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Embracing informed learner self-assessment during debriefing: the art of plus-delta

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Abstract

The healthcare simulation field has no shortage of debriefing options. Some demand considerable skill which serves as a barrier to more widespread implementation. The plus-delta approach to debriefing offers the advantages of conceptual simplicity and ease of implementation. Importantly, plus-delta promotes learners' capacity for a self-assessment, a skill vital for safe clinical practice and yet a notorious deficiency in professional practice. The plus-delta approach confers the benefits of promoting uptake of debriefing in time-limited settings by educators with both fundamental but also advanced skills, and enhancing essential capacity for critical self-assessment informed by objective performance feedback. In this paper, we describe the role of plus-delta in debriefing, provide guidance for incorporating informed learner self-assessment into debriefings, and highlight four opportunities for improving the art of the plus delta: (a) exploring the big picture vs. specific performance issues, (b) choosing between single vs. double-barreled questions, (c) unpacking positive performance, and (d) managing perception mismatches.

Keywords: Debriefing, Plus-delta, Learner self-assessment, Feedback

Introduction

The evolution of simulation-based education in healthcare has been accompanied by growth in the number of debriefing methods, frameworks, and/or conversational strategies [1–6]. Many debriefing methods demand considerable skill, which impedes effective implementation. The plus-delta approach to debriefing has multiple benefits since it is conceptually simple and easy to implement, while promoting learner capacity for self-assessment—a skill vital for safe clinical practice [2, 5, 7–12]. With plus-delta, facilitators engage learners in a self-assessment of their own performance [12], which in turn provides opportunity for individual and team reflexivity [13, 14]. Unfortunately, many facilitators lack awareness of the importance of learner self-assessment in promoting professional practice, resulting in an inability to maximize the impact of this approach or in some cases, an avoidance of the method altogether. We believe this straightforward approach can demystify the art of debriefing and promote its uptake, while concurrently capitalizing on the benefits of informed learner self-assessment. In this paper, we clarify the implementation of plus-delta and offer strategies to best execute the approach by clearly defining the role and benefits of learner self-assessment in debriefing.

This paper has several aims, structured in a step-wise manner to guide the reader through the background, rationale, and strategies for adopting learner self-assessment in debriefing. First, we define the plus-delta approach and describe its role in debriefing. Second, we argue for the important role for incorporating informed learner self-assessment into debriefings and map debriefing strategies to Ross' four-stage model for fostering learning through self-assessment [15]. We then describe four opportunities for fine-tuning the art of the plus-delta, namely (1) using plus-delta for the big picture vs.

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specific performance issues, (2) single- vs. double-barreled questioning, (3) unpacking positive performance, and (4) managing perception mismatches. To close, we discuss how to incorporate various forms of informed learner self-assessment into debriefing.

What is plus-delta?

The plus-delta approach describes a debriefing strategy in which participants are asked to reflect on the entire simulation event (or portions thereof) and assess their individual and/or collective performance. When applying this approach, facilitators ask learners: "What went well and what would you do differently (or improve) next time?" [7, 9, 12]; "What did you do well, and what did not go well, and why?" [10]; "What was easy and what was challenging for you?" [5]; or other similar questions. Outside of healthcare, the US Army has adopted a version of this approach through a performance feedback method termed "After Action Review" [16, 17]. Following training, soldiers engage in a facilitated conversation to clarify what aspects of performance met pre-defined standards, and where there was opportunity for improvement [17]. The plus-delta approach, when coupled with feedback and teaching, can be used as the primary conversational strategy in a debriefing [7, 9–11] or used more selectively by blending it with other strategies (e.g., focused facilitation) depending on the learning context, amount of time available, and facilitator preferences (e.g., learner vs. instructor-centered debriefing) [12, 18]. Ideally, an effective plus-delta generates two lists of behaviors (i.e., things that the learners felt went well, and things that the learners felt could be improved), which then prompts further discussion, reflection, and/or learning during the debriefing. The true function of plus-delta is to conduct a learner self-assessment, the benefits and downsides of which have been extensively studied, debated, and described in the healthcare and education literature [19, 20].

Learner self-assessment for professional development

Although traditional notions highlight the importance of self-assessment for professional development, professionals are notoriously poor at assessing their own performance [19]. In a series of educational studies, participants were recruited to self-assess themselves after performing a wide range of tasks requiring humor, logical reasoning, and English grammar. These studies found that participants in the lowest scoring quartile tended to overestimate their performance [21]. Similar patterns have been observed in healthcare providers. Physicians often fail to recognize knowledge deficits, with less experienced and/or poorer performing clinicians demonstrating a tendency to overrate their knowledge and skills [19, 22–26]. Trainees exemplify this discrepancy and consistently overestimate competency in the face of both inadequate performance and adequate performance [22–24, 26]. Even experienced clinicians sometimes struggle to accurately assess their ability to integrate skills into clinical practice [19, 25].

Despite these inaccuracies, there are several important benefits of learner self-assessment. When self-assessments are accurate, additional learning can be gained from performing the act itself, thus allowing for skill development in the absence of expert assessment [27]. Learners who engage in self-assessment set higher goals and commit more effort to the acquisition of these goals, which equates to enhanced future performance [26, 27]. Objective feedback informed by specific performance standards amplifies the benefits of self-assessment [28–31].

Informed self-assessment describes the "set of processes through which individuals use external and internal data to generate an appraisal of their own abilities" [32]. Learners aware of specific benchmarked standards with access to objective data (i.e., external data) demonstrate improved self-assessment abilities compared to those who rely solely upon their own internal judgments (i.e., internal data) [29–31, 33–35]. Ross et al. proposed a four-stage model to foster learning through informed learner self-assessment that incorporates many of these key elements: (1) involve students in defining the criteria used to judge performance, (2) teach students how to apply the criteria, (3) give students feedback on their performance (informed by objective data) and self-assessments, and (4) help students develop action plans [15].

Learner self-assessment in debriefing

Critics may question the value of learner self-assessment during debriefing if clinicians struggle with providing accurate self-assessments of their own performance [19]. We argue that such criticism highlights why we should integrate learner self-assessment into debriefing; after all, without having learners self-assess, how will you know how they perceive their own performance? If learners overestimate their own performance, would you not want to know so that you could directly address this misperception? Failure to conduct a learner self-assessment during debriefing places the facilitator at risk for missing out on critical learner misperceptions that may be perpetuated if they are not addressed during the debriefing. Furthermore, the process of learner self-assessment promotes individual and team reflexivity, whereby group members actively "reflect upon … strategies, goals, processes, and outcomes to process key information and adapt accordingly" [14, 36]. Debriefing represents a form of post-action team reflexivity. The plus-delta approach triggers teams to evaluate their performance, which enhances team performance by promoting shared mental models, triggering adaptation, and crystallizing learning [13, 14]. For these reasons, we see a facilitated learner self-assessment as serving a distinctly unique role in debriefing, which emphasizes the importance of being able to conduct a plus-delta during debriefing in a purposeful manner.

Thus, in simulation-based education, debriefing can both engage learners and enhance their capacity for self-assessment in a manner conducive to effective learning. Table 1 provides an overview of how Ross' four-stage model can foster learning through self-assessment in debriefing [15]. Stage 1 can be achieved during the prebriefing by having the facilitator review specific performance goals with students and/or introducing a performance checklist for the simulation event [30]. Debriefings offer the optimal venue for addressing stages 2, 3, and 4. To teach learners how to apply performance criteria (i.e., stage 2), facilitators should first conduct a plus-delta with learners and then use language that explicitly connects performance criteria with observed behaviors [15] when closing performance gaps. For example, one strategy would be to view videos of expert modeled performance that demonstrates desired benchmarks [29]. In order to provide feedback on their self-assessments (i.e., stage 3), facilitators should close performance gaps by reviewing performance relative to specific standards (e.g., use of a performance checklist) [30, 31, 33] and generalize discussion to other clinical contexts (i.e., stage 4), both which are tasks central to effective debriefings [2, 12, 37].

