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Original Research

The Royal Flying Doctor Service Initiation of Helicopter Video Simulation Orientation Training for Air Medical Crews in Western Australia: A Pilot Study

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A B S T R A C T

Objective: In May 2022, the Royal Flying Doctor Service Western Operations in Western Australia pioneered the introduction of the first organizational helicopter emergency service with 2 Eurocopter EC145 helicopters. This article describes the pilot study undertaken, assessing the implementation and flight crew confidence outcomes of the supplementation of video simulation training to standard clinical training for helicopter air medical retrieval.

Methods: Survey assessments using a 5-point Likert scale provided anonymous demographic data with summarized results of the means and standard deviations. Nonparametric tests were used to compare responses between the control and experimental groups from pretraining to postintervention to postpractical.

Results: The findings showed an increase in confidence rates after a classroom session and further increases after a practical session in the control group. The intervention group showed a small rise in overall confidence levels after being shown video simulations following the completion of their classroom session before commencing their practical session. This study established that regardless of the airframe, clinical staff, often with significant experience in air medical retrieval and critical care medicine, do not automatically have confidence in performing critical care procedures in a new aircraft type to which they have not previously been oriented. The results display a statistically significant increase in confidence levels in procedural performance after the classroom session compared with the pretraining questionnaire, with a subtle further rise when video simulations are included in the classroom session. When a classroom session is subsequently supplemented with a practical simulation session, confidence levels continue to rise.

Conclusion: Implementing a comprehensive educational strategy including classroom and practical elements for clinical staff in their orientation to new aircraft improves their confidence in performing critical care procedures if required in flight. The addition of in-flight prerecorded videos demonstrating these critical care procedures is a useful adjunct to simulation training for flight crew in air medical retrieval, and further analytical studies may indeed show a statistically significant improvement in staff confidence.

The Royal Flying Doctor Service (RFDS) is a renowned Australian charitable health care organization providing 24-hour emergency air medical and primary health care services to nearly 7 million (29% of the Australian population) rural and remote Australians.[1] In May 2022, the RFDS Western Operations in Western Australia (RFDSWO)

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John Iliff and Glenn Powell were the lead clinicians for the Rotary Wing Project at RFDSWO.

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pioneered the introduction of the first RFDS helicopter emergency service (HEMS) with 2 Eurocopter EC145 helicopters. Located in Jandakot, Perth, these aircraft service a 250-km range surrounding the Perth metropolitan area and are designed for interhospital and modified primary retrievals (retrievals from medical facilities not staffed with doctors and possessing very limited diagnostic and treatment capabilities).[2,3] With the commencement of the RFDSWO HEMS, a tailored educational program was introduced to include video simulations demonstrating how critical care interventions are performed in flight.

Before the introduction of the RFDSWO EC145, the flight crew workplace consisted of the fixed wing aircraft Pilatus PC-12 turboprop and the Pilatus PC-24 super versatile jet. Clinical training for flight doctors and nurses involved classroom-based and ground-based clinical simulations run by the RFDSWO Clinical Education Department. After this, early in-flight clinical exposure experience was "peer reviewed" and assisted in the form of a "buddy flight."

Simulation training has multifaceted benefits for both the patient and the flight crew in HEMS,[4] providing frequent, short, intense learning periods and boosting clinician skill sets.[4] New, high-risk, and infrequent tasks can be supportively made routine.[4] Logistically difficult situations and critically unwell patients can be artificially managed before facing the complex critical care scenario in flight.[5−7] As a result, new air medical clinicians can be better supported to adjust to the aviation and air medical work space. The safe practicing environment overcomes logistical and environmental factors of noise, turbulence, fatigue, shift work, and working alongside new team members.[7]

This prospective study aimed to optimize clinical training for new air medical clinicians who had not previously been oriented to the newly introduced EC145. The clinical orientation consisted of a classroom program followed by a practical session inside the cabin of the helicopter. An intervention group then had their classroom session further supplemented with the addition of prerecorded videos during the education program demonstrating the performance of critical care scenarios in flight, with the theory being that prerecorded in-flight video simulations of critical care procedures would increase the perceived clinical confidence of the staff in conducting such procedures during a rotary wing retrieval.

