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ORIGINAL RESEARCH

Mountain rescuers' experiences with video-assisted and verbal debriefings: a qualitative study

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Abstract
The reflection on previous performance during debriefing plays an important role in learning from simulations. While debriefings are traditionally held as verbal debriefings (VD), advancements in video and software technology led to an increased use of video-assisted debriefings (VAD). Although VAD is nowadays considered to be the gold standard, prior research has found mixed results concerning the experiences connected to this form of debriefing. This study sheds light on the experiences of all the actors involved in the process, by including both participants and facilitators. A distinction between their experiences within VD, lower-tech and high-tech VAD was made. In total, 42 mountain rescuers and five facilitators participated in this study during three one-day-long simulation trainings. While participants shared their experiences in focus group interviews, the facilitators were invited for individual interviews. The results indicate that both participants and facilitators preferred high-tech VAD for its ability to objectively review their performance in detail. It was seen as beneficial to gain a deeper understanding of how mistakes occurred during the simulation and the visualisation improved the acceptance of feedback. However, it has also been found that VAD in general can be intrusive and cause additional cognitive demand, stress, and unpleasant emotions. The study shows that VAD can have advantages over VD but requires careful implementation by the facilitators to prevent the possible drawbacks.

Keywords Simulation · Mountain rescue · Verbal debriefing · Video-assisted debriefing · Focus group interview

In the event of a medical emergency, it is important that emergency rescue services quickly attend to patients to save their lives and protect their health (Nehme et al., 2016). While providing fast and adequate medical care outside of hospitals is already challenging, harsh and mountainous regions further complicate these tasks. Therefore, mountain rescuers take a

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special place in the rescue chain. With operations in remote locations and adverse conditions (e.g., weather, terrain, multiple casualties) their work is considered particularly demanding (Callender et al., 2011). While members in other rescue services (e.g., emergency medical service [EMS] professionals in the United States) are usually paid professionals, mountain rescuers in Germany provide their work voluntarily (Cash et al., 2020). Due to the voluntary nature of their work, mountain rescuers face constraints on the time available for training and providing service (Cowlishaw et al., 2010; Nichols et al., 2014). With only a limited amount of time available and comparatively high demands, their training has to be especially effective. Therefore, the majority of European and American mountain rescue services rely on simulations to learn and evaluate their skills (Elsensohn et al., 2009).

Role of simulations

To prepare mountain rescuers for their tasks, "hands-on" training on real patients is not only problematic due to time constraints, but training with real patients might also raise concerns in terms of patient safety. Additionally, the expenses associated with training on real patients can be prohibitive. These costs encompass not only equipment and training facilities but also potential liabilities arising from any adverse outcomes during training exercises (Pietsch et al., 2016).

In the absence of opportunities for practical training on real patients, simulations assume a pivotal role in the medical training of mountain rescue organisations (Elsensohn et al., 2009). Simulated environments mimic lifelike scenarios, thereby offering a safe yet authentic training experience for both participants and simulated patients (Ayaz & Ismail, 2022; So et al., 2019). While simulations provide a safe opportunity to practice rare and possibly dangerous procedures, the debriefing afterwards is considered one of its most important components for learning as it allows reflecting on previous performance (Dreifuerst, 2009; Lee et al., 2020; Shinnick et al., 2011).

Importance of debriefings

The practice of discussing, interpreting, and learning from previous experiences is known as after-action review, after-event review, huddles, hot-washes, postmortems or debriefing (Allen et al., 2018). While originating from military practices, the term "debriefing" is the most common in healthcare services and research (Keiser & Arthur, 2021). Therefore, "debriefing" will be used throughout this paper. While there can be differences in the structure or formality of the procedure, the purpose remains the same: "to systematically review individuals' performance on a recent task or event in order to create a learning opportunity with the aim of improving subsequent performance" (Villado & Arthur, 2013, p. 515). Several meta-analyses have shown that debriefings improved learning and team performance (Cheng et al., 2014; Couper et al., 2013; Tannenbaum & Cerasoli, 2013).

Although there are different ways to conduct debriefings, Villado and Arthur (2013) divided the process into five primary phases. Each phase can be linked to a well-established psychological theory or concept thus explaining the effectiveness of the process. As depicted in Fig. 1, the first two phases of the debriefing focus on the possible difference

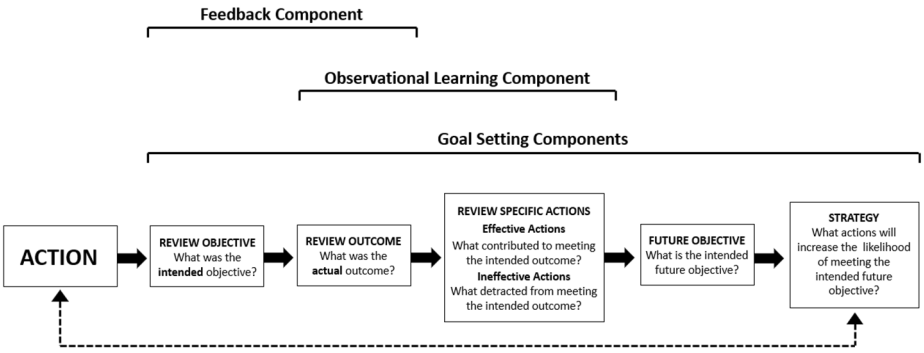

Fig. 1 Depiction of Primary Phases of the Debriefing Process and the Associated Psychological Theories (Villado & Arthur, 2013)

between target and actual performance, thus, providing feedback for the participants. This can be linked to feedback intervention theory (Lipnevich & Panadero, 2021). During the third phase, the specific actions of the team and their outcomes are reviewed in detail. The goal of this phase is to identify and discuss behaviours and their results. Participants receive individual feedback and team-related feedback. In addition, they also often experience the individual feedback that is provided to other members of the team. Combined with the video from the simulation, phases two ("review outcome") and three ("review specific actions") can be linked to observational learning theory (Luo et al., 2021). The last two phases focus on the goals of the participants by discussing future objectives and the strategies needed to meet the intended objectives. Combining the last two with the previous phases, the whole process of debriefing applies the principles of goal-setting theory (Keiser & Arthur, 2022).