The art of the plus-delta

In this section, we introduce four specific considerations when implementing plus-delta, offered in the order of decision-making typically required of a facilitator during a debriefing.

Assessing the big picture vs. specific performance issues

As with other conversational strategies, selective use of plus-delta may be appropriate at various points in discussion depending on the debriefing focus. In a blended method of debriefing, we locate plus-delta during the analysis phase [12, 38]. At the beginning of the analysis phase, facilitators may use a plus-delta to obtain a learner assessment of the "big-picture", or the entire clinical event (Fig. 1a). In doing this, facilitators identify the learner agenda and recognize perception mismatches early in the analysis phase, which in turn helps prioritize topics for the remainder of the debriefing [18]. Of course, a plus-delta at the beginning of the analysis phase is not always necessary or appropriate. For example, when a rich reactions phase allows identification of numerous topics for discussion, facilitators may forgo a plus-delta and dive directly into focused facilitation. Facilitators should tailor the use of plus-delta to debriefing context (i.e., what has already been discussed) and learner needs.

Alternatively, the plus-delta approach can be used as a tool to explore specific aspects of performance (Fig. 1b). A preview statement preceding the plus-delta question supports the use of the plus-delta approach to unpack specific learner behaviors. For example, the facilitator might say: "I'd like to spend some time discussing the task of defibrillation; and I'd like to get your take before

Table 1 Fostering learning through self-assessment in debriefing using Ross' four-stage model

Stage	Goal	Activity	Strategies
1. Define the criteria	Clarify criteria used to judge performance	Prebriefing	- Solicit input from learners on potential performance criteria - Review performance criteria—this can be general or specific (e.g., performance checklist or assessment tool)
2. Apply the criteria	Teach learners how to apply criteria in context	Debriefing	- Conduct a plus-delta to obtain a learner self-assessment - Highlight and discuss positive performance - Use language to connect positive behaviors with performance criteria - Review performance checklist or assessment tool relative to performance in simulation - View expert modeled performance (e.g., pre-recorded on video)
3. Provide feedback	Deliver feedback on their performance and reflect on self-assessments	Debriefing	- Identify perception mismatches - Explore and discuss (i.e., focused facilitation) perception mismatches to uncover rationale driving perceptions - Use external data (e.g., video, performance checklists, objective data) to inform feedback - Provide feedback to close performance gaps
4. Develop goals and action plans	Support learners to develop action plans that generalize learning to other contexts	Debriefing	- Discuss how key learning points can be generalized to other clinical contexts - Identify and summarize key learning points/action plan

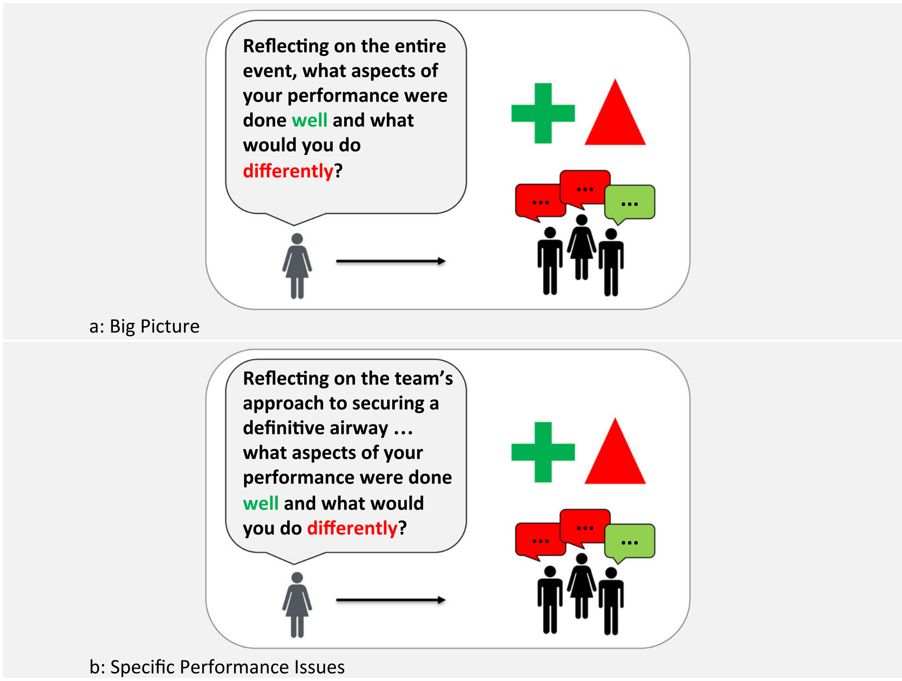

Fig. 1 Use of plus-delta for learner self-assessment of: **a.** The big picture or **b.** Specific performance issues

I share mine" as a preview to a plus-delta on how defibrillation was conducted during the simulated cardiac arrest event, which might sound like: "Reflecting on the three instances when you had to defibrillate the patient, can you share what was done really well, and what you would do differently next time?". Even using plus-delta this purpose, we encourage facilitators to keep in mind the need to identify and further explore perception mismatches as they arise.

Single- vs. double-barreled questioning

We see two main ways of approaching questioning when using plus-delta: single-barreled questioning (i.e., one-part question) and double-barreled questioning (i.e., two-part question). Single-barreled questioning involves asking the "plus" question first (e.g., "What aspects of your performance were done well?"), followed by reflective discussion of each of these points (Fig. 2a). Once completing the discussion of "plus" items, facilitators then pose the "delta" question (e.g., "What aspects of your performance would you change next time?"), followed by facilitated discussion and group reflection. With double-barreled questioning, facilitators asks both the "plus" and "delta" questions back to back (e.g., "What aspects of your performance were done well, and what things would you do differently next time?"), thus leaving it to the learner group to determine what aspects of performance to explore during discussion (Fig. 2b).

We see pros and cons to both approaches. Single-barrel questioning are inherently limiting, conferring more control (of debriefing content) to the facilitator by asking a question with a narrower scope. If, for example, a facilitator is debriefing a team of novice learners who have just performed poorly, they may see value for the learner group to explore positive aspects of their performance first. In this case, posing the "plus" question with the single-barreled approach would serve that purpose. As a downside, this approach exerts more control over the content of discussion may force the conversation in a direction misaligned with learner wishes, particularly when learner performance was sub-optimal (or vice versa). Double-barreled questions allow more freedom of response, placing the onus on learners to identify which aspects of performance, either "plus" or "delta" or both, to highlight during discussion. This approach often uncovers the learner agenda (i.e., the issues that more most important to the learners), which helps facilitators shape future discussion towards learner priorities [18]. Double-barreled questioning risks focusing learner groups entirely on answering only one part of the question (i.e., typically the "delta" question). In situations where learners focus on poor performance, a mentality of "bad is stronger than good" may overtake the debriefing, making it hard to shift gears despite potentially different preferences or perspectives [39]. In some cases, facilitator may never get around to re-asking the "plus" part of the question again, potentially leading to a debriefing that neglects positive aspects of performance.