Ultimately, these in-flight complex care procedures are typically high-stress situations compounded by fatigue, stress, and environmental influences. The clinical education team wanted to ensure all clinicians were as well prepared as possible. The in-flight video simulations aimed to provide guidance to the flight crew, preparing them with foresight of how to manage a difficult situation at altitude in a confined cabin before patient care. The authors believed it would allow the learner to visualize clinical performance and enhance their learning experience during the clinical orientation, reassuring them that it was indeed possible to perform these procedures during an actual retrieval while flying.

After a narrative literature search, no air medical scenario-based training videos recorded while the aircraft is flying have been found.

Methods

Aims

The aims of this research paper were to 1) assess the impact of the introduction of the video simulation training tool for the HEMS EC145 air medical crew; 2) improve air medical training with video simulation, mitigating air medical logistical, environmental, and personal difficulties to optimize patient care; and 3) assess the impact of clinical orientations including classroom and practical sessions for clinical staff confidence not previously oriented to a specific aircraft type.

Table 1
Participant Demographics and Experience

Demographic	Number of Participants (%)
Total	45 (100)
Sex	
Male	21 (46.7)
Female	24 (53.3)
Age range (y)	
20-29	1 (2.2)
30-39	14 (31.1)
40-49	14 (31.1)
50-59	10 (22.2)
60-69	6 (13.3)
Years of experience in a fixed wing aircraft	
0-5	19 (42.2)
6-10	11 (24.4)
11-15	6 (13.3)
15+	9 (20.0)
Years of experience in a rotary wing aircraft	
0-5	37 (82.2)
6-10	4 (8.8)
11-15	4 (8.8)

Setting

This study took place at the RFDSWO base in Jandakot, Perth. The flight medical crew training evaluation was undertaken during 5 separate training days between November 24, 2021, and December 23, 2021.

A 4-stage survey (Table 1) was rolled out during the training program consisting of a pre- (benchmark), during, and postclassroom survey and a postpractical survey (Fig. 1). Surveys were sent to flight crewmembers via e-mail using the REDCap 12.07 Vanderbilt University (Nasville, TN, USA) platform from the RFDS Public Health Research Unit located in Canberra, Australian Capital Territory, Australia. The survey results were deidentified.

Education and Training

The dedicated EC145 training day program started with a 3-hour session on cabin safety requirements of the aircraft as mandated by the Civil Aviation Safety Authority (CASA). This highlighted the emergency procedures for the aircraft along with a demonstration in how to conduct operations safely around the helicopter. This was then followed by the clinical orientation of the training, which consisted of a 2-hour classroom session. This covered the location and functioning of clinical equipment in line with the standard operating procedures. How the 3 clinical procedures of a log roll, advanced life support (ALS)/cardiopulmonary resuscitation (CPR), and intubation would be performed was also described. This was followed by a 1-hour ground-based practical simulation session in which learners were given time to reaffirm equipment location and function and then to perform the 3 clinical procedures in the aircraft while it was on the ground.

In the interest of efficiency and the predicted likelihood of occurrence in flight, the clinical educators selected 3 critical interventions to simulate inside the helicopter: logrolling a spinal patient and advanced resuscitation measures including resuscitation and intubation. The educators took the view that other interventions such as chest drains, splint application, and cannulation would be performed before loading the patients into the aircraft in most circumstances.

The control group was exposed to the classroom session and then proceeded directly to the practical session. After the same classroom session, the intervention group was also shown videos demonstrating the critical care procedures before performing their practical session on the ground.

