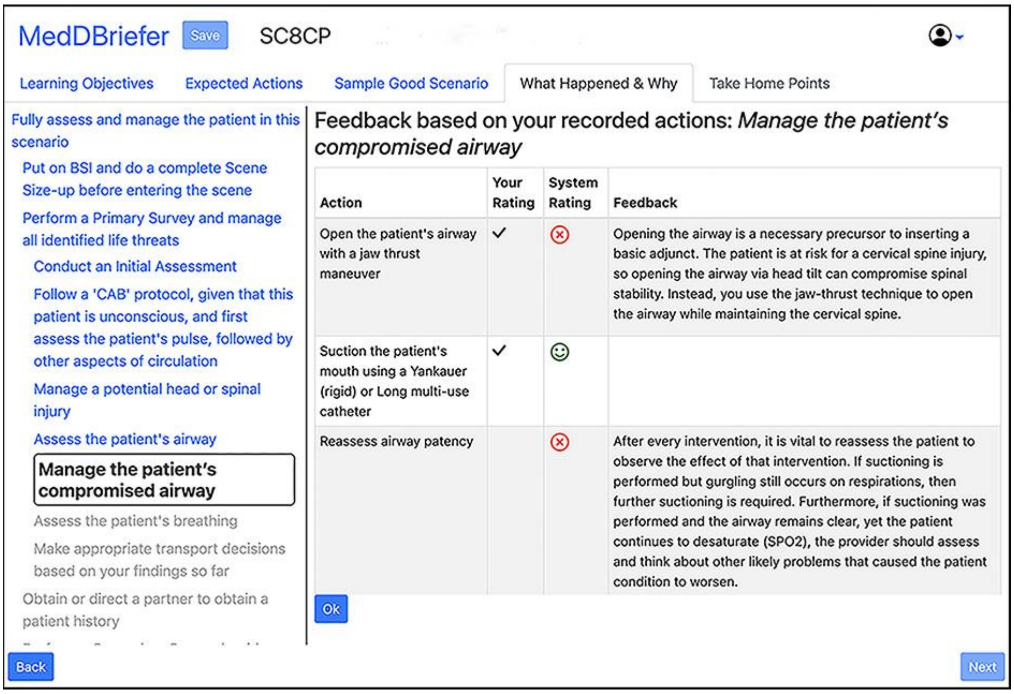
Although debriefing is often deemed to be SBT's most critical component, little is known about how to guide human instructors and automated tutors in conducting an effective debriefing (e.g., Cheng et al., 2017). In addition to enabling students to practice scenarios, MedDbriefer provides a research platform to extend the field's knowledge about SBT, with a focus on debriefing. Toward that end, we implemented two approaches to

Figure 2: Excerpt from a MedDbriefer narrative debriefing log



debriefing in MedDbriefer. One approach reflects that taken in state-of-the-art tutoring systems for healthcare providers, such as vSim for Nursing (Laerdal Medical, 2020): a step-by-step textual recount of students' actions

Figure 3: Self-assessment during a debriefing based on the DEBRIEF protocol



during a training scenario, with color-coded (green/yellow/red) feedback. (See Figure 2.) The other approach adapts one of several debriefing protocols that have been proposed to enable SBT instructors to conduct effective debriefings—namely, DEBRIEF (Sawyer & Deering, 2016). (See Figure 3.) Although several simulation researchers and practitioners have advocated the use of debriefing protocols, there is little empirical evidence to support this practice (Cheng et al., 2017; Sawyer et al, 2016).

As a step towards addressing this gap in SBT research, we are conducting a randomized controlled trial (RCT) to compare the effectiveness of these two approaches to debriefing in MedDbriefer. This paper describes MedDbriefer and an initial field trial that we conducted to prepare for this comparative study.

MedDbriefer

MedDbriefer supports a "voice treating" approach to developing students' clinical reasoning skills. Voice treating entails verbalizing the assessment and treatment actions the healthcare provider would perform, how he would perform them, which actions he would delegate to a team member, etc. Although students often mime actions and use readily available equipment (e.g., a stethoscope) while voice treating, they can focus on identifying clinical problems and deciding how to manage them because they don't need to fully execute procedures.