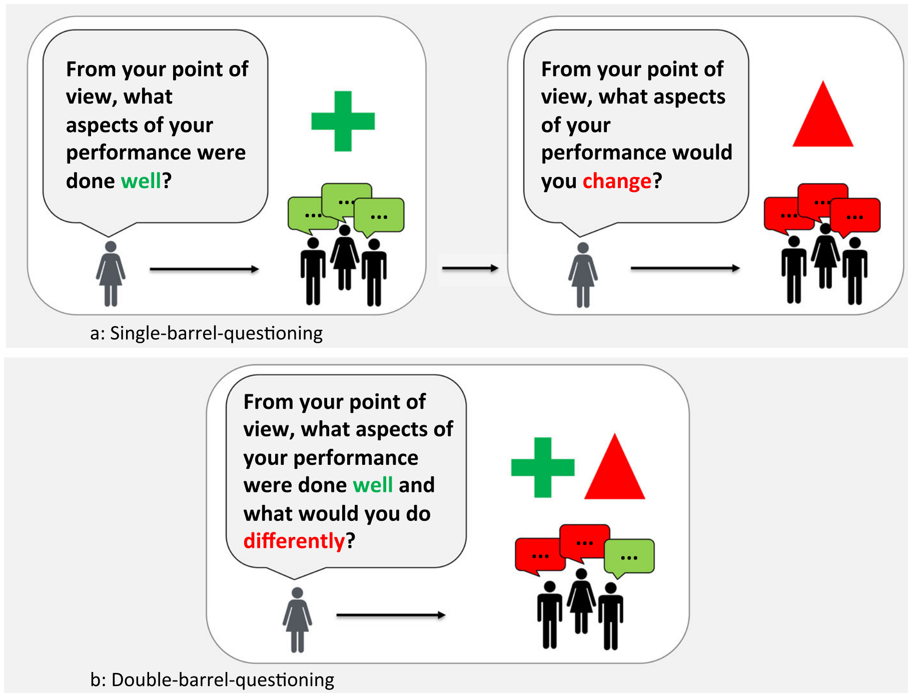

Fig. 2 Phrasing of questions in plus-delta for: **a.** Single-barrel questioning or **b.** Double-barrel questioning

Unpacking positive performance

Reflecting on our experiences teaching plus-delta to simulation educators around the world, we have discovered a tendency to focus on discussion of "delta" items at the expense of "plus" items. An inherent assumption drives this behavior, namely that learners derive more value learning from poor performance than good performance [39]. This concept, referred to in psychology literature as negativity bias [40], is especially pronounced when learners feel there is an opportunity to adapt their performance [41], as in simulation. As educators, when we see healthcare teams excel during clinical scenarios, we assume that all team members appreciate that all aspects of the case were managed well and how they were able to collectively achieve those goals. This is a dangerous assumption. When learners do something properly, other learners do not automatically appreciate (a) what was done well, (b) how it was done, (c) and why it was important to be done in that fashion. Failure to explore aspects of positive performance represents missed learning opportunities during debriefing [42].

We support Dieckmann et al.'s assertion about the value in unpacking positive performance (i.e., "learning from success") during debriefings [43] and believe that plus-delta facilitates this activity. Following up the "plus" question with additional probing questions to explore the "what," "how," and "why" aspects of performance will deepen learning. For example, in response to the question "What aspects of performance were done well?", learners may say: "I really thought that Michael did a great job as the team leader – he was awesome!". To unpack this further, the facilitator could ask: "Tell me more about what you liked about Michael's leadership", "What made Michael an effective leader?", "How did Michael bring you together as a team?", or "Why was it so important to have a strong leader?" (Fig. 3). Alternatively, a skilled facilitator may further deepen discussion through focused facilitation (e.g., advocacy inquiry [37, 44], circular questions [45]) to explore the underlying rationale for these behaviors [12] (Table 2). All of these approaches encourage learners to reflect deeply on one aspect of the team's performance, thus ensuring that all learners can carry these positive behaviors through to their next clinical encounter.

Managing perception mismatches

One challenge facilitators face is when their assessment of the learner performance differs from the learners' perception of their own performance. The plus-delta approach captures a small "biopsy" of learner insights. With just one or two questions, facilitators obtain an overview of how learners viewed their own performance, which they can quickly compare with their own personal assessment and/or pre-defined performance measures. In some instances, learners provide a self-assessment that does not agree with the facilitator's assessment of their performance [19, 22, 23, 25, 46]. This becomes

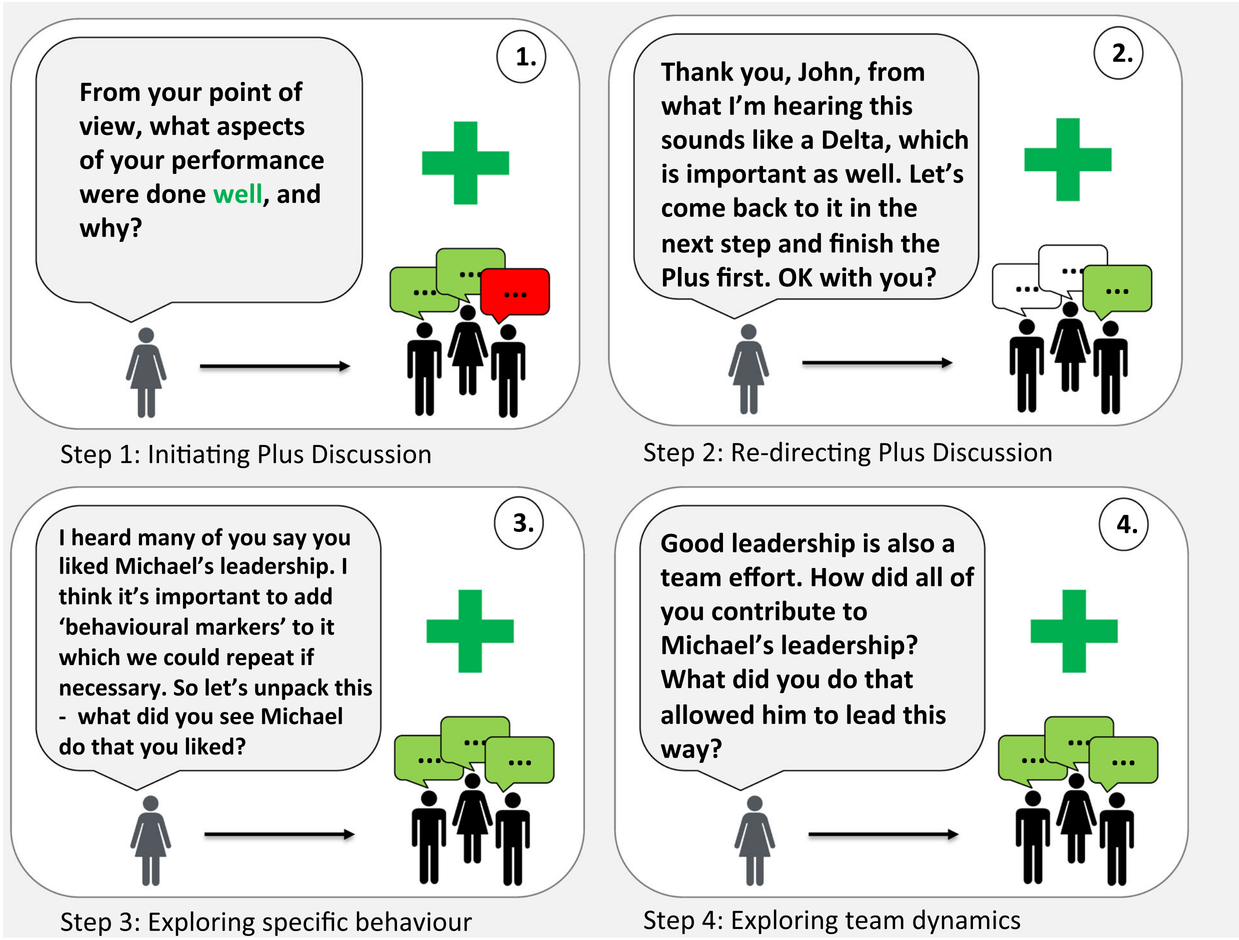

Fig. 3 Steps for unpacking positive performance in plus-delta: 1. Initiating plus discussion. 2. Re-directing plus discussion. 3. Exploring specific behavior. 4. Exploring team dynamics