Debriefing with media support

While the process of debriefing in its origins is over four decades old, new ways to conduct it are steadily developed (Morrison & Meliza, 1999; Sawyer et al., 2016). One of the most discussed methods to conduct debriefings is to integrate video playback into the process.

Traditionally, debriefings are performed verbally under the guidance of an experienced facilitator. These debriefings can be classified as verbal debriefings (VD). A more modern approach to debriefings combines verbal feedback with additional video footage of the simulation. This type of debriefing is called video-assisted debriefing (VAD). While some authors refer to VAD as the "gold standard" for debriefing (Levett-Jones & Lapkin, 2014), others found no significant effects on subsequent performance when comparing VAD to VD (Grant et al., 2014; Savoldelli et al., 2006; Sawyer et al., 2012). Newer research found that the advantages of VAD may be coupled with other debriefing characteristics such as the facilitation approach, with self-led debriefing profiting the most from VAD (Keiser & Arthur, 2021; Tannenbaum & Cerasoli, 2013).

In theory, VAD is expected to have advantages over traditional VD. As conceptualised in the study by Zhang et al. (2020), VAD can be integrated into the experiential learning theory (ELT) by Kolb (2015). The ELT framework describes learning as a cyclical process that can

be divided into four phases. During simulation, the participants first engage in a *concrete experience*. This is followed by the debriefing, in which the previously made experience is reflected upon (*reflective observation*). By analysing the perceptions during the debriefing, lessons and principles are extracted from the experience (*abstract conceptualisation*). Lastly, the gained knowledge gets prepared and applied to future scenarios (*active experimentation*). While the last three steps generally apply to VD as well as VAD, the phase of *reflective observation* should benefit the most from VAD, as it provides visual and auditive material on which to base the observation and reflection.

VAD is also considered to be a more objective way to debrief than VD (Villado & Arthur, 2013). While VD relies on the correctness and accuracy of recall by the facilitator, VAD can show scenes from the simulation reducing potential recall bias. The reduction of potential bias in recall also applies to the participants, who are less likely to accurately memorise certain events or behaviours, due to the high cognitive demand of the simulated tasks. Therefore, arguments about what and how actions have happened can potentially be limited with video evidence within VAD (Schertzer & Waseem, 2024).

Another advantage directly connects to the underlying theoretical understanding that explains how debriefings work. As depicted in Fig. 1, phase two and three of the debriefing are linked to observational learning theory (Luo et al., 2021). Observational learning can be fostered with video playback, as key behaviours and scenes during simulation are being made visible again. Therefore, learners can direct their attention to the displayed behaviour and its consequences to gather the required information that is needed to mimic or in general learn from the observed actions (Johnson, 2020). During simulation, it is unlikely that the participants have the time and cognitive resources to direct enough attention towards others to learn from their behaviour. Therefore, reviewing the simulation with video can foster observational learning.

VAD typically provides an outside perspective of the simulation and its participants. By providing an overview of the team and its processes during simulation, communication and interpersonal dynamics within teams can be visualised and are therefore easier to reflect upon (Ha, 2014; Jacobs, 2017). With the combination of an outside perspective and joint reflection with a facilitator, VAD can lead to a different view on the simulation performance in contrast to the original assessment made by the participants themselves. It has also been shown that VAD increased the perceived importance of teamwork (Johansson et al., 2017).

Besides the positive factors associated with VAD, research has also found negative aspects commonly connected with this method. Due to the prominent display of negative behaviour or mistakes, participants within VAD can feel stressed, intimidated, and even humiliated (Cantrell, 2008; Ha, 2014). This is problematic, as one of the key requirements of debriefings is the psychological safety of participants (Salas et al., 2008). Psychological safety can be defined as "[.] individuals' psychological state where they feel safe and can easily speak up and share their thoughts, perceptions, and opinions without risking retribution or embarrassment" (Kang & Min, 2019, p. E6). Without psychological safety, reflective learning conversations may be inhibited which in turn reduces the effectiveness of debriefings (Kolbe et al., 2020).

Combining verbal explanations with video sequences during debriefing might also influence the attention of the participants. In the study by Savoldelli et al. (2006), the authors argue that the additional visual information provided by VAD led to an information overload that distracted participants away from the constructive information given by the facilita-

tor. Reed et al. (2013) found that participants rated the expertise of facilitators differently depending on the type of debriefing they attended. Facilitators who conducted VAD received lower ratings than those who held VD. Similar to the conclusion of Savoldelli et al. (2006), the authors hypothesised that the video took away the attention from the facilitator towards the video on display.

Furthermore, the integration of VAD can potentially increase the time for the debriefing as well as the overall costs of the simulation (Garden et al., 2015). Both aspects can vary depending on the video equipment, software, and overall implementation of the VAD.

Current studies mainly focus on the effectiveness of VAD compared to VD (Keiser & Arthur, 2021; Niu et al., 2021; Zhang et al., 2019b). Although it is important to examine which debriefing form is the most effective in terms of learning and performance outcomes, the experiences of participants and facilitators have not been thoroughly examined yet. However, these experiences are important as well. For instance, negative emotions such as intimidation or humiliation during debriefing have consequences for the psychological safety of the participants and in turn their learning outcome (Lateef, 2020). The few existing qualitative studies that focussed on participants' experiences found that VAD enhances the perceived objectiveness and acceptance of feedback. Participants also said that they learned from viewing others and that VAD reduced their own recall bias. However, participants also reported a stronger fear of negative feedback, indicated unnatural behaviour during the simulation and overall higher stress and intimidation in the VAD condition (Cantrell, 2008; Ha, 2014; Rosvig et al., 2023; Zhang et al., 2019a). To our knowledge, there is currently only one study, conducted by Krogh et al. (2015) that explores the perspective of the facilitators in VAD. The facilitators in this study viewed VAD as a tool for various purposes, such as triggering reflection and discussion, or to neutralize criticism. They also see the potential drawbacks of VAD, with the possibility of distracting the participants from the verbal feedback they try to give, as well as having to stop the debriefing to find the video segment that they want to show.

