Case Report

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Medical air transport crash: Case report of crisis/ emergency management by a flight nurse

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ABSTRACT

Though medical air transport is a fast-developing field, no specific regulations have been formulated regarding the training and skills required by the health professionals involved in aeromedical missions, especially emergency nurses. Despite the potential benefits observed in case- and simulation-based training, there is a lack of evidence suggesting that a complete team training in all emergency skills leads to improved prognosis in a critical situation. Regarding non-technical skills, the repeated simulations of crisis resource management skills (problem solving, situational awareness, resource utilization, communication, and leadership) for nurses are associated with better knowledge retention. However, there is little demonstration of their relevance in improving the patient's prognosis in real care situations. This paper is a case report of a medical air transport crash during the outbound segment of the flight. The aircraft sustained serious damage, and many of the crew were injured. The flight nurse was responsible for providing care to the other crew members, managing decision-making in life-threatening situations, and sharing information with the professionals on board the aircraft as well as with the rescue team. This report aims to demonstrate the importance of flight nurses and other medical crew (such as flight physicians and physiotherapists) being proficient in aircraft emergency procedures and receiving effective crisis resource management training.

Keywords: Emergency nursing; Crew resource management, healthcare

INTRODUCTION

Approximately 3% of all medical transports are performed by aircraft in the United States of America.[1] Medical air transport is the major alternative used for shifting critically ill patients between states and countries.[2] Usually, the level of care provided, and complexity of procedures performed by air medical crews demand the presence of a flight physician. Moreover, very few descriptions of regulations and essential requirements in case of non-doctor competencies are available.[3] The role of the flight nurse in the medical air multi-professional team includes updating and ensuring compliance with the aircraft's medical equipment checklist, having knowledge of the patient's clinical conditions and case, monitoring the patient, and following medical recommendations.[4] Despite the potential benefits observed in case- and simulation-based training, there is a lack of evidence that complete team training in all emergency skills leads to improved prognosis in a critical situation.[5]

Emergency staff usually face multiple diagnostic challenges, resource limitations, and disruptions in work environments.[6] To deliver the best patient care

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in chaotic situations, health professionals must follow coordinated team-based strategies directed by crisis resource management (CRM) principles.[7] Interestingly, CRM behavioral skills were initiated into aviation in the 1970s and were progressively incorporated into medical practice.[8] Accordingly, nurses are expected to demonstrate shared leadership during crisis, with appropriate decision making capabilities and emotional intelligence skills, so that emergency care culminates in the best possible prognosis for the patient.[9] Education through repeated simulations of CRM skills (problem solving, situational awareness, resource utilization, communication, and leadership) for nurses is associated with the retention of knowledge, but there is little demonstration of its relevance in improving the patient's prognosis in real care situations.[10]

This paper is a case report of an air medical transport crash during the outbound segment of the flight (on the way to pick up the patient). The accident occurred during landing at the Juscelino Kubitschek Airport (ICAO designation SNDT), in the city of Diamantina, the state of Minas Gerais, Brazil. The plane had a runway excursion and fell off a cliff, right after the end of runway 21.

Serious damage occurred to the aircraft, and many of the crew were injured. The flight nurse, who had also sustained critical injuries, was responsible for providing care to the other crew members, managing decision-making in that life-threatening situation, and sharing information with professionals inside the aircraft as well as the rescue team. All victims had good outcomes, essentially due to the initial care they received.

This report aims to demonstrate how important it is for the flight nurse, as well as the other medical crew (such as flight physicians and physiotherapists), to be proficient in aircraft emergency procedures and receive effective CRM training. A retrospective compilation of data from the crash and rescue records has been carried out, with subsequent exposure of the main findings.

CASE REPORT

A Bombardier LearJet 31, configured for medical air transport, took off from the city of São Paulo (São Paulo, Brazil) bound for the city of Diamantina on 2 January 2021, to transfer a critically ill patient back to São Paulo. The crew was composed of two pilots, one emergency physician, and one flight nurse.