clear when one or more learners categorize behaviors in the "plus" column that the facilitator believes belong in the "delta" column, or vice versa. Here facilitators face a perception mismatch—namely, learners' believe they have performed well, when in fact they have performed below the standard (or vice versa). Discordant assessments of performance amongst learners thus highlight differences in perception that require further discussion. This is important because people tend to wrongfully assume that others share their perception [47] which prevents them from explicitly discussing them. Reflecting on differences in perceptions allows team members to update team mental models that represent knowledge structures, thus enabling team members to build accurate explanations and expectations of a task [14, 48]. As such, facilitators should prioritize perception mismatches as key learning opportunities during debriefings. Perception mismatches also threaten psychologically safe learning environments. Without the feeling that they can speak their mind, learners may withhold their self-assessment to protect themselves from feared criticism or feel alone with, or even ashamed of, their individual perception [49].

To foster psychologically safe conversations when perception mismatches exist, we encourage facilitators to explicitly introduce the issue with a preview statement: "I'm hearing two slightly different perspectives on the way the team approached airway management. Let's spend some time reflecting on how and why this unfolded…." A preview statement provides clarity and frames the upcoming portion of discussion for learners. Facilitators may subsequently pose additional probing questions to explore the "what," "how," and "why" of their performance, or they may use specific focused facilitation strategies (e.g., advocacy inquiry [37, 44] or circular questions [45) to uncover the rationale driving certain learner behaviors (Table 2). Facilitators help normalize differences in experiences and explicitly appreciate shared self-assessment(s) that seem to stand out or be in the minority. This intervention also helps

Table 2 Examples—language to manage perception mismatches in debriefing

Plus-delta question	Preview statement	Focused facilitation
Single-barreled questions		***Advocacy inquiry*** [34, 40]
"What were some aspects of your performance that you did well?"	"So, one of the things that I'm hearing is that you guys think that the communication in that scenario went very well. I can understand that, but I've also got a slightly different perspective that I would like to share with you."	"I noticed that there was a lot of communication amongst the team during that scenario, but it seemed to me that several of the key tasks didn't get completed because they were not specifically given to one team member … I'm concerned that this led to a delay in those key tasks. How did you see it?"
"What would you do differently next time?"	"I'm hearing that you thought that there was too much confusion about what type of shock that you were dealing with in this scenario, and that delayed your ultimate management. I can see your point of view but want to share a slightly different perspective."	"I saw there was some confusion as to what type of shock you were dealing with as you tried to work it out amongst the team. During this time the patient still got an initial bolus of intravenous fluids, which worries me as that might have been potentially harmful for a patient in cardiogenic shock. Can you share with me your thoughts as you were working through this problem?"
Double-barreled questions		***Circular questions*** [41]
"What was easy, and what was challenging for you?	"I'm hearing different perceptions of what was easy and what was challenging. I think this is both normal and important for collaborating as team members. Let's take a moment and explore these differences further."	"How do you explain these differences in your perception of challenges?" "In your view, how important is it to agree on these challenges?" "If you were saying 'OK, I'll take the lead and I need your help with this', what do you imagine the other team members would do?"
"From your point of view, what did you do well, and what would you do differently next time?"	"I'm hearing different perception of what went well and what could be done differently. It is very common to see things from one's own perspective. Highlighting differences is important and why we debrief. Let's take a moment and explore these differences further."	"How do you explain these differences in your perception of what went well and what could be improved?" "On which aspects do you agree? What is different in these aspects? On which aspects do you not agree? What's different here?"

manage group polarization (i.e., shift towards talking about certain issues while neglecting others) [50]. Through these combined approaches, facilitators gather various perspectives, gain understanding about learners' rationale for behavior, and work to close gaps in knowledge, skills, or teamwork that contributed to the perception mismatch.

Discussion

The process of learner self-assessment enables performance improvement, lifelong learning, and most importantly, safe patient care. A genuine connection between the educator and learner fosters learning through the self-assessment process [26]. In debriefing, this connection can be built by ensuring a psychologically safe learning environment through implicit (e.g., body language, eye contact) and explicit strategies (e.g., validation, normalization) [49]. To maximize the benefit of this process, the facilitator should work towards optimizing accurate learner self-assessment.

In describing effective informed self-assessment practices, Epstein et al. highlight that the "power of self-assessment lies in … the integration of high-quality external and internal data" to assess performance [51]. Many debriefings rely heavily (or entirely) upon internal data, or learners' "self-perception of their performance and emotional state" [31], which relies on personal biases and is often flawed. The incorporation of external data sources (e.g., objective data, performance checklists, and video) into their debriefing conversations can counter biases and misperceptions arising from internal data. Recently published guidelines from the American Heart Association recommend the inclusion of objective CPR data during post-event debriefings, as evidence suggests data-informed debriefing improves provider performance and survival outcomes from cardiac arrest [52]. The impact of using performance checklists as external data sources can be augmented if learners clearly understand these benchmarks, and if learners actively make judgments of their performance using these criteria [30, 53]. The introduction of the performance standards during the pre-briefing, coupled with a plus-delta approach supported by performance checklist review (relative to performance) during the debriefing, would enact this recommendation. Lastly, we see opportunities for the selective use of video as objective, external data to facilitate informed learner self-assessment during debriefing. Video review could potentially clarify misperceptions in performance, or serve to illustrate outstanding performance that meets or exceeds standards [29].

Learner self-assessment, while often fraught with inaccuracies, has clear benefits that can support learning during debriefing. Ross' four-stage model provides a guiding framework for specific strategies that foster learning through self-assessment in simulation-based education [47]. Facilitators may further master the art of plus-delta by managing perception mismatches, selectively engaging learners in self-assessing performance at either the "big picture" level or for specific performance issues, thoughtfully using single- vs. double-barreled questions, and unpacking positive performance. In providing evidence and strategies for informed learner self-assessment, we hope facilitators will embrace and confidently implement the plus-delta approach to debriefing in a manner that further enhances learning outcomes.

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Immediate faculty feedback using debriefing timing data and conversational diagrams

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Abstract

Background: Debriefing is an essential skill for simulation educators and feedback for debriefers is recognised as important in progression to mastery. Existing assessment tools, such as the Debriefing Assessment for Simulation in Healthcare (DASH), may assist in rating performance but their utility is limited by subjectivity and complexity. Use of quantitative data measurements for feedback has been shown to improve performance of clinicians but has not been studied as a focus for debriefer feedback.

Methods: A multi-centre sample of interdisciplinary debriefings was observed. Total debriefing time, length of individual contributions and demographics were recorded. DASH scores from simulation participants, debriefers and supervising faculty were collected after each event. Conversational diagrams were drawn in real-time by supervising faculty using an approach described by Dieckmann. For each debriefing, the data points listed above were compiled on a single page and then used as a focus for feedback to the debriefer.