Aim of the study

The few existing qualitative studies that focussed on the experiences connected with VAD and VD either examined solely the facilitators or the participants of the debriefing. By interviewing both groups, this study combined the experiences connected to all the actors involved in the debriefing process. Additionally, the VAD was held in two ways, as there is no universal or standardised framework on how to implement the technology. Therefore, this study examined the experiences of facilitators and participants within VD, high-tech and lower-tech VAD. The following research questions were addressed:

RQ 1 How did the participants experience high-tech VAD, lower-tech VAD, and VD?

RQ 2 How did the facilitators experience high-tech VAD, lower-tech VAD, and VD?

Method

Research design overview

To answer the research questions, a qualitative interview study with mountain rescuers has been conducted. As the participants went through the different simulations and debriefings in groups of four, focus group interviews were held within the respective groups. Facilitators were interviewed individually.

Simulation cycle

The study was conducted during a time period of three days in the central facility for the safety and training of the Bavarian mountain rescue organisation. Data was collected within a "medical simulation training"-cycle (SIMMed), consisting of three simulation stations. The simulation stations featured the following scenarios: **U**nconscious patient with **H**ypothermia in need of **R**esuscitation (UHR), **F**emur fracture caused by a **F**all from approx. 3 m (**C**hild patient) (FFC) and **U**nconscious climber with **H**ead **T**rauma due to falling rocks on a climbing route (UHT). As shown in Table 1, the scenarios were tied to one of the three different debriefing forms (VD, lower-tech VAD & high-tech VAD) held subsequently at the end of each simulation.

During the UHR station, the participants had to rescue and resuscitate an unconscious hypothermic patient inside a large cooling chamber (temperatures ranged from −5 to -10 degrees Celsius) with low-light conditions. The participants had to climb to the simulation mannequin, which was placed on a narrow edge four meters above ground. Participants secured themselves with a guide rope while approaching the patient. Following the initial diagnosis, the participants had to start resuscitation and administer medication based on the hypothermic condition of the patient. After stabilising the patient, the mannequin was placed inside a rescue bag and was evacuated by rope.

Within the FFC scenario, the participants had to treat and rescue a child patient suffering from a femur fracture, after falling into a small enclosure from approx. 3 m. The participants had to rappel themselves from a simulated helicopter to the child mannequin. After the initial diagnosis, the emergency physician within the group had to administer the appropriate dosage of medication, while the rest of the team secured the patient. Once the child patient received adequate treatment, the mannequin was evacuated by a simulated helicopter using a rescue bag.

The UHT scenario featured an unconscious climber with head trauma due to falling rocks on a climbing route. The participants were transported to a position halfway up a large climbing wall (approx. 20 m) and had to climb to the simulation mannequin positioned at

Table 1 Overview of the Simulated Scenarios and Their Respective Debriefing Forms

Scenario	Scenario Description	Debriefing form
UHR	**U**nconscious patient with **H**ypothermia in need of **R**esuscitation	VD
FFC	**F**emur fracture caused by a **F**all from approx. 3 m (**C**hild patient)	Lower-tech VAD
UHT	**U**nconscious climber with **H**ead **T**rauma due to falling rocks on a climbing route	High-tech VAD

Note. Each scenario had its own debriefing form that followed right after the end of the simulation

the top edge of the wall. Once the mannequin was initially diagnosed, the medical condition of the mannequin was changed by the facilitator, thus creating a more challenging situation. After stabilising the patient, the mannequin was secured inside a rescue bag and both participants and patient were evacuated by a simulated helicopter.

Although the three scenarios featured different tasks, they were designed to be similar in terms of complexity and the problems presented to the participants. All three scenarios shared technical challenges to reach the simulated patient (climbing, rappelling), difficult medical tasks (patient with hypothermia, child patient and patient with changing medical conditions) and logistic challenges to evacuate the patient (evacuation by rope and simulated helicopter).

Debriefing forms

All debriefings were structured based on the facilitator's training and certification within the Bavarian mountain rescue organisation. The facilitators were given technical training to operate the new VAD equipment and the freedom to integrate the video recordings into their existing debriefing structure as they found most effective. Therefore, the facilitators used the video recordings during VAD based on their professional judgment.

During VD, the facilitator held the debriefing without any technical equipment solely by discussing the course of the simulation as well as the actions and decisions made by the participants. The VAD differed regarding the complexity of the technical equipment used.

Lower-tech VAD included a tablet (Apple iPad Pro, 11 inch) mounted on a tripod with an external microphone (Rode NTG-2) attached. The start of the video recording was manually matched with a stopwatch by the facilitator. Timestamps of important events were written down by the facilitator to rediscover the scenes during debriefing. The chosen video segments were then played back via 'AirPlay' onto a large TV screen by the facilitator.

High-tech VAD captured the perspectives of two mounted cameras and the audio from lapel microphones for each participant. Within the simulation, two facilitators were necessary to simultaneously manage the simulated scenario and the equipment needed for the high-tech VAD. The facilitator in charge of the scenario was equipped with a stopwatch and a portable two-way radio. The second supporting facilitator managed the specialised video-debriefing software "LearningSpace" developed by 'CAE Healthcare' with a laptop and an external mixer for the audio recordings of the lapel microphones. During the occurrence of important events, the facilitator in charge of the scenario transmitted information about the time and additional information to the second supporting facilitator, who was also equipped with a portable two-way radio. The communication via radio was necessary, as the simulated scenario only offered a limited amount of space for the technical equipment needed for high-tech VAD. The facilitator who led the simulation also held the debriefing by choosing video segments that were marked with timestamps during simulation. Within the debriefing, the selected scenes were displayed on a large screen and contained both camera angles as well as the additional information that was transferred between the facilitators.