The video simulation footage demonstrated the flight doctor and flight nurse performing a log roll of a patient in spinal precautions

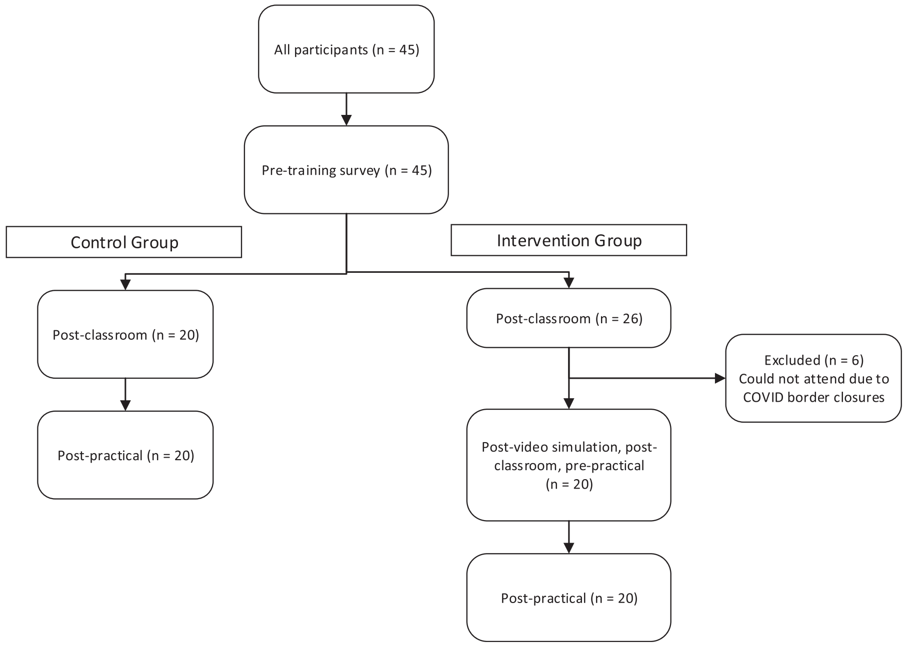

Figure 1. The Training and Study Group Flowchart. COVID, coronavirus disease.

Figure 2. A snapshot of the clinical crew and manikin before commencing the log roll.

Figure 3. A snapshot of the clinical crew performing intubation.

(Fig. 2), ALS/CPR, and intubation (Fig. 3). The 3 videos lasted between 30 seconds and 2 minutes and were recorded on an iPhone (Apple, Cupertino, CA) by a separate member of the flight crew who was secured in the removable cabin seat. A manikin was used in place of a patient and was fully restrained on the stretcher as per CASA regulations. The intervention group was allowed to rewatch the videos if specifically requested.

Sample Size

A total of 60 clinical staff members was set as the target to be enrolled; a maximum of 15 would be accommodated on each of the 5 days of the initial education program. This was decided to allow for small group teaching, not eclipsing 8 clinical staff members per clinical educator. The clinical educators consisted of a senior flight nurse/midwife with 15 years of air medical experience and nearly 3 years as a clinical educator for RFDSWO and an air medical consultant with an Australian College of Emergency Medicine fellowship and postgraduate qualifications in health professions education. Both trainers were the respective nursing and medical leads for the helicopter service and devised the standard operating procedures for the service.

Staff randomly volunteered on 1 of the available training days in line with their availability outside of their rostered clinical time. They had no prior knowledge which days would be the control group or the intervention group. It was decided by the researchers before participant sign-up that the control group would consist of the first 2 dedicated training days and the intervention group the following 3. Staff members who could not attend on these 5 days had their clinical orientation at other suitable times, but they were not included in the study.

Data Collection and Statistical Analysis

The pre- and posttraining surveys were sent anonymously using the public-facing RFDS Public Health Research Unit e-mail. Participants were kept anonymous and deidentified. The surveys requested responses using a 5-point Likert scale as well as years of experience in the organization and dichotomous responses. Responses were summarized using means and standard deviations. Nonparametric tests were used to compare responses between the control and experimental groups from pretraining to postintervention to post-practical.