Results: Twelve debriefings were included (μ = 6.5 simulation participants per event). Debriefers receiving feedback from supervising faculty were physicians or nurses with a range of experience (*n* = 7). In 9/12 cases the ratio of debriefer to simulation participant contribution length was ≧ 1:1. The diagrams for these debriefings typically resembled a fan-shape. Debriefings (*n* = 3) with a ratio < 1:1 received higher DASH ratings compared with the ≧ 1:1 group (*p* = 0.038). These debriefings generated star-shaped diagrams. Debriefer self-rated DASH scores (μ = 5.08/7.0) were lower than simulation participant scores (μ = 6.50/7.0). The differences reached statistical significance for all 6 DASH elements. Debriefers evaluated the 'usefulness' of feedback and rated it 'highly' (μ= 4.6/5).

Conclusion: Basic quantitative data measures collected during debriefings may represent a useful focus for immediate debriefer feedback in a healthcare simulation setting.

Keywords: Interprofessional collaborative practice, Debriefing, Faculty development (simulation educator or technician)

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Background

Providing adult learners with meaningful feedback is likely to be an important contributor to improved future performance [1–3]. Debriefing following simulation-based medical education (SBME) events is a key step in allowing participants to identify performance gaps and sustain good practice [3–5]. To achieve this goal, it is acknowledged that effective debriefing is important [6, 7]. Yet, as is often observed a gap may exist between ideal approaches to debriefing and actual performance [4].

To bridge this gap, a number of debriefing assessment tools provides a guide for rating and reviewing performance [8–10]. The tools available include the Objective Structured Assessment of Debriefing (OSAD) and the Debriefing Assessment for Simulation in Healthcare (DASH). OSAD and DASH assess debriefers on a Likert scale based on a set of ideal behaviours [8, 10]. As a result, they are useful for illustrating concepts to novices and providing a shared mental model of what a good debriefing looks like. However, they are not easily integrated into debriefer feedback, mentoring or coaching [11]. While these tools appear to be widely adopted in the training of debriefers, validation studies were limited to analysis of delayed reviews of recorded debriefings [8–10, 12]. In addition, while the tools may identify areas for the debriefer to improve, the arbitrary scores provided do not necessarily translate to improved future performance. In this study we seek to close this gap by exploring the use of quantitative data measures as a supplementary tool for debriefer feedback.

Current faculty development programmes often use the tools listed above as an aid to achieve improved debriefings [11]. In many programmes, feedback to new debriefers follows direct observation (or video review) by more experienced colleagues. Mentoring may also be useful if provided in a structured manner to help progress new debriefers towards mastery [13]. Coaching using a supportive and pre-agreed approach may also be important for facilitating stepwise improvements in debriefer performance [6, 13, 14]. These 3 strategies (i.e. feedback, mentoring and coaching) are attractive concepts but the best approaches to debriefer faculty development remain uncertain.

Based on an observation of debriefings conducted in various non-healthcare settings, we hypothesised that the use of quantitative data for feedback may provide an additional option for debriefer faculty development [15]. Notably, the current debriefing literature does not extensively report on using such quantitative data for debriefer feedback. There is a precedent for using a data-driven approach to feedback in healthcare more broadly [2, 15, 16]. Studies of data-driven feedback for healthcare providers showed improved team performance and this approach has been evaluated in both the social science and sporting literature [15–19].

As a result, in this study, we set out to (A) *examine the utility of basic quantitative debriefing performance data collected in real-time*; (B) *to compare the use of this data to existing assessment tools (i.e. DASH);* and (C) *to assess the future role of this approach for debriefer faculty development* [7, 20].

Methods

Study setting

The study was a collaboration between experienced debriefers at the Center for Advanced Pediatric and Perinatal Education (CAPE) at Stanford University (USA) and two Australian SBME centres in the Western Sydney Local Health District network [14]. This study explored the use of recording length of contributions during debriefings and use of conversational diagrams as a means of assessment of debriefing performance with reporting based on STROBE statement guidelines [21].

Inclusion criteria and study subjects

Following the written consent of all simulation participants, debriefers and supervisors, we observed a series of 12 debriefings across two simulation sites. Debriefings were enrolled from January to March 2019 as a convenience sample selected on occasions where the availability of experienced supervising faculty as per the definition by Cheng et al. [13] allowed completion of the study protocols. At the time of data collection, COVID-19 pandemic social distancing restrictions were not in place. Observations and recording were conducted in real time for various elements using a paper data collection sheet. All the debriefings had a single lead debriefer and two supervising faculty present.

Outcome measures

We recorded the following data points in real time: (A) *study subject interactions* [7] (Fig. 1); (B) *timings*; (C) *quality* (DASH scores) [8] and (D) *demographics*. Demographics included role, gender and debriefing experience. Study subject age was not recorded. Junior doctors were defined as postgraduate year (PGY) 3 or less.

An a priori plan was made to assess the relationship between each member attending the debriefing by hand-drawing conversational diagrams for each debriefing (Fig. 1) [7]. The figures provided reflect the distribution of interactions, timing of each person and the relative strength of the interactions between each study subject. Two investigators observed each of the debriefings. Investigator A recorded the demographics of study subjects while Investigator B measured total time and the duration of conversation that each debriefing study subject contributed. Based on Dieckmann's approach, we

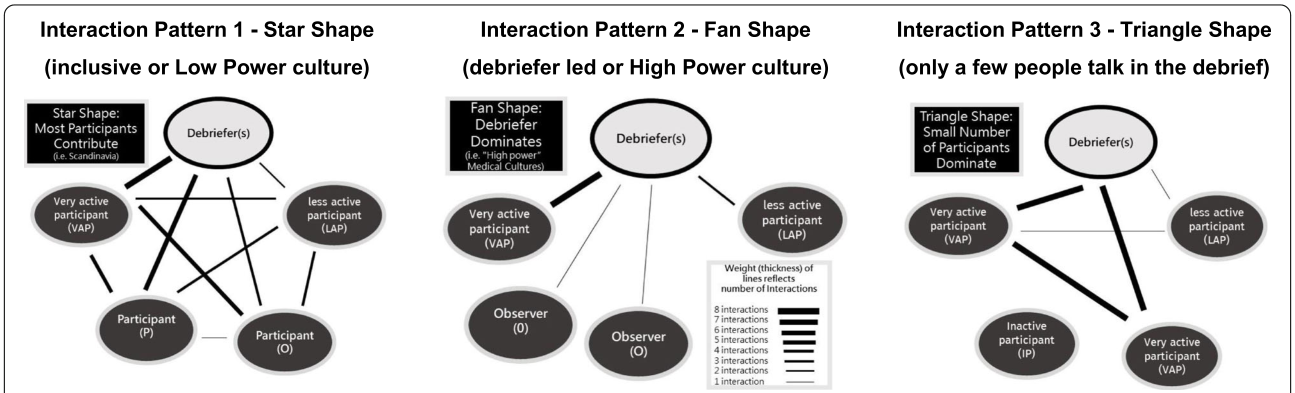

Fig. 1 Conversational diagrams. Interaction and strength coding (adapted from Dieckmann et al. and Ulmer et al.). Interaction pattern 1—star shape (inclusive or low power culture). Interaction pattern 2—fan shape (debriefer led or high power culture). Interaction pattern 3—triangle shape (only a few people talk in the debrief)

drew a line between two study subjects on the diagram who shared a strong interaction, which is defined as either a question and response or two connected statements in a debriefing [7]. In each resulting diagram, circles show each study subjects their roles and contribution timing, while the lines represent the significant interactions. As the study was in real time, we simplified diagram coding by not separating statements/questions exchanged between each person.