Since MedDbriefer runs on a tablet, students will ultimately be able to use it to do practice scenarios just about anywhere—in a small meeting room, dorm room, etc.—without needing simulation equipment or a human instructor. A peer who is neither the EMS team leader nor a team member plays the role of "session observer", by using MedDbriefer's checklists to record the team leader's verbalized actions. As shown in Figure 1, MedDbriefer's *Observer Interface* (OI) provides two main checklists. The *assessment checklist* (Figure 1, left) is patterned after one of the "scorecards" used to evaluate EMS candidates during the National Registry of Emergency Medical Technicians' (NREMT) certification exam (NREMT, 2020). The *intervention checklist* (Figure 1, right) includes treatments and other actions that EMS providers commonly perform (e.g., transferring the patient to the ambulance). Interspersed throughout the checklist menus are prompts for the observer to issue to the team leader if he fails to provide sufficient detail while voice treating. For example, the Circulation menu displays a prompt for the team leader to specify which pulse(s) he is checking. (See Figure 1.) The system also provides feedback on the team leader's actions. For example, MedDbriefer displays a callout for the observer to issue when the team leader checks the "patient's" pulse (e.g., *Slow heart rate*, highlighted in yellow in Figure 1).

The chief difference between the two debriefing approaches that MedDbriefer implements is the extent to which they engage students in active reflection on their performance. In the narrative approach, the automated agent critiques each step of the team leader's solution (e.g., Laerdal Medical, 2020). Figure 2 illustrates MedDbriefer's implementation of this approach. In contrast, protocol-based debriefings encourage students to play a more active role in assessing their performance. This approach is illustrated by Sawyer & Deering's (2016) proposed adaptation of the US military's DEBRIEF protocol for simulation-based training in healthcare. DEBRIEF stands for **D**efine the debriefing rules; **E**xplain the learning objectives; specify the performance **B**enchmarks; **R**eview what was supposed to happen; **I**dentify what actually happened and **E**xamine why; and **F**ormalize the "take home" points. During a post-scenario discussion structured according to DEBRIEF, instructors prompt students to assess whether their solution met a set of performance standards ("benchmarks") and consider why it fell short of meeting particular standards.

In MedDbriefer's adaptation of DEBRIEF, the tutor summarizes the "Expected Actions" (Benchmarks) early in the debriefing session. During the "What Happened and Why" (Identify and Examine) phase, students are prompted to check off the actions they believe they performed and then compare their self-ratings with the system's ratings. (See Figure 3.). Feedback on incorrect actions is identical to that presented in the narrative version of MedDbriefer. (See Figures 2 and 3.). Abundant research demonstrates the superiority of active approaches to learning over more passive approaches (Chi & Wiley, 2014). Self-assessment is one form of active learning that consistently shows a positive association with knowledge and skill development (Andrade, 2019). Hence, prior research suggests that the DEBRIEF protocol-based version of MedDbriefer will predict higher learning gains than the narrative version.

Initial Testing

At this writing, an RCT to examine this hypothesis is in progress. Approximately 40 students enrolled in EMS training programs are being randomly assigned to a debriefing condition (narrative versus DEBRIEF protocol-based; Figures 2 and 3). First, each student completes an online pretest. This test includes similar questions to those on the NREMT-Paramedic cognitive exam, which targets the clinical knowledge and reasoning skills needed for EMS practice. Next, students do eight scenarios that involve traumatic injury (e.g., due to a lawnmower rollover accident). The first two scenarios serve as a pretest; they are not followed by a debriefing. The intervention is comprised of the next four scenarios, which engage the student in debriefings. Students then do two posttest scenarios without a debriefing. The posttest scenarios exercise the same clinical knowledge and reasoning skills as the pretest scenarios. Students then take on online posttest that is isomorphic to the online pretest. Finally, they complete a brief survey with open-ended questions about what they learned, whether they think that MedDbriefer would be useful for EMS training and why, and how it could be improved.

To prepare for this trial, we conducted a small field test that followed the same procedure and used the same scenarios and instruments as those described in the preceding paragraph. Four recently certified paramedics (seniors in the university's EMS program) participated as team leaders during the scenarios. Peers trained to use the Observer Interface logged the team leaders' actions. All four participants received narrative debriefings after the intervention scenarios. Analysis of debriefing logs, feedback surveys, and screen recordings of observers' interaction with the OI revealed several changes that we needed to make before the RCT, for example: refinements to the algorithms that analyze session logs to generate a debriefing (Katz et al., 2022); clarifications to several feedback messages; and filling in some gaps in the OI's checklists—for example, to add cardiac monitoring by electrocardiogram to the intervention menus.