During the one-day-long SIMMed training, the participants experienced all debriefing forms as groups of four. The SIMMed training was designed as a simulation cycle, meaning that the groups simultaneously started at different simulation stations and went through the cycle successively. As the debriefing form was directly connected to the simulated scenario (see Table 1), the variation in the initially experienced debriefing form between the groups

was intended to minimise the influence of possible sequencing effects. As each participant engaged with all three debriefing forms, the study used an exploratory approach comparing the experiences within cases.

During each simulation day, the facilitators were permanently assigned to one simulation station. Qualitative data from participants and facilitators was gathered after every simulation day during focus groups (participants) and individual interviews (facilitators). Only the facilitators who led both the simulation as well as the debriefing during high-tech VAD were included in the individual interviews.

Study participants

In total, 42 mountain rescuers (9 females; 32 males) and five facilitators (1 female; 4 males) agreed to participate. One individual did not provide personal information. All participants were members of the Bavarian mountain rescue force with an advanced medical background (emergency physician, emergency medical technician, rescue paramedic, or equivalent qualification). On average, they had about 14 years of active membership in the Bavarian mountain rescue organisation. The facilitators, in comparison, held a longer active membership in the rescue organisation of about 20 years and carried out the SIMMed as facilitators on average nine times. Three of the five facilitators had previous experience with conducting VAD. Of these three individuals, one had conducted VAD four times and the other two only once.

Instruments

Questionnaires

Basic biographical data (e.g., age, gender) and information regarding the experience of participants and facilitators were collected via a biographical questionnaire.

Focus group interview

Interview questions were asked based on the Debriefing Experience Scale (Reed, 2012) and the Debriefing Assessment for Simulation in Healthcare (DASH) – Student Version (Simon et al., 2010) questionnaire. The questions were grouped into four main sections: (1) overall experience, (2) learning and reflection, (3) skills of the facilitator and (4) additions. While the first two parts were centred around the differences between the debriefings and the learning involved, the third section was focused on how the facilitator led the debriefing. Lastly, the trainees shared further thoughts.

Individual interview

Facilitators who performed VAD were asked how they experienced the debriefing modality compared to the previously performed VD. The questions for the interview were based on the DASH – Instructor Version (Simon et al., 2012) questionnaire and were divided into four sections: (1) use of VAD, (2) experiences of the participants, (3) (technical) challenges and (4) additions.

Data collection

As the facilitators had limited experience with VAD, all of them received a technical introduction to both VAD systems. The introduction took place on a separate day before the three days of SIMMed training started. Facilitators received instructions to use the VAD technology as they deemed most appropriate.

At the start of the pre-briefing, the participants were informed about the planned study one week ahead of time within their central online knowledge management tool. With this tool, the participants had the option to prepare themselves for the simulated scenarios and to gather information about the study in advance. At the beginning of the SIMMed simulation cycle, the participants were introduced to the context and objectives of the simulated scenarios including their relevance for mountain rescue. Furthermore, the study and the different debriefing methods were presented. During this presentation, the facilitators emphasized the importance of being able to make mistakes without the fear of judgment. Moreover, the confidentiality of the performance during simulation and the content of the debriefing was assured.

Following the pre-briefing, both facilitators and participants were given the option to not participate. Each person filled in a written declaration of consent and the APA Ethical Principles of Psychologists and Code of Conduct were followed. Starting the data collection, both facilitators and participants received the biographical questionnaire. Next, the participants were told to separate themselves into groups of four. Each group consisted of at least one emergency physician to perform certain tasks that are prohibited for other medical personnel by German law (e.g., dispensing of medications). The groups were then randomly assigned to one of the stations of the simulation cycle. After each scenario, they received the debriefing form of the respective station in a separate room (UHR station – VD; FFC station – lower-tech VAD; UHT station – high-tech VAD). With the completion of the scenario and the corresponding debriefing, each group changed to the next simulation station until they completed the full cycle. Facilitators were permanently assigned to one simulation station and conducted the debriefing that was linked to the scenario of the station. At the end of the simulation cycle, the participants were interviewed in their respective groups while the facilitators were interviewed individually. The interviews were held in German by the first author and two research assistants. To ensure correct transcription, the interviews were audio recorded. The interviews of the participants ranged from 21 to 38 min (M=28.75, SD=6.01) and the facilitator interviews took between 8 and 16 min (M=12.83; SD=3.14). Overall, a total of 11 participant interviews and five facilitator interviews were transcribed verbatim.

Analysis

The data was analysed by using qualitative content analysis with a deductive and inductive approach (Mayring, 2014). To get familiarised with the statements of both participants and facilitators, the first and second author of the study as well as one of the research assistants repeatedly went through the transcriptions and audio recordings of the interviews. Notes of early impressions and ideas for the coding scheme were taken. The main categories for the group interviews with the participants and the individual interviews of the facilitators were deductively formed, focussing on previous research and the structure of the interview.

Table 2 The Main Categories of the Results and Their Respective Subcategories

Main categories	Subcategories
Overall preference for the debriefing form	
Outside view and its value	Learning from observing others Own perspective vs. outside view
Acceptance of feedback	Use of video evidence Discussions during debriefing
Dealing with emotions	Debriefing forms and different emotions Balancing positive and negative feedback
The future of debriefings	Current difficulties Possible future improvements

Smaller analytical categories and changes to the deductively formed categories were then created inductively during the coding process by the first and second author of the study as well as one of the research assistants. To ensure agreement between the coders, the coding was done collaboratively between the first and second author and one of the research assistants. In case of discrepancies in the coding, a systematic resolution process was established. During the process, discrepancies were discussed among the coders by explaining each individual interpretation of the coded segment and the reasoning behind the coding decisions. The coders then referred to the coding manual to see whether the existing definitions and rules for the categories were able to resolve the discrepancies. If this was not the case, the coders re-evaluated the coded segment until an agreement was reached. Consequently, the coding manual was revised to minimise possible discrepancies.