Utterances and gestures were not included in our scoring. Electronic diagrams presented were directly transcribed from free-hand drawn original diagrams. Any freehand or illegible annotations (n = 5) noted were excluded from the resultant electronic diagrams.

The timings of contributions of individual study subjects were measured using PineTree Watches™ Version 2.7.0 a multiple subjects stopwatch (www.pinetreesw.com). At the conclusion of each debriefing, Investigator A collected individual DASH scores from study subjects and completed the supervisor version of the scores [8].

Debriefer feedback

Following each debriefing, semi-structured feedback was provided from supervising faculty. This was intentionally supplemented by referencing the data collection and was limited to 10 min. The approach used hybrisied the feedback methods described by Cheng et al. with the use of timing data and relational diagrams described above [14]. We assessed the impact by asking debriefers for a rating of the usefulness of the information provided (Likert scale 1–5).

Analysis plan

Data were analysed using IBM SPSS (V24). Mean and standard deviation (SD) were used to summarise continuous variables. Frequencies and percentages were used for categorical variables. A two-sample t-test was used to test for differences in the distribution of continuous variables. A gestalt assessment of shape type (Fig. 1) was based on the work of Dieckmann et al. [7].

Results

Seventy eight simulation participants were enrolled comprising a mix of students (n = 14); doctors (n = 54); registered nurses (n = 9) and ambulance officers (n = 1). There was a high proportion (48.7%) of junior doctors and predominance of female subjects (53.8%). Baseline expertise of debriefers is outlined in Table 1 (divided into novice, intermediate, experienced) based on work by Cheng et al. [13]. The supervising faculty (n = 5) were all experienced based on Cheng's work. Figure 2 shows detailed contributions of all simulation participants, debriefers and supervising faculty combined with an illustrative representation of their interactions. The diagrams produced were a mixture of shapes (Fig. 1). In cases where debriefers talked for longer than the participants (ratio of ≧ 1:1), a fan-shaped appearance was typically observed. This shape is seen in cases 2, 5, 6, 7, 11 and 12 all of which had timing of contribution ratios suggesting relative debriefer 'dominance' (Fig. 2). Cases 1, 4 and 9 had a star-shaped appearance and all had a predominance of contributions from simulation participants (ratio of < 1:1). DASH Element 1 simulation participants' ratings in the < 1:1 debriefings were higher than in the remaining (μ = 6.79 vs μ= 6.44; p = 0.036). None of the debriefings displayed a triangular shape, though we observed that students contributed less in large debriefings (i.e. cases 7, 8 and 11). Of note, nursing simulation participants appeared to contribute less to discussions than medical colleagues in the larger interdisciplinary debriefings (i.e. cases 10 and 12).

DASH scores were provided by all simulation participants. For all six elements of the DASH scores, the debriefer self-assessments were much lower than the

Table 1 Observational assessment of consecutive SBME debriefings

Topic	Study subject characteristics**	DASH scores					
		DASH element 1 Mean (SD)	DASH element 2 Mean (SD)	DASH element 3 Mean (SD)	DASH element 4 Mean (SD)	DASH element 5 Mean (SD)	DASH element 6 Mean (SD)
Case 1 Adult cardiac arrest	5 study subjects: 5 junior doctors (4 male; 1 female)	6.6 (0.49)	6.6 (0.49)	7 (0)	6.8 (0.4)	6 (0.63)	6.4 (0.49)
	1 debriefer: emergency registrar A, (male—novice*)	5	4	5	4	4	5
	1 supervisor: ICU nurse A (female—experienced*)	6	6	6	4	4	4
Case 2 Airway	7 study subjects: (5 junior doctors (3M; 2F), RN (F) student (F))	6.71 (0.45)	6.86 (0.35)	6.71 (0.45	6.57 (0.49)	6.43 (1.05)	6.57 (0.49)
	1 debriefer: emergency registrar B (female—novice*)	5	6	4	6	6	5
	1 supervisor: ICU nurse B (male—experienced*)	5	5	5	5	6	6
Case 3 Adult cardiac arrest	8 study subjects: (8 junior doctors (4M; 4F))	6.63 (0.70)	6.63 (0.70)	6.75 (0.43)	6.25 (0.97)	5.88 (1.45)	6.63 (0.48)
	1 debriefer: emergency registrar C (male—novice*)	4	5	6	5	5	6
	1 supervisor: ICU nurse B, (male—experienced*)	5	6	6	6	5	5
Case 4 Airway	5 study subjects: (5 junior doctors (3F; 2M))	6.8 (0.4)	6.8 (0.4)	7 (0)	7 (0)	7 (0)	7 (0)
	Debriefer: emergency registrar A (male—intermediate*)	5	5	5	4	5	5
	1 supervisor: specialist A (male—experienced*)	6	6	7	6	6	6
Case 5 Airway	6 study subjects: junior doctors (1M, 2F); 3 students (1M, 2F)	6.17 (0.37)	6.5 (0.5)	6.67 (0.47)	6.67 (0.47)	6 (1.15)	6.5 (0.5)
	Debriefer: emergency registrar A (male—intermediate*)	6	5	6	6	6	5
	1 supervisor: nurse educator A (female—intermediate*)	6	6	7	6	4	5
Case 6 Seizure	7 study subjects: 3 junior doctors (2M; 1F), 4 students (2M; 2F)	6.57 (0.49)	6.57 (0.49)	6.86 (0.35)	6.86 (0.35)	6.43 (0.73)	6.57 (0.49)
	1 debriefer: anaesthetic Doctor A (female—intermediate*)	5	5	4	5	5	5
	Supervisor: specialist A (male—experienced*)	6	6	7	6	4	5
Case 7 Asthma	6 Study Subjects: 3 Junior Doctors (2M; 1F), 3 Students (1M; 2F)	6.67 (0.47)	7 (0)	7 (0)	7 (0)	6.5 (0.5)	7 (0)
	Debriefer: Emergency Registrar A (Male - Intermediate*)	5	6	5	6	6	6
	Supervisor: Specialist (Male - Experienced*)	6	7	5	6	5	6
Case 8 Adult cardiac arrest	8 study subjects: 6 junior doctors (3M; 3F), 2 students (1M; 1F)	6.75 (0.43)	6.88 (0.33)	7 (0)	6.88 (0.33)	7 (0)	6.88 (0.33)
	Debriefer: emergency registrar C (male—intermediate*)	6	6	6	5	6	6
	Supervisor: specialist (male—experienced)	6	7	5	6	5	5
Case 9 Sepsis	4 study subjects: 3 junior doctors (1M; 2F), 1 RN (1F)	7 (0)	7 (0)	6.75 (0.43)	7 (0)	6.75 (0.43)	7 (0)
	Debriefer: nurse educator A (female—experienced*)	5	5	4	4	4	4
	Supervisor: specialist (male—experienced*)	6	6	d	6	6	6
Case 10 Trauma	8 study subjects: 4 doctor (2M; 2F), 3 RN (3F), 1 Ambu (M)	5.75 (0.43)	6.38 (0.48)	5.88 (0.60)	6.13 (0.78)	5 (1.22)	5.63 (0.86)
	Debriefer: emergency specialist A (female—experienced*)	4	5	5	4	5	5
	Supervisor: nurse (female—experienced*)	6	7	5	5	5	5
Case 11	6 study subjects: 4 doctor (2M; 2F), 1 RN (F), 1 student (M)	6.67 (0.47)	6.67 (0.47)	6.5 (0.5)	6.5 (0.76)	6 (1)	6 (1)