Ethics

Internal approval was provided by the RFDSWO's Quality Team Committee and then endorsed by the RFDS Federation Clinical Health

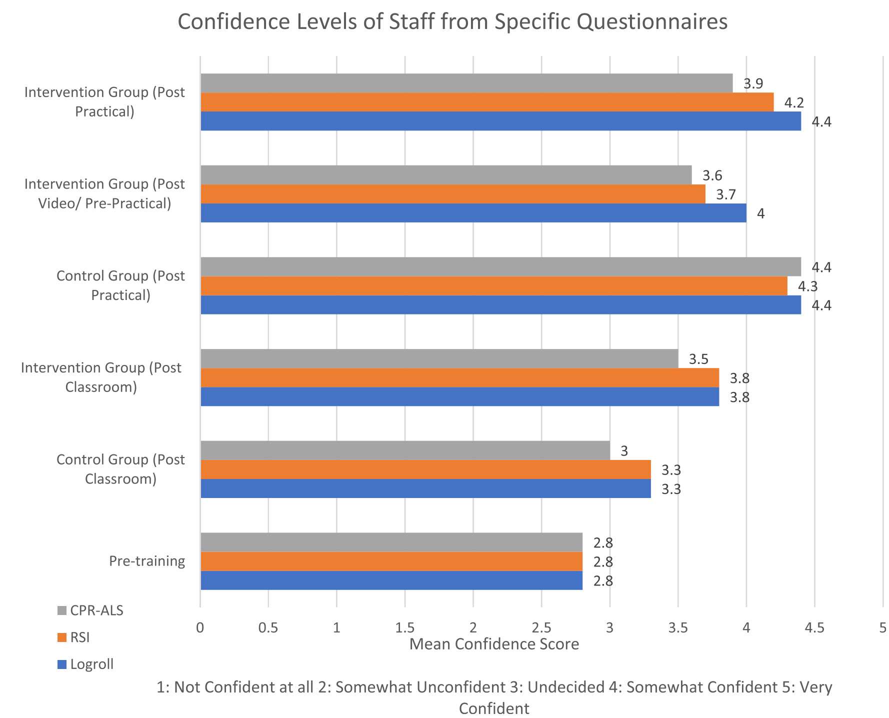

Figure 4. A bar graph showing confidence levels from the survey results. CPR-ALS, cardiopulmonary resuscitation−advanced life support; RSI, rapid sequence intubation.

Service Ethics Committee on October 20, 2021. Subsequently, the Australian Capital Territory Government Human Research Ethics Committee and Low Risk Sub-Committee deemed the project ID: 2021.QAI.00177 a quality assurance/improvement activity.

Results

The results show that before the clinical orientation staff show a low average level of confidence in performing critical care interventions in a new airframe that they have not been previously oriented in (mean score = 2.8) (Fig. 4). After the classroom session, confidence levels increased to an average score of 3.0 to 3.8 for all participants. The change in score from pretraining to postclassroom (Table 2) is statistically significant or close for all 3 skills (Mann-Whitney *U* test, $P < .0001$ for the log roll and rapid sequence intubation [RSI] and $P = .0577$ for CPR-ALS).

The results revealed differences in the postclassroom average confidence scores for the intervention and control groups with the intervention group having higher mean scores before having the videos simulations played. The difference in the score between the intervention and control groups (Table 2) is not statistically significant given the total number of participants.

The control group with no access to in-flight prerecorded video simulations and the intervention group showed a significant increase in the average staff confidence levels in all 3 skills after the completion of their training after the practical session. The control group averaged 4.3 to 4.4 and the intervention group 3.9 to 4.4 across all 3 skilled procedures after the practical session. The change in score from postclassroom to postpractical (Table 2) is also statistically significant for the log roll and RSI but not for CPR-ALS (Mann-Whitney *U* test, $P = .0068$, .007, and .1291, respectively).

The postpractical score between the intervention and control groups is not statistically significant ($P = .9018$ for the log roll, $P = .8746$ for RSI, and $P = .0718$ for CPR-ALS).