The following main categories emerged: (1) Overall preference for the debriefing form, (2) outside view and its value, (3) acceptance of feedback, (4) dealing with emotions, and (5) future of debriefings. In succession to coding the interviews of the participants and the facilitators, the first author reorganised overlapping themes between both groups. Together with the second author, the overlapping themes were evaluated to ensure a sensible structure in analysing the reported experiences. Additional subcategories were created to further divide the five main categories. An overview of the final five main categories and their respective subcategories can be found in Table 2.

Results

To present the results of our study, we will first share the findings of the participants, followed by those of the facilitators. Wherever possible, a distinction between high-tech VAD and lower-tech VAD will be made. Direct quotations of the participants are labelled with an indication of the focus group and participant (FG 1–11, P 1–4). Facilitators are abbreviated with FA and a number that refers to the specific person (FA 1–5).

Overall preference for the debriefing form

Of all 42 participants, the majority (20 participants) preferred high-tech VAD. In their opinion, high-tech VAD provided better audio and video quality compared to lower-tech VAD. The higher quality was perceived as useful because it did not pick up unwanted background noise and captured the scenario from two different angles. Together with the option to put

timestamps in the recorded video, the participants felt that the debriefing was more focused and "to the point". With the mentions of seven participants, the second most preferred debriefing form was VAD in general. Within VAD, participants enjoyed the outside perspective, which gave them a broader view and showed the different interactions during the scenario as illustrated by the following quote: "I think the great advantage of video debriefing is that you can see or revisit situations that you did not experience […]. And that offers many more opportunities to assess the entire situation." (FG 10, P 4). Low-tech VAD and VD share the third place regarding the preferred debriefing form of the participants (each mentioned by six persons). Within lower-tech VAD, participants favoured the lack of lapel microphones which made them feel "under pressure" and hindered them from displaying "natural behaviour". Moreover, the participants stated that without having to pay attention to the wires of the lapel microphones, they felt more comfortable. The advantage of VD was seen in the clear structure of the debriefing. The participants felt that this debriefing form allowed them to discuss different ways to solve their tasks, without focusing on one specific mistake that they had made. Lastly, three participants had no preference regarding the debriefing form. They were either satisfied with the debriefings in general or said that "It always depends on the situation or the task at hand." (FG 9, P 3).

All five facilitators preferred VAD in comparison to VD. The facilitators liked the possibility of visualising important events that happened during the scenario to give precise feedback. FA 2 explained: "I think that you can communicate more clearly what you want to say to the participants […].". Another advantage was seen in the objectivity of the video on display. According to the facilitators, VAD provided the opportunity to review the simulated scenario without bias, which in turn reduced the need to justify or discuss negative feedback. In addition, all facilitators stressed that the video display acknowledged their professional opinions. Having video evidence supporting their position was perceived as helpful because participants seemed to accept negative feedback more easily regardless of possible differences in hierarchy. This is expressed by FA 1: "And yes, when I say something [*referring to VD*], trainees do not necessarily have to believe me. Especially when discussing with doctors as a non-doctor my position can be tricky. But as soon as they can see the situation and themselves again, it has a different effect.".

The outside view and its value

Learning from observing others

Participants reported that viewing the scenario from an outside perspective allowed them to see the actions of their colleagues. Seeing how the actions of themselves and their colleagues were related to the performance of the team was considered highly beneficial. One participant explained it as follows:

> I think it is really important to see what the others are doing because you often see that one of your team members was stressed out or someone had a lack of information. Then you realise for yourself that communication might be important in that case. In fact, you often just do not notice that. Especially when you are working as a doctor at the head of the patient, you are so focused on your task. And then you can ask yourself: Why wasn't the information present? (FG 1, P 3)

Besides understanding how the actions of the team relate to each other, it was also considered helpful to see others making mistakes. According to participants, revisiting the situation with the help of the video clarified the origin of negative outcomes on the team level. Moreover, participants indicated that they gained insights into how errors could have been prevented. Some participants, however, admitted that they mainly focused on themselves when watching the video. They emphasised that their own performance was their biggest concern and they wanted to detect whether they had made any mistakes.

The facilitators had a similar impression mentioning that most participants were mainly focused on themselves during VAD. FA 1 stated: "[…] when they watched the video, I had the impression that most of them were looking at themselves: How did I behave? How did that work out for me? And they want to take away a positive result that - to put it mildly - they did great.".

Own perspective vs. outside view

Seeing themselves on video provided a contrast to the picture the participants had of themselves. Many participants reported a deviation from what they felt and thought during the simulation compared to what they saw on video. This deviation is expressed in the quote by FG 3, P 3: "Actually, I think I evaluate myself correctly most of the time. However, now I realise that the mistakes, which I actually considered not to be so serious present themselves differently on screen.". Participants also stated that they easily lost track of time during the simulation. Showing them video segments in combination with a timeline of the scenario was experienced as very helpful in improving their feeling for the time elapsed during different tasks. Participants who described themselves as self-critical mentioned that VAD also provided the possibility to gain a more positive view of their performance.

Similar to the participants, the facilitators also stressed the importance of having a neutral outside perspective because it is very rare for the participants to see themselves during training or in real-life situations. They highlighted that the video by itself is unfiltered and it is up to the participants to reflect upon themselves. For example: "You see yourself impartially and without prejudice, mercilessly but also mirrored: This is how you act. Live with it and draw your conclusions. The decision is up to you." (FA 1). It was difficult for the facilitators to judge what kind of conclusions the participants drew from the video and the debriefing. According to the facilitators, the participants usually do not state publicly whether their perceptions have changed after the debriefing.