Table 1 Observational assessment of consecutive SBME debriefings *(Continued)*

Topic	Study subject characteristics**	DASH scores					
		DASH element 1 Mean (SD)	**DASH element 2 Mean (SD)**	**DASH element 3 Mean (SD)**	**DASH element 4 Mean (SD)**	**DASH element 5 Mean (SD)**	**DASH element 6 Mean (SD)**
Sepsis	Debriefer: emergency registrar B (male—intermediate*)	5	4	3	4	4	4
	Supervisor: specialist (male—experienced*)	6	6	5	6	6	5
Case 12 Trauma	8 study subjects: 5 doctor (3M; 2F), 3 RN (3F)	6.13 (0.60)	6.25 (0.66)	6.13 (1.05)	6.38 (0.86)	5.13 (1.45)	5.88 (0.93)
	Debriefer: emergency specialist B (male—experienced*)	5	6	5	6	5	5
	Supervisor: nurse (female—experienced*)	6	6	5	6	5	4
Overall DASH scores	Mean study subject DASH score (n = 78) (mean of total = 6.50)	6.50 (0.34)	6.64 (0.25)	6.66 (0.37)	6.63 (0.30)	6.12 (0.64)	6.46 (0.45)
	Mean self-debriefer DASH score (n = 12)(mean of total = 5.01)	5 (0.58)	5.17 (0.69)	4.83 (0.90)	4.92 (0.86)	5.08 (0.76)	5.08 (0.64)
	p value (t test)	$p = < 0.0001$	$p = < 0.0001$	$p = < 0.0001$	$p = < 0.0001$	$p = < 0.0001$	$p = < 0.0001$

*Footnote[13]: < *10 Debriefings* = novice ('discovery'), *10–50 Debriefings* = intermediate ('growth'), > *50 Debriefings* = experienced ('maturity')

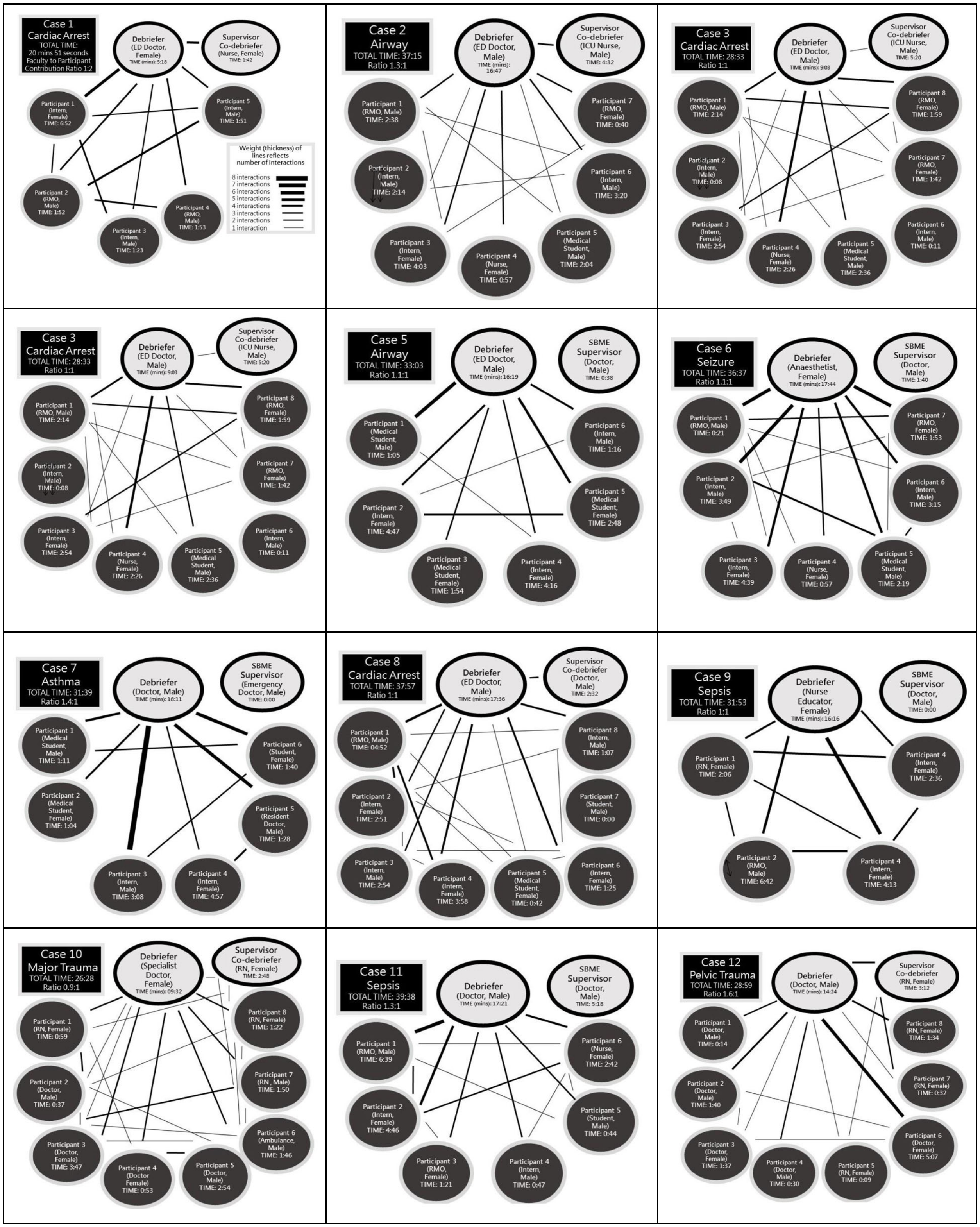

Fig. 2 Timings and interactive diagrams of debriefings (n = 12)

ratings provided by the participants. The differences reached statistical significance for all six DASH elements ($p < 0.001$). In regards to debriefers' experience, of the 12 questionnaires shared 10 were returned resulting in a response rate of 83.3%. Debriefers rating the *'usefulness'* of quantitative data provided for their feedback and indicated they found it useful (ų = 4.6/5 SD 0.49).

Discussion

Debriefers have the challenging and rewarding task of guiding simulation participants in their post-experience reflection—both by affirming good behaviours and facilitating the remedy of shortfalls in performance [6, 22]. A debriefer's ability to guide participants plays an important role in the delivery of simulation. In this observational study the striking findings included a predominance of debriefers talking more than participants (Fig. 2), significantly higher DASH scores provided by participants compared with those self-rated by debriefers and higher participant DASH scores for the debriefers who talked less. In addition, we observed a high level of debriefer satisfaction in using basic quantitative data (timing and diagrams) as an aid to providing feedback. We have structured the following discussion based on the three objectives outlined in the background section.

Can real-time quantitative debriefing performance data be used for feedback?

This study assessed the use of timing data and conversational diagrams. Debriefers receiving feedback based on this data rated its *'usefulness'* as ų = 4.6 on a 5-point Likert scale. This is an encouraging finding. While it does not guarantee translation into better debriefing, in other settings data-driven feedback has been shown to significantly improve performance [2, 23]. This study was interrupted by the recent COVID-19 pandemic leading to an under-recruitment of debriefings ($n = 12$), yet we were still able to observe a broad range of interdisciplinary simulation participants and 7 debriefers across 2 SBME sites (Table 1). This suggests that results can be extrapolated to other locations.