Discussion

Simulation training for helicopter air medical retrievals has taken a forefront position internationally, providing medical flight crew with a greater contextualized understanding of the logistics and difficulties faced during a patient retrieval.[4,5,8,9] European HEMS are leading simulation training with promising results, especially within Scandinavia. Norwegian HEMS assessed simulation training over 1 year between October 31, 2014, and October 31, 2015, in 10 HEMS.[10] Findings showed flight crews' consistently highly rated simulation training with workload directly impacting capacities to undertake simulation training during on-call hours.[10] Helicopter rescue in Bologna, Italy, followed in 2019, implementing and evaluating simulation training with HEMS flight nurses using scenarios in an AgustaWestland AW169 helicopter.[7] Despite the limiting cohort of 14 flight nurses, simulation training was deemed valuable in credentialing, recertification, and upskilling in the air medical environment.[7] These

Table 2
Training Questionnaire Mean Confidence Score Results With Standard Deviation

Skill (Mean ± Standard Deviation)	Pretraining (n = 45)	Control Group Postclassroom (n = 20)	Intervention Group Postclassroom (n = 26)	Control Group Postpractical (n = 20)	Intervention Group Postvideo (n = 20)	Intervention Group Postpractical (n = 20)
Log roll	2.8 ± 0.9	3.3 ± 0.9	3.8 ± 0.8	4.4 ± 0.5	4.0 ± 0.8	4.4 ± 0.6
RSI	2.8 ± 0.9	3.3 ± 0.9	3.8 ± 0.6	4.3 ± 0.5	3.7 ± 0.9	4.2 ± 0.7
CPR-ALS	2.8 ± 0.9	3.0 ± 1.0	3.5 ± 0.8	4.4 ± 0.5	3.6 ± 0.9	3.9 ± 0.9

CPR-ALS = cardiopulmonary resuscitation−advanced life support; RSI = rapid sequence intubation.

evaluations echoed highly positive results from the flight medical crews, including improved infrequent clinical skill sets, teamwork, and situational awareness.[7,10] With this knowledge, the authors firmly believe simulation is a prerequisite for any orientation program but could be further enhanced.

This study established that regardless of the airframe, clinical staff should have a clinical orientation for any new aircraft to improve confidence in performing required roles in flight despite 57.7% of the participants having over 5 years of experience in this study. This highlights that clinical staff, often with significant experience in air medical retrieval and critical care medicine, do not automatically have confidence in performing critical care procedures in a new aircraft type to which they have not previously been oriented. It shows self-awareness from these clinicians that new conditions to operate in require an extra level of training to prepare them for clinical operations. This is important for any air medical organization to consider because it cannot be assumed that new staff members are comfortable performing complex procedures on any aircraft that they have not flown on before.

The results from this study indicated an increase in confidence level in procedural performance after the classroom session compared with the pretraining questionnaire. This even occurred among clinical staff who have worked in many different air medical organizations with numerous airframes between different helicopters and fixed wing aircraft.

When a classroom session was subsequently supplemented with a practical simulation session, confidence levels continued to rise, with average scores increasing from 3.2 to 3.5 to 4.3 to 4.4 between the 3 procedures simulated in the control group. This further supports the results found by other European HEMS providers.

In the intervention group, who had access to the videos before commencing the practical session, we observed postclassroom session average scores of the 3 critical care procedures of 3.5 to 3.8 increase to 3.6 to 4.0 after being shown the in-flight simulation videos. However, it was observed that the average confidence level dropped for the performance of RSI after the playing of the video for staff before commencing the practical session. After the practical session, the mean confidence score in the intervention group increased to 3.9 to 4.4.

Although only a pilot study, this study provides supportive evidence of our hypothesis that staff should undergo a clinical orientation with simulation exercises for the specific airframe when it comes to preparing for critical care interventions. Our results displayed a clear increase in clinicians' confidence in their ability to perform procedures after a classroom session and a practical session. Specifically, we believe this study suggests the addition of prerecorded videos simulating the performance of these skills while the aircraft is in-flight improves clinical staff confidence for some learners in their ability to perform the procedure if required. This study did not reveal statistically significant evidence to support this, and further detailed analysis would be beneficial, especially subgroup analysis in relation to age and experience. However, the study did confirm that staff members have statistically significant improvement in their confidence levels after a classroom-based training followed by a practical session inside the aircraft.

