

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

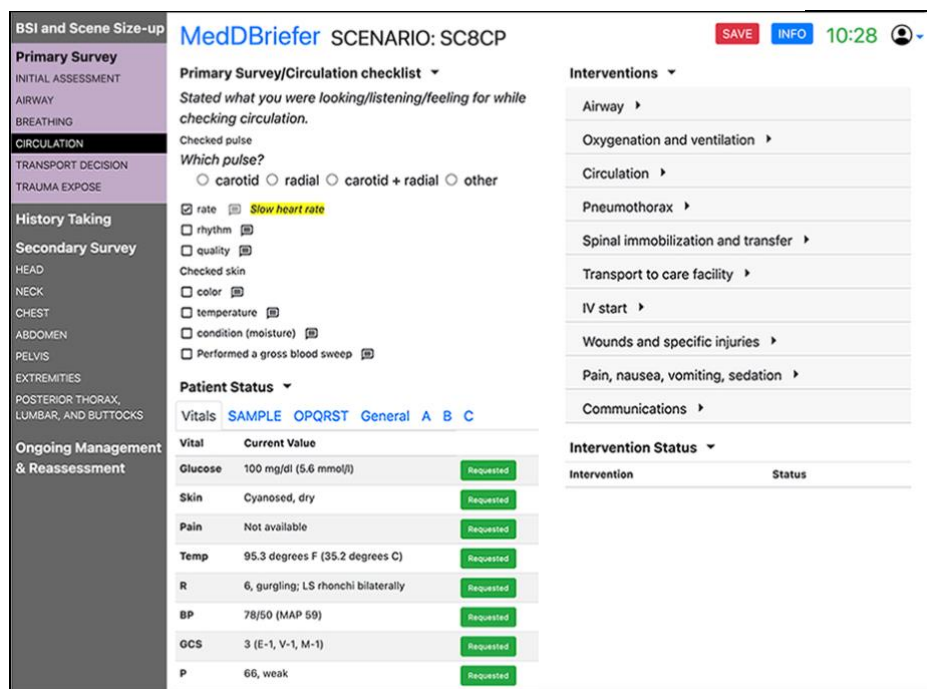
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Abstract: MedDbriefer allows paramedic students to engage in simulated prehospital emergency care scenarios and receive an automated debriefing on their performance. It is a web-based tool that runs on a tablet. Although debriefing is purported to 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



MedDbriefer SCENARIO: SC8CP SAVE INFO 10:28

BSI and Scene Size-up

Primary Survey

INITIAL ASSESSMENT

AIRWAY

BREATHING

CIRCULATION

TRANSPORT DECISION

TRAUMA EXPOSE

History Taking

Secondary Survey

HEAD

NECK

CHEST

ABDOMEN

PELVIS

EXTREMITIES

POSTERIOR THORAX, LUMBAR, AND BUTTOCKS

Ongoing Management & Reassessment

Primary Survey/Circulation checklist

Stated what you were looking/listening/feeling for while checking circulation.

Checked pulse

Which pulse?

☐ carotid ☐ radial ☐ carotid + radial ☐ other

☒ rate ☐ rhythm ☐ quality

Checked skin

☐ color ☐ temperature ☐ condition (moisture)

☐ Performed a gross blood sweep

Patient Status

Vitals **SAMPLE** OPQRST General A B C

Vital	Current Value	Status
Glucose	100 mg/dl (5.6 mmol/l)	Requested
Skin	Cyanosed, dry	Requested
Pain	Not available	Requested
Temp	95.3 degrees F (35.2 degrees C)	Requested
R	6, gurgling; LS rhonchi bilaterally	Requested
BP	78/50 (MAP 59)	Requested
GCS	3 (E-1, V-1, M-1)	Requested
P	66, weak	Requested

Interventions

Airway

Oxygenation and ventilation

Circulation

Pneumothorax

Spinal immobilization and transfer

Transport to care facility

IV start

Wounds and specific injuries

Pain, nausea, vomiting, sedation

Communications

Intervention Status

Intervention	Status
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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

ID	Timestamp	Action Description	Feedback
10	01:05	Checked pulse quality. Findings: Weak radial pulses	
11	01:16	Requested vital: P. Found: 66, weak	
12	01:27	Checked if airway were patent. Findings: Partially obstructed with vomit and water	
13		performed a modified jaw thrust.	Missing intervention. Opening the airway is a necessary precursor to inserting a basic adjunct. The patient is at risk for a cervical spine injury, so opening the airway via head tilt can compromise spinal stability. Instead, you use the jaw-thrust technique to open the airway while maintaining the cervical spine.
14		Checked if airway had intact physical structures. Findings: Physical structures are intact	Missing assessment step. Though this patient did not have any facial trauma, be sure to look for injuries such as gun-shot wounds or facial fractures, as these may affect what basic or advanced airways you can use. Avoid using a nasopharyngeal airway in patients with a suspected basilar skull fracture or nasal injury.
15	02:00	suctioned the patient's airway. Catheter type: Yankauer (rigid)	Remember to check the effect of this action by asking for: intervention status.
16		inserted an oropharyngeal airway (OPA).	Missing intervention. Remember: 'basic before advanced'. This patient is unconscious and therefore unable to maintain his airway (e.g. without an OPA, the tongue could obstruct the airway.) Insert a basic airway adjunct to maintain airway patency and allow you to pre-oxygenate the patient prior to intubation.
17	02:56	performed bag-valve mask ventilation.	

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

MedDbriefer Save SC8CP

Learning Objectives Expected Actions Sample Good Scenario What Happened & Why Take Home Points

Fully assess and manage the patient in this scenario

Put on BSI and do a complete Scene Size-up before entering the scene

Perform a Primary Survey and manage all identified life threats

Conduct an Initial Assessment

Follow a 'CAB' protocol, given that this patient is unconscious, and first assess the patient's pulse, followed by other aspects of circulation

Manage a potential head or spinal injury

Assess the patient's airway

Manage the patient's compromised airway

Assess the patient's breathing

Make appropriate transport decisions based on your findings so far

Obtain or direct a partner to obtain a patient history

Back

Feedback based on your recorded actions: *Manage the patient's compromised airway*

Action	Your Rating	System Rating	Feedback
Open the patient's airway with a jaw thrust maneuver	✓	✗	Opening the airway is a necessary precursor to inserting a basic adjunct. The patient is at risk for a cervical spine injury, so opening the airway via head tilt can compromise spinal stability. Instead, you use the jaw-thrust technique to open the airway while maintaining the cervical spine.
Suction the patient's mouth using a Yankauer (rigid) or Long multi-use catheter	✓	😊	
Reassess airway patency		✗	After every intervention, it is vital to reassess the patient to observe the effect of that intervention. If suctioning is performed but gurgling still occurs on respirations, then further suctioning is required. Furthermore, if suctioning was performed and the airway remains clear, yet the patient continues to desaturate (SPO2), the provider should assess and think about other likely problems that caused the patient condition to worsen.

Ok

Next

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**evue 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 an 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

Participant	Multi-system trauma		Difficulty breathing	
	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.

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