Acceptance of feedback

Use of video evidence

Sympathy and the way the facilitators provided the feedback during the debriefing were considered important for the acceptance of feedback by the participants. This was especially true for VD as no objective review media was supporting or refuting the claims of the facilitators. For example:

> If you only receive verbal feedback, it [*referring to the acceptance of feedback*] depends on the type of facilitator. How likeable is s/he? Sometimes you can accept the

> feedback more and sometimes less easily. The facilitator's way of providing feedback has an impact on how much you take away from the debriefing. However, if there is video evidence, you simply cannot argue about the feedback, no matter how unpleasant or friendly the way of giving the feedback was. (FG 1, P 1)

The unbiased nature of the video itself can be used by the participants to strengthen their position and to dispute the feedback of the facilitator. For example: "After a normal debriefing [*referring to VD*], you sometimes leave with the impression: 'That did not happen like that.' You cannot clarify it. With VAD, however, we can say 'Let us look at it again'." (FG 1, P 4). Although the participants expressed an advantage by using VAD to have objective evidence supporting their perception, they also acknowledged that the video can confirm the critical comments of the facilitator. When seeing their mistakes on video, participants indicated that they often came to the same conclusions as the facilitators which resulted in accepting the provided feedback.

Facilitators shared a similar impression stating that the participants appeared to accept the feedback more easily. They also felt that VAD increased the credibility of their feedback as indicated by FA 4: "I believe that the feedback is accepted better. It is a bit like being a video-referee. With the other debriefing [*referring to VD*], they probably whisper behind my back: 'He has no idea'.". However, facilitators also stressed that accepting feedback still depends on the person receiving the feedback. They noticed that some participants tend to explain themselves regardless of whether they have received video feedback or not. Nevertheless, the facilitators were convinced that with VAD, those participants would reflect on their actions later.

Discussions during debriefing

According to the participants, VAD was not only used to limit discussions about whether the critical observations of the facilitators were correct or not, but also to start a reflective discussion by showing segments of the simulation and asking open-ended questions. For example: "We had debriefings in which the facilitator gave us feedback and showed us video evidence afterwards. However, it was more interesting the other way around. Seeing the video first, then having to think along and ask yourself what has happened and why things unfolded as they did" (FG 10, P 1). Through this procedure, participants felt that they gained a deeper understanding of what the facilitator wanted them to take away from the debriefing. Moreover, participants mentioned that the process of debriefing was more purposeful within VAD because discussions caused by misunderstandings between facilitators and participants were resolved faster than in VD.

Facilitators expressed mixed opinions about discussions during the debriefing. Two facilitators thought that without video, the participants shared their views about what and how things have happened among themselves leading to an open discussion during debriefing. In their opinion, showing the video to the participants resulted in simply agreeing with the feedback. However, three of the facilitators recognised that they could use the video segments in different ways, which fostered discussion among the participants. For example: "I think it depends on how you moderate the debriefing. You can also achieve deeper discussions without VAD. However, with VAD you can stay on a more factual level, without describing situations that might be ambiguous or biased" (FA 4). Similar to the impressions

of the participants, the facilitators also felt that discussions caused by misunderstandings were reduced with VAD.

Dealing with emotions

Debriefing forms and different emotions

During high-tech VAD participants were aware of the technical equipment which strengthened their feeling of "being under observation". For example: "During the first simulation scenario [*referring to high-tech VAD*] with the microphone and the two cameras, I thought: 'Oh, now I am being recorded. Do not say anything stupid and perform well, because otherwise it will be noticed.' Of course, it will be noticed anyways but everyone will see it again." (FG 2, P 1). The feeling of being closely monitored led some participants to feel "stressed", "under pressure" and inhibited from showing "natural behaviour". These emotions seemed to change after they had their first high-tech VAD: "At the beginning, I thought to myself: 'Oh my god!'. However, during the debriefing, I saw that I was more active than I experienced myself. Therefore, it gave me a more positive image of myself than I had during the simulation." (FG 3, P 1). Participants did not report negative emotions related to the technical equipment of lower-tech VAD. However, the idea of watching footage in front of members of the team, which might contain mistakes was considered critical within both types of VAD: "Generally speaking, I do not like seeing myself in videos, because if the simulation does not go well, you can always be exposed." (FG 10, P 4).

Facilitators had mixed opinions about the emotions of the participants regarding the debriefing forms. On one hand, they saw that some participants did not like their mistakes being displayed to other members of the team indicated by FA 3: "In one group, I had the feeling that when I tried to give constructive feedback about a problem in the treatment of the patient, one person in the team felt attacked on a personal level". On the other hand, the facilitators mentioned that other participants were genuinely excited and reacted positively to VAD. Even though they had positive experiences with the participants, some facilitators recognised the destructive capabilities of VAD and added disclaimers before the start of the debriefing. For example: "Before we started, I said: 'Whatever happens during this debriefing, stays in this room. The video is just an aid and not a tool to keep you under surveillance.' and so on. If you use the video in the wrong way, you can hurt people." (FA 4). Although all interviewed facilitators preferred VAD in comparison to VD, some also had negative emotions during VAD. Depending on whether they have used VAD before, facilitators stated that it felt unusual for them and that they had to get used to the equipment first.

Balancing positive and negative feedback

Overall, the participants were content with the tone within the different debriefing forms and how the facilitators balanced their feedback. For example, "I think we have a pleasant atmosphere for years now and you do not need to be afraid of being embarrassed." (FG 1, P 3).

However, this has not always been the case, as one participant remembers: "In the past, it was more like 'I will give you hell', but nowadays you get the feeling that you are learning something new from the debriefing." (FG 1, P 1). This change was contributed to the facilitators and how they conducted their debriefing. The participants emphasized that the

facilitators need to balance their feedback as expressed by the following quote: "[…] the moderation of the facilitator is important. Showing mistakes but also providing a positive learning opportunity without being ashamed is the goal at the end of the day. And that was implemented very well today." (FG 10, P 4). Participants stated that the balancing of feedback depends on the facilitator and is not related to the debriefing form per se. While some facilitators were perceived as rather strict, others were experienced as mild, meaning that they revealed fewer mistakes or rarely provided negative feedback.

Facilitators also recognised that balancing their feedback is important and connected to keeping the participants within the voluntary rescue force. For example: "The participants should receive a take-home message. It should not be scathing criticism, but rather pointing out what they have learned and providing constructive feedback. It is important that they also enjoy the simulation training and say: 'Today was a great day, I want to come back next year.'." (FA 3). Therefore, the facilitators stressed that they have used VAD not only for displaying mistakes and showing where they originated but also to visualise positive situations and interactions during simulation. With VAD, they realised that they could easily create an overly negative impression of the team's performance, which they wanted to prevent. Instead, careful moderation was important to them.