There is an assumption in this study that staff members are fully confident in their performance of these procedures on the ground in a hospital/clinic setting and in aircraft to which they are already oriented. It should be noted that clinical staff within RFDSWO undergo yearly clinical assessment, ensuring organizational standards and operational practices are maintained.

There are limitations of this study. The total group of 46 participants across the control and intervention groups was smaller than expected, impacting the statistical significance of the data gathered; these participant numbers are similar to those in the wider literature.[4] Although we have seen encouraging results that support our hypothesis, ongoing large cohort studies are required to strengthen the air medical simulation training evidence base.

In total, 40 air medical flight crewmembers fully completed the clinical training on the days of the study. During the study, there was a loss of participants because of coronavirus disease 2019 restrictions in relation to unexpected furloughing of staff members. The clinical requirements of the service also meant that in 1 circumstance 6 senior staff members were pulled away from the clinical orientation program to perform urgent clinical duties in relation to Western Australia border closures. It was not possible given the late nature of the participants' cancellation in these incidences to find replacements to fill their spots. It should also be noted that staff volunteered to contribute to the survey, which limited the total sample size, and 1 staff member did not perform the pretraining questionnaire but proceeded to perform the rest of the questionnaires during the training program.

The authors also acknowledge that although flight crews received the exact same classroom session and simulation session, there is potential for subtle differences between each day that impact individual participants, who often have different questions and learning requirements. It has also been considered that different staff have different learning models in-line with educational theory.[11] The addition of simulation videos would cater to different learning types such as the visual learner, who benefits from seeing others perform.[7] These videos may not cater to the learning styles of certain staff members. It is also feasible that the participants in the study may have sought approval from the clinical trainers by marking highly.

It could be argued that optimal simulation training would involve flight crew performing simulation exercises in flight. Practically, this is difficult to achieve because of a multitude of factors, including flight hours for pilots and aircraft. Requesting pilots to perform specific flights for clinical staff to perform simulations reduces their availability for real taskings and also uses up flight hours, which are under strict regulation from CASA.[12] Aircraft serviceability and availability as response units outweigh specific simulation flights. As a not-for-profit charitable organization, RFDSWO is cognizant of the importance of using funds efficiently. Purchasing extra fuel to conduct dedicated flight simulations for all clinical staff would be an expensive exercise; therefore, alternative effective educational opportunities need to be explored.

HEMS, particularly night flights, are considered the riskiest of all air medical retrieval types.[13] The poor lighting, vibrations, noise, turbulence, and the logistics of caring for a critically unwell patient with limited space and movement permitted are tough and, until recently, had to be learned in flight with patients on board.[5,9,14] The risks associated with managing patient deterioration in flight need to be mitigated with advanced air medical clinician preparation. The implementation of prerecorded video simulations showing these skills being performed in flight during clinical orientation have the potential to further enhance clinical preparedness, ensuring staff can intervene if required at an optimum level. Further study of their impact in clinical training would be of significant benefit.

The requirement of mandatory clinical training for each specific aircraft type regardless of experience is pivotal for every clinician to deliver optimal patient care. Executive staff would need to ensure dedicated time is allocated for recording and editing of such material by clinical education teams. Research shows uncompromised, regular simulation training should be fostered in the workplace.[7,9] The addition of in-flight prerecorded video simulations to classroom and practical exercises can only further enhance such positive outcomes. It is hoped that the addition of this educational tool can be rolled out in a more extensive fashion to include all aircraft in the RFDS fleet including the fixed wing aircraft and can broaden out to more interventions.

Conclusion

Implementing an educational strategy that includes classroom-based learning as well as practical components is vital for optimizing staff confidence in their ability to operate in the challenging arena of air medical retrieval. It allows them to be better prepared to appropriately intervene in the situation of a critically unwell patient in flight. The addition of in-flight prerecorded video simulations demonstrating critical care procedures in flight is a useful adjunct to simulation training for flight crew in air medical retrieval. These findings are translatable to all clinicians in the prehospital environment. Simulation training allows newly oriented staff to visualize how such procedures should be performed and highlights that they are possible in a challenging environment such as an actively flying helicopter where multiple factors make such clinical interventions more challenging than they would be on the ground.

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