While landing at the Diamantina airport, the aircraft was not able to lose speed properly (for reasons yet to be disclosed) and ended up having a runway excursion and falling off a cliff located a few meters away from the end of runway 21. During maneuvers for landing, the aircraft missed the runway and landed in a ravine. The impact occurred with the aircraft tilting its nose down when meeting the end of the track, after being in a horizontal position on the land, already decelerating, at an estimated speed of 80 knots. All passengers wore a three-point seat belt, chest, and hip buckle. The engines remained on, and major structural damage occurred internally (**Figures 1 and 2**). There was no explosion. The posterior evaluation showed that all aircraft documentation was up to date and adequate. These considerations certainly also contributed to a better outcome of the accident.

The following statement was made by the first author of this article, who was the flight nurse of this mission:

> I did not lose consciousness at any time after the impact. At first sight, there was a big mess inside the aircraft. Immediately, I noticed an injury with profuse bleeding on my forehead; I had a severe headache and felt intense pain in several locations such as my right eye, back, and left thigh. I had no trouble breathing and was able to move all four limbs. The engine noise was loud, and there was no adequate lighting. Despite the presence of fog, I was able to establish eye contact with the other crew members. As there was a high chance for an explosion to follow, the first thing to do was try to abandon the aircraft. The front main exit was destroyed, so I unlocked the rear emergency exit. I managed to get out over the right wing, receiving debris and dust from the engine's jet blast. This was the only possible way out available at that time. Outside the aircraft, I looked for the other crew members, but no one had been able to abandon ship. At this point, I realized that I would have to apply the START (Simple Triage and Rapid Treatment) method to evaluate my colleagues, to define the treatment and transport priorities, as I was the only one among them effectively equipped to provide any emergency care.
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> Inside the cabin, in the front, I found the flight physician. She was conscious and able to walk, so I directed her to the emergency exit, helping her to exit the aircraft safely. I moved her away from the risk area, and she remained in rest. Soon after, the pilot also found the exit. He had a severe cough and speech trouble, but it was possible to understand his message: 'the co-pilot remains entrapped in the cockpit!'. Despite the pilot's reported symptoms inferring soot poisoning, he was also classified as a 'green' victim according to the START method. I guided him away from the airplane, for him to breathe fresh air. Soon after, I spotted the co-pilot trapped in his seat. He made movements but was unable to communicate. From that

Source: authors.

Figure 1. External and internal images of the medical air transport crash.

Source: authors.

Figure 2. Internal rear view of the aircraft after the accident.

moment on, all efforts were made to remove this victim. There was no access from within the plane. At this moment, the physician approached and offered help. We tried to break the front window with our own hands, but without success. The pilot returned after a few minutes feeling better and, in a desperate attempt to help, found a metal bar near the crash site and tried to break the window with it. However, that piece of metal was extremely hot and, as a result, he ended up with severe burns in both hands. There were no other tools to clear the way to the cockpit.

Without further options to help, I climbed the cliff from which we had fallen off, to seek help. The airport was located on top of the cliff but, unfortunately, it did not have a fire station, due to its small size and traffic movement. A single motorcyclist approached at the time and I shouted: 'My aircraft has crashed, I need a sledgehammer to break the cockpit glass.' Fortunately, he lived a few meters away, and gave me a lift. We went to his residence and took all possible instruments to break into the cabin. I returned to the scene but, despite using all these instruments, there was no success in our attempts to break the window. The co-pilot was already unconscious.

The pilot entered the aircraft again and, after much effort, opened the cockpit door and managed to free the co-pilot from the wreckage, pulling him out. Both fell unconscious inside the cabin at that time. I then managed to remove them from inside the aircraft and, once outside the airplane, I started clinical evaluation of the co-pilot following the XABCDE technique: there was no apparent major bleeding, I opened the airways with smooth chin lift with clear visible permeability, and there were clear symmetrical chest expansion and breathing movements. The radial pulse was palpable, strong, and full. I had no other medical devices to initiate any type of immobilization or assistance. Considering the high risk of explosion, I stopped evaluation at this point and opted to move him away from the site, using quick removal techniques.