The future of debriefings

Current difficulties

While VD has been their standard method of debriefing, participants reported some difficulties with VAD technology. During lower-tech VAD participants complained about the sound quality of the external microphone. As the different simulation stations were all inside one large training facility, noise from other stations was picked up by the external microphone. This led to the following problem: "You could not assign voices to individual people and there were a lot of conversations that were simply not understandable. When everybody had individual microphones [*referring to high-tech VAD*] it was a lot better" (FG 3, P 3). Another difficulty mentioned was that the video gave the participants only one camera angle which was easily obstructed by the participants during the simulation. As for high-tech VAD, participants reported better audio and video quality, but also occasional technical failures with either the audio cutting out or one debriefing in which there was no video or audio at all. During the simulations, some participants mentioned that their lapel microphones felt very uncomfortable and that they were distracted by the microphone and its cable slipping from its intended place. Participants mentioned that the facilitators generally needed more time for their debriefing in both forms of VAD. However, as the low-tech VAD did not feature an option to mark important sections of the video during the simulation, the participants found that the facilitators needed more time during lower-tech VAD, to find the video segments that they wanted to display. This was considered negative, as it took away time from the debriefing.

Facilitators shared the opinions of the participants regarding the differences in audio and video quality between low-tech and high-tech VAD, occasional technical failures of high-tech VAD and the time-consuming nature of VAD in general. Additionally, they also reported a high cognitive demand during VAD. Facilitators described that the high cognitive demand was caused by dealing with VAD technology in combination with having to

lead through the simulation simultaneously. They indicated factoring in possible technical failures as well, which in turn increased their perceived cognitive demand. FA 1 described in the following way: “You have to have a backup plan because if you rely on the VAD technology and it stops working, you have to ensure that the participants still have something to take away from the debriefing.”. However, they mentioned that after getting used to both the equipment and the VAD itself, the perceived cognitive demand was reduced. Facilitators also reported that the VAD drew away the attention from their verbal explanations thus limiting the flow during debriefing. For example: “As soon as you turn on the video, the participants only pay attention to the video. So, you have to stop, then talk again and then switch on the video again” (FA 4).

Possible future improvements

For future debriefings, the participants linked most of their feedback to the difficulties that they witnessed during the debriefing. Therefore, one of the possible future improvements focussed on the time that the facilitators needed to find the video segments, which they wanted to show to the participants. They either proposed a system to mark important video segments in low-tech VAD or hoped that the facilitators would gain more experience with high-tech VAD to become more proficient in finding important video segments. They also touched on the audio quality within low-tech VAD, with the addition to also have a lapel microphone for the facilitator to relate their verbal information to what the facilitators have told them during the simulation. Similar to the possible audio improvements, they also wished for more camera angles within high-tech and especially low-tech VAD. Concerning the role of the facilitators and their use of VAD, the participants wished for a unified structure during all debriefing forms. For example: “What I would like to see is an overall more structured debriefing, because we had three debriefings that all had a different structure.” (FG 1, P 4).

Facilitators had similar ideas to improve future debriefings. They expressed a wish for a more intuitive way to set markers in the high-tech VAD software, or the option to be able to set markers during low-tech VAD. They also stated that they would like to have soft- and hardware that is more suitable for their simulation conditions. For instance, they indicated, that the VAD equipment was not operable inside of the cooling chamber, which they used to simulate extreme weather conditions. Lastly, some facilitators expressed the wish to either get more experience with VAD or to visit some form of training to become more proficient with the technology.

Discussion

In this study, we explored the reported experiences within two forms of VAD compared to VD. By combining both the views of the participants and the facilitators, we wanted to gain a holistic view based on the input of all the actors involved in the debriefing process. With this approach, we were able to identify the perceived positive and negative aspects that come with each distinct form of debriefing. By doing so, we created an overview that can be used by practitioners and researchers to improve the experiences connected to debriefing and thus foster learning.

In relation to our first research question "How did the participants experience high-tech VAD, lower-tech VAD and VD?", we found that the majority of participants preferred high-tech VAD over all the other debriefing forms. Participants appreciated the superior audio and video quality, with the possibility to review the simulation from two different angles and to jump to the important parts of the video by having timestamps within the debriefing software. However, despite these technological advantages, some participants favoured lower-tech VAD or VD as the absence of head-mounted lapel microphones and two cameras was considered less intrusive and led to a more natural behaviour during simulation. This can be seen as a conflict. On the one hand, we have the fidelity of the video recording but on the other hand, this visual material might not display the true behaviour of the participants. With VD, the participants preferred the clear structure and the fact that the debriefing allowed them to discuss different ways to solve their tasks without focussing too much on specific mistakes and how they originated. These different preferences indicate that each debriefing method may cater to the individual and situational (learning) needs of the participants.

Regarding our second research question "How did the facilitators experience high-tech VAD, lower-tech VAD and VD?", the facilitators unanimously preferred VAD over VD as it allowed for a more clear and objective debriefing, which is in line with the depiction of VAD in previous studies (Schertzer & Waseem, 2024; Villado & Arthur, 2013). They reported that the video reduced possible biases and that it enhanced the credibility of their feedback. This was considered helpful, as the visual proof was less disputable especially if the facilitator was lower in terms of medical hierarchy than the participants.

However, the facilitators noted a higher cognitive demand when managing VAD, particularly during high-tech VAD. This was caused by having to deal with the technical equipment of VAD, while simultaneously leading through the simulation. Having to split their attention could lead to errors in the observation of participants or mistakes in controlling the simulation.