Regarding the use of timing data, we present the results for individual times and ratios of contributions of debriefers versus simulation participants (Fig. 2). While the timing data set is interesting within the boundaries of study conditions, it is unclear if this would be practical to measure in typical simulation environments due to resource constraints. It is also unclear whether individual timing data is useful to the debriefers receiving feedback or whether timings reflect quality. For example, knowing an individual talked for a certain period does not necessarily reflect the usefulness of the content, nor the appropriateness of the contribution for promoting reflection. Within these limitations, in using the data for feedback we found it easy to start meaningful conversations with the debriefers about improving future performance [14]. For example, the data on timing allowed discussion of how to involve quieter participants, and how to increase the number of questions that encouraged reflection rather than 'guess what I am thinking'. While the availability of timings and diagrams appeared to help with feedback, this information arguably may also have been provided using direct observation alone.

From a practical standpoint, we recommend for measuring timing data that a chess clock would be sufficient. A chess clock can provide a simplified binary division of simulation participant and debriefer contributions and would be more practical than our tested method. This approach could provide an estimation of how much the debriefer is talking compared to the participants [6]. With this in mind, from the study findings we note that many debriefings appear to fit a *'sage on the stage'* category. This is evidenced by 9/12 debriefings in which facilitators talked for equal or longer than the simulation participants. This important finding may be explained by the increasing requirement of multiple hats to be worn by simulation educators or by a lack of training in our debriefer cohort. Debriefers may revert into more familiar approaches to teaching during debriefings such tutoring, explanations and lecturing [24]. To address this problem, timing data could help shape future behaviour. Of interest, in a concurrent study we are also investigating the use of cumulative tallies of debriefer questions, debriefer statements and simulation participant responses. In a similar way to using the chess clock approach for timing, this approach may provide an easy to measure method of estimating the debriefer inclusivity.

In regard to the conversational diagrams, these illustrations were used concurrently with the timing data (Fig. 2) for feedback to debriefers. These diagrams were described by Dieckmann et al. in terms of typical roles in SBME, as well as Ulmer et al who described a variety diagram shapes according to culture [7, 20]. We divided the debriefings in terms of those where the debriefer(s) spoke more than or equal to simulation participants ($n = 9$) and events where the debriefer(s) spoke less ($n = 3$). Using this binary division as a basis for analysis, we observed a pattern in the corresponding shapes of the diagrams (Fig. 2). Similar appearances and shape patterns were reported in Dieckmann and Ulmer's papers [7, 20]. However, on close inspection of each diagram obtained, we could not find the triangular pattern described by Dieckmann et al. The triangle pattern (Fig. 1) is suggestive of 2 or 3 participants dominating. An absence of this pattern was surprising as the range of contribution lengths varied widely (Fig. 2) with some participants not talking at all and some participants talking for > 6 min.

This finding could be due to errors in diagram drawings or random chance. Future studies could avoid any uncertainty in this area by analysing debriefings carefully with use of video and professional transcription.

The astute reader would note that medical students contributed less in larger debriefings (i.e. cases 7, 8 and 11) and nurses contributed less than physicians in mixed groups (i.e. cases 10 and 12). This important observation reminds us of the importance of ensuring a simulation learning climate that feels safe for all, and that the topics chosen for discussion in the debriefing are of interest to all [25–27]. In this study, the majority of recorded interactions were between the debriefer and simulation participants. Very few interactions were recorded between the participants—an important omission—which may represent a target for our own approaches to faculty development at a local level.

In summary, the simulation literature outlines an array of behavioural characteristics exhibited by debriefers that can promote improved future performance [6]. Existing assessment tools such as DASH have an established role in identifying these characteristics. Use of timing data and conversational diagrams may represent an adjunct which may help debriefers understand their performance, track changes over time and assist supervisors in providing debriefer feedback.

How does quantitative debriefing performance data compare to existing tools?

Existing debriefing assessment tools such as DASH have pros and cons that have been briefly described in the background section. In this study DASH scores were provided by all debriefers and simulation participants. While this was not the primary outcome, it shines a light on the limitations of DASH use. Of note, the 7 debriefers rated themselves significantly lower than the scores from the simulation participants for all DASH elements. These findings reflect our personal experience of using DASH. Prior to the study we had also observed debriefers underscoring themselves and simulation participants overscoring. This finding is interesting, and may be explained by the phenomenon of *'response bias'*, which is reported as a problem of assessment scales and surveys [28, 29]. Variation in DASH scores between raters, as well as the time that DASH takes to complete, may reflect the relative subjectivity of the scores provided and limit its value for debriefer feedback [14]. Furthermore, neither the DASH nor OSAD provide specific measurable goals for new debriefers to target in their next debriefing. Therefore, we suggest a continued use of DASH for highlighting ideal behaviours with supplementation of the various quantitative data tools we have outlined in this paper.

What is the potential role of these findings in the development of debriefers?

As stated, the recipe for success for debriefer faculty development may not come from a single approach. In this study, we found the availability of both quantitative and qualitative data was useful. Experience of using timing data and diagrams together was generally positive, but recording the data and applying this approach was resource intensive. Moreover, the recent pandemic has limited SBME in-person interactions, making current applicability questionable. In the context of the current remote learning climate, a recent study recognised that current methods of faculty development lack a structured approach [30]. We agree that structure is clearly an important factor that faculty development programmes might lack [11]. The quantitative approaches described in our work may assist with providing this structure at the point of care by allocating our attention to observing debriefings in a focused manner. The approaches described should not supercede local planning, adequately resourced and culturally sensitive debriefer faculty development [11, 30].

In terms of other solutions to a relative lack of structure in faculty development programmes, some experts have proposed the use of *DebriefLive*®. This is a virtual teaching environment that allows any debriefer to review their performance [30]. Using this (or similar) software could allow debriefers to observe videos, rate themselves and track progress. In view of the current need for social distancing and the use of remote learning, video review may be an alternative to use of the paper forms and real-time feedback that we used [31–33].

Limitations

The limitations of our findings are acknowledged especially in relation to the relatively small sample size of the study. We also accept that results aree context specific and the approaches described would prove challenging outside of a research setting. Regarding use of the DASH tool as a 'gold standard', we note that this tool has been through limited validation. The relevant study used 3 example videos that were scored remotely by online reviewers [8]. On the other hand, validation of OSAD was much broader with studies conducted on electronic versions and in languages other than English [12, 33, 34]. We acknowledge that it is possible our results would have been different had OSAD been used [10]. Regardless, it is our view that the use of any tool as a single approach to faculty development is limited. Locally, we are now using the tools listed above with the data-driven approach assessed in the study [35]. We use either video conferencing or a real-time approach depending on the current local policy on social distancing and remote learning [36].

In conclusion, the use of quantitative data alongside traditional approaches to feedback may be useful for both debriefers looking to improve their future performance and supervising faculty seeking to improve local faculty development programmes.

Abbreviations

CAPE: Center for Advanced Pediatric and Perinatal Education; COVID-19: Coronavirus disease 2019; DASH: Debriefing Assessment for Simulation in Healthcare; ED: Emergency department; ICU: Intensive care unit; OSAD: Objective Structured Assessment of Debriefing; PGY: Postgraduate year; RN: Registered nurse; SBME: Simulation-based medical education; STROBE: Strengthening the Reporting of Observational studies in Epidemiology; WSLHD: Western Sydney Local Health District

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Authors' contributions

AC and LM conceived the study. AC and KB extracted data from the simulation centre database and collated the data. AC performed the analysis of results. All authors contributed to and have approved the final manuscript.

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Availability of data and materials

No additional data available.

Declarations

Ethics approval and consent to participate

The protocols for this study were prospectively examined and approved by the Western Sydney Local Health District (WSLHD) research and ethics committee (HREC 2020/ETH01903).

Consent for publication

All authors consent to publication.

Competing interests

The authors declare that they have no competing interests.

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