Table 1: Performance on pretest and posttest scenarios

	Multi-system trauma		**Difficulty breathing**	
Participant	**Pretest scenario**	**Posttest scenario**	**Pretest scenario**	**Posttest scenario**
P1	.76	.95	.80	1.0
P2	.62	.86	.50	.93
P3	.69	.83	.72	.90
P4	.86	.95	.79	.93

Although underpowered, this field trial suggests that MedDbriefer holds the potential to support learning. The fifth author performed a detailed analysis of each participant's data. For example, using the NREMT's trauma assessment checklist (NREMT, 2020) she scored students' performance on the pretest and posttest scenarios (#points earned/42 maximum). As Table 1 shows, all participants' scores increased from pretest to posttest—both on the scenarios that involve managing multi-system trauma and those that involve managing compromised breathing. Scores on the cognitive pre- and post-tests were mixed: Two students' scores increased from pretest to posttest, one student's scores stayed about the same, and one student's scores decreased. However, a closer analysis indicated that debriefing feedback contributed to gains on several test items. For example, one item targeted students' understanding that positive pressure ventilation should be avoided if a patient has a pneumothorax. Participants 1-3 missed this question on the pretest but answered it correctly on the posttest. They all received feedback that addressed this topic during debriefings. In contrast, Participant 4 answered this question incorrectly on both tests. She was the only student who did not receive feedback on this topic during debriefings.

Participants' feedback on the system, as expressed on the post-session survey, was highly positive. In addition to stating that the debriefing feedback was helpful (3 comments), the four participants agreed that, when fully developed, MedDbriefer will provide a useful tool for EMS training; for example, "When I was studying it was very difficult to find resources/scenarios that I could use for psychomotor testing by myself and with other students. This will be an amazing resource!" The data from the RCT will allow us to measure the extent to which MedDbriefer meets students' expectations and predicts gains in clinical knowledge and reasoning skills.

References

Andrade, H. L. (2019). A critical review of research on student self-assessment. In *Frontiers in Education* (p. 87).

Amiry, A.A., & Maguire, B.J. (2021). Emergency medical services (EMS) calls during COVID-19: Early lessons learned for systems planning (a narrative review). *Open Access Emergency Medicine*, OAEM *13*, 407.

Cheng, A. et al. (2017). Debriefing: The state of the art and science in healthcare simulation. *Healthcare simulation education: Evidence, theory, and practice*, 158-164.

Chi, M.T., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. *Educational* Psychologist, *49*(4), 219-43.

Katz, S., Albacete, P., Gallagher, J., Jordan, P., Platt, T., Silliman, S., & Yang, T. (2022). Comparing alternative approaches to debriefing in a tool to support peer-led simulation-based training. In *Intelligent Tutoring Systems: 18th International Conference, ITS 2022, Bucharest, Romania, June 29-July 1, 2022, Proceedings* (pp. 88-94). Cham: Springer International Publishing.

Laerdal Medical (2020). vSim for Nursing: Building competence and confidence—anytime and anywhere. https://www.youtube.com/watch?v=rXak70MxnAk

NREMT (2020). Advanced level psychomotor examination. https://www.nremt.org/getmedia/6302f735-b899-499e-8a51-26fefac999df/Patient-Assessment-Trauma-v2020_2.pdf

Sawyer, T. & Deering, S. (2016). Adaptation of the US Army's after-action review for simulation debriefing in healthcare. *Simulation in Healthcare*, *8*(6), 388-397.

Acknowledgments

This research is supported by grant 2016018 from the National Science Foundation. The ideas and opinions expressed are those of the authors and do not necessarily represent the views of the NSF. We thank John Gallagher, Karen Kornblum, Emily Miller, Collin O'Connor, Erin O'Meara, Thomas Platt, Stuart Prunty, Samuel Seitz, Emma Sennott, Keith Singleton, Zachary Smith, and Marideth Tokarsky for their contributions.