Learning and reflection through VAD

Participants as well as facilitators recognised the value of the external perspective provided by VAD, which allowed them to review both individual performance as well as team dynamics. By seeing oneself or others during VAD, the principles of observational learning can be applied (Johnson, 2020). Through observation, relevant actions can be identified and mimicked. With the external perspective, the participants were able to see and reflect on how the actions of themselves and their colleagues were related to the performance of the team. It also corrected possible misconceptions about their performance thus fostering further reflection by the participants. These findings are in line with the studies by Ha (2014), Jacobs (2017) and Johansson et al. (2017).

However, facilitators observed that participants often only focused on their own performance, which some participants have partially confirmed. The participants' prioritisation of personal performance during VAD can be seen as less critical than the focus on task-irrelevant aspects (e.g., personal characteristics, such as "looking good") as reported in similar studies (Fukkink et al., 2011; Johansson et al., 2017). However, by focusing on one's own performance, the chances of learning from others are reduced. This finding suggests a need for facilitators to guide participants during the debriefing to balance their self-assessment with team-oriented reflections to further benefit from VAD.

Emotions and the acceptance of feedback

Our study showed mixed emotional responses connected to the different debriefing forms. While the equipment used within high-tech VAD caused stress and self-consciousness among some participants, these feelings partially disappeared after the participants became accustomed to the technology. However, viewing videos that contained mistakes in front of other members of the team was seen as critical within both forms of VAD. In fact, it can be considered as a threat to psychological safety. To maintain psychologically safe conditions, the facilitators employed implicit and explicit strategies such as ensuring confidentiality and conducting the debriefing in a private environment (Kolbe et al., 2020). Furthermore, both participants and facilitators expressed the importance of balancing feedback. To balance the VAD, facilitators did not only show errors but also highlighted the positive actions that happened during the simulation. This was done to maintain motivation and to ensure psychological safety by avoiding overly harsh and one-sided feedback. Similar to the findings by Krogh et al. (2015), facilitators also noticed that VAD can easily impair the psychological safety of the participants. Although the facilitators were aware of the destructive capabilities of VAD and used strategies to maintain psychologically safe conditions, they were not always successful. For instance, one facilitator reported that the constructive feedback given was perceived as a personal attack by the participant. We conclude that the efforts needed to ensure the psychological well-being of the participants seem to be especially important within VAD and breaches to psychological safety need to be recognised and responded to by the facilitators.

The role of the facilitator is similarly important during VD, as the acceptance of feedback is also dependent on the facilitators and their relationship with the participants. This is a critical finding, as subjective values such as the likeableness of the facilitator appear to have an impact on what and how much the participants take away from the debriefing. Moreover, without a video recording supporting the argument, participants might also easily dismiss significant feedback. With VAD, both facilitators and participants stated that the objectivity of the video improved the acceptance of feedback. These findings show that even though VAD might cause initial discomfort for the participants, it was perceived as a more objective learning experience of which they reported to have profited.

Future improvements and recommendations

Participants and facilitators highlighted various areas for improvement concerning VAD equipment and debriefing practices. Participants advocated for better audio quality and additional camera angles, especially within lower-tech VAD. Although high-tech VAD was superior in both aspects, it still had technical flaws and came with the drawback of increased intrusiveness and less comfort for the participants. Participants also noticed differences in the structure of the various debriefings and therefore wished for a standardised debriefing procedure.

Facilitators shared these impressions and expressed the desire for more intuitive and stable VAD systems that are also better suited for their simulation training. However, as the facilitators did not have much time to get acquainted with these systems, repeated usage and training with VAD technology might improve their experiences even without technical changes.

In conclusion, even though high-tech VAD is generally preferred for its detailed and objective nature, lower-tech VAD and VD also have unique advantages. Future developments in high-tech VAD could try to incorporate the positive characteristics of low-tech VAD and VD. For instance, improving high-tech VAD might go along with balancing the sophistication and intrusiveness of the technical equipment to have both high-quality and natural footage of the participants. Moreover, as the facilitators play a key role in managing the VAD equipment as well as guiding the debriefing, special VAD training needs to be implemented to reduce cognitive demands and maximise the educational benefits of high-tech VAD.

Limitations of the study

It has to be noted that even though the facilitators had a separate training day on which they received technical instructions on both VAD systems, they still had limited experience in the use of VAD at the start of our study. During data collection, they gained more experience which might have affected the findings to some extent. However, when it comes to the implementation of new technology at the workplace, the initial phase of adaptation is especially important for the acceptance and continuation of new technology. As the facilitators perceived VAD as an added value, it is probable that they continue this endeavour and try out different approaches that are feasible for the simulation settings relevant to mountain rescue. These changes might also include a revision of the current debriefing practices or the adoption of a new debriefing model altogether. The facilitators had similar approaches to the structure, expectations, and goals of the debriefing due to their training and certification within the Bavarian mountain rescue organisation. However, the participants noticed differences in the practical implementation with the addition of the new VAD technology. This is a consequence of the flexibility the facilitators had in using the video recordings during VAD. Rather than having to cohere to a newly implemented, rigid, and possibly unfamiliar debriefing structure, the facilitators were given the option to use the video recordings in their debriefings as they considered the most beneficial. While these differences in the use of video recordings created distinct experiences for the participants, we believe that this approach aligns with the exploratory qualitative design of our study. However, future practice can be improved by standardising the implementation of video recordings within the debriefing, thus creating equal experiences for the participants.

By comparing the experiences of the participants within cases, the possibility of sequencing effects exists. To minimise sequencing effects, we varied the order of debriefing forms across participants. Additionally, we have checked our data and found no evidence of potential biases that might be related to the order of debriefings. This is also reflected in our results, which show a clear preference for high-tech VAD. The preference for high-tech VAD is not consistent with the logic of sequencing effects, as they would likely lead to a more even distribution of preferences, given that the participants started with different debriefing forms at the beginning of the simulation cycle.

Similarly, the simulation scenarios might have also affected our findings. To address this potential risk, we made sure that the scenarios were comparable and included similar technical, medical, and logistical challenges. Although these efforts were made, creating truly homogeneous experiences without using the same simulation scenario is not feasible and would possibly lead to other problems, such as practice effects.

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Declarations

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