After that, I returned to find the pilot, who had been supported by the physician and remained lying on the ground near the aircraft, with patent airways, respiratory movements, and eyes wide open. In a brief period of time, the co-pilot recovered consciousness. The priority at this point was to leave the area. I positioned everyone as far from the aircraft as I could and took the portable oxygen cylinders with me, to reduce the risk of explosion.

After a few minutes, the city's local Emergency Medical Service team got on site. Before I was examined, I reported the clinical conditions of the crew to the rescuers and suggested the priorities for evaluation. I was taken to a hospital nearby and diagnosed with rib, spine, and leg fractures and a subdural hematoma—all of these were treated using conservative treatment methods.

DISCUSSION

Conceptually, emergency nurses play a key role in performing teamwork, thus increasing the efficiency and safety levels of the care provided to the patient.[11] However, the practical implementation of this concept faces several difficulties. Despite the evidence supporting the need for certified courses in emergency training for critical care nurses, there is, in general, a lack of clarity about emergency nurse titles, education, skills, and competencies, given the vast professional heterogeneity.[12,13] Furthermore, the regulation of nursing practices varies in different countries and this can confuse professionals who study international policies.[14] Therefore, a clear understanding of the field of action is essential for safe nursing practices. In addition to technical skills, the development of behavioral skills can also improve teamwork.[15] For example, a systematic review of nurse–physician communication, especially in emergency situations, concluded that the teamwork skill is crucial yet inadequately addressed.[16] Ideally, both technical and behavioral issues must be addressed before the implementation of advanced nurse practices.

Brazilian civil aviation agency (Anac, acronym in Portuguese of *Agência Nacional de Aviação Civil*) does not have specific regulations regarding the training and skill requirements for health professionals involved in aeromedical missions. Despite the crucial role played by nurses and physicians in these missions, they are actually considered as "passengers" by this regulatory agency. On the other hand, the national Ministry of Health has published a document that describes the curriculum that is intended to be taught to all health professionals who are to take part in medical air transport.[17] As stated in this document, the training program should comprise subjects as "normal and emergency procedures during flight," "safety inside and around the aircraft," and "emergency evacuation." These are part of the minimal training required for the medical staff (nurses and physicians) and are supposed to be covered within a ten-hour course.

When it comes to CRM training, none of the agencies has specific recommendations for health professionals. The Ministry of Health does not consider it a part of the minimal required training. Anac, despite instituting regulations on this topic, does not consider health professionals as crew members. Hence, it is not mandatory for nurses and physicians to participate in CRM training programs.[18] Although there is no formal requirement, several Brazilian air patient transport companies perform continuous nursing training.

Usually, the focus is primarily on identifying and controlling damage collateral, flight safety, and emotional management of the stress induced by the aeromedical operation. Some companies train the crew in Air Medical Resource Management based on Federal Aviation Administration guidance.[19] This specific training addresses minimum skills related to everyday situations management.

It is of paramount importance that all medical staff be trained and familiarized with emergency procedures that could be performed during aeromedical missions. Both technical and non-technical (CRM) nursing skills should be developed, as they are to be applied in each phase of the mission, especially when some unexpected emergency occurs, as in this extreme case of an airplane crash during landing. Bureaucratic nursing professionals with little involvement in their roles would certainly not be able to perform the reported actions with such accuracy.

Flight nurses are formally trained and have certifications in some countries like the United States, Canada, United Kingdom, and Germany. This is a way of homogenizing the performance of these professionals in specific skills related to the multiple particularities of aeromedical transport.[20]

Also necessary is the public consultation of released reports by the National Transportation Safety Board of several medical air transport accidents. These data should be applied to safety culture, suggesting improvements and preventing new incidents.[21]

Therefore, this report demonstrates the importance of emergency staff who are well trained in technical skills and behaviors, thus re-emphasizing the need to expand training and certifications, especially among emergency nurses.

Emergency nurses must have situational awareness and the ability to make appropriate decisions in critical situations. This reflects the need for constant practice and training, along with strong technical knowledge.

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