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Original Research

Exploration of a Preflight Acuity Scale for Fixed Wing Air Ambulance Transport

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A B S T R A C T

Introduction: Despite the prevalence of fixed wing medical flights for specialized care and repatriation, few acuity rating scales exist aimed at the prediction of adverse in-flight medical events. An acuity scoring system can provide information to flight crews, allowing for staffing enhancements, protocol modifications, and flight planning, with the aim of improving patient care, outcomes, and preventing losses to providers because of costly diversions.

Methods: Our medical crew developed an acuity scale, which was applied retrospectively to 296 patients transported between January 2016 and March 2017. Patients received scores based on conditions identified during the preflight medical report, the initial patient assessment, demographics, and flight factors.

Results: Five patients were identified as high-risk transports based on our scale. Three patients suffered adverse events according to our defined criteria, 2 of which occurred before transport and 1 during transport. The 3 patients suffering adverse events did not receive a score that indicated adverse events in flight.

Conclusion: Our scale was not predictive of adverse events in flight. However, it did illuminate factors worthy of consideration. Consideration of these factors may have prevented adverse events.

Fixed wing air ambulance flights are increasingly commonplace for persons traveling to obtain specialized medical care at distant facilities or to repatriate. Despite the increased prevalence, few studies have been published detailing the specific risks and acuity factors associated with in-flight adverse medical events during fixed wing transport. Although patient safety and stability are primary considerations in any interfacility transport, fixed wing air ambulance flights include unique stressors in addition to those related to the patient's diagnosis and condition. The preflight handoff can be complicated by language differences and unpredictable, nonstandardized pretransport care. Flights are often lengthy, and multiple stops increase the impact of flight physiology on the patient. Any of these events can potentiate deviations from carefully developed medical protocols, necessitate alterations in flight plans, and impact patient outcomes. Risk stratification and acuity scoring tools are commonly used in health care settings, such as trauma care, surgery, anesthesia, critical care, and obstetric units. Several have been developed for air medical transportation, but none have been universally accepted as the standard. Furthermore, none include multiple technical/fuel stops, which may impact patient care and outcomes because of time extensions and pressure changes.

Our US-based proprietary air ambulance service provides basic life support and advanced life support global transportation for repatriation and for those seeking specialized medical care. Flights are both domestic and international and are initiated and funded by patients, family members, hospital case managers, or travel insurance agencies. All flights are single-patient transports conducted in a Lear 35 or Lear 36XR. Patients are allowed to be accompanied by a relative. The flight crew consists of 2 pilots. Medical teams, which vary according to anticipated need, have the capacity to consist of a physician (medical doctor), critical care registered nurses (RNs), and paramedics with advanced certifications (emergency medical technician-paramedic [EMT-P]). All medical personnel have a minimum of 5 years of critical care experience and have specialized training in flight physiology and advanced emergent medical interventions. Preflight patient reports are obtained via telephone by the RN staffing the flight,

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the chief flight nurse, or the medical director. Preflight patient assessments are conducted at the sending facilities before transport by the medical personnel staffing the flight. The medical director is available by satellite phone at all times.

Upon initiation of patient contact, the lead medical team member obtains a signed consent for transport from the patient or accompanying family member. This form describes the risks of transport in general and of air transport in particular. An additional "high-risk" consent form, which further details the risks of transport for patients perceived as medically unstable and which emphasizes the strong possibility of patient mortality, may be obtained at the discretion of either the medical director or the lead medical team member. This consent is based on patient factors, such as septic shock and hemodynamic instability, that individual flight teams believe to have the potential to result in untoward events. There is acknowledged variability in factors that potentiate this discretionary form, which is based more on team members' experiences and intuition than validated criteria.

During preflight briefings, pilots provide the medical team with flight details such as weather, expected turbulence, and anticipated time to arrival. In turn, the medical team informs the pilots of the patient's diagnosis and on the use of special equipment such as onboard suction, mechanical ventilation, or ventriculostomy. Pilots are also informed of the need for stops to replenish oxygen and anticipated delays for any reason.

The purpose of this study was to develop a risk stratification guideline based on the following parameters: specific patient factors that are identifiable during the premission medical report and initial assessment, the intensity of in-flight care required, and prolonged transports involving multiple technical/fuel stops. Such a tool could serve to rate the acuity of fixed wing transports before assuming patient care and predict the potential for untoward in-flight events. It could potentially trigger enhancements to team staffing and modifications to predetermined medical protocols, thus enhancing safety and promoting optimal patient outcomes. Alterations to the flight plan could be better anticipated. Finally, it could support the creation of a standardized, validated high-risk consent form and facilitate more accurate transport cost estimates, which could minimize financial losses to fixed wing transport providers.

Methods

A literature search was conducted in Web of Science and Google Scholar for factors that impact patient stability, increase the risk of adverse medical events, and have the potential to lead to negative transport outcomes. Preference was given to the most current literature although older research was considered when pertinent.

The majority of the literature on air medical transportation relates to rotary aircraft in the context of trauma, war, and/or interfacility handoffs. Less information is available about fixed wing air ambulance transportation, whether civilian or military. Of the studies concerned with patient care and risk reduction during fixed wing transportation, most focus on a specific aspect of care such as ventilation,[1] cardiac pacing and defibrillation,[2] or maintaining intracranial pressure stability.[3,4] Significantly, 1 study, although older (2001), defined a high-risk transport patient as "a patient with dysfunction in one or more organ systems which is unstable and which would require urgent medical intervention if it were to deteriorate"[5(p883)] The body system parameters that classify persons as high risk are described.

Two risk stratification tools used for fixed wing transports were found. The Acute Physiology and Chronic Health Evaluation II was used in 1 study[2] to evaluate patients' acuity to justify transportation to achieve a higher level of care but not to assess the potential in-flight risk for adverse events. This scale is useful in predicting the risk of mortality but is not meant to predict other types of adverse events, nor does it include variables related to an extended flight. The Stratification of Air Medical Transport by Expression of Symptoms in Patients was developed in another study[6] to determine the feasibility of transporting 2 patients on the same flight and the need for a pressurized cabin and to aid in planning medical crew configuration. However, some patient factors we believed to be important were not identified on this scale. Furthermore, the number of patients and need for pressurization are not relevant to our service because all of our flights are single-patient transports in a pressurized cabin. Finally, our medical team is typically different from the ones in this study, and a physician is included only as required by paying entities.

Hospital rapid response team tools were not considered appropriate for the purpose of this study. In general, they are validated for inpatient use, and many, such as the Pediatric Early Warning Score, are population specific. Ground transport scales were considered. However, as with hospital rapid response tools, they are not inclusive of flight or flight physiology factors. Although many of the tools reviewed include individual parameters that we considered relevant, no scale was found that measures the acuity of patients preparing for fixed wing transport with the attempt at predictive prevention of adverse in-flight events.

Rating Scale Development

Our research team, comprised of the medical director, chief flight nurse, and staff flight nurse, identified selected factors from the literature search that increased the risk for adverse medical events or poor outcomes during fixed wing transfers. These factors were used to create a scale in which acuity ratings for both patient and flight factors were assigned on the basis of their perceived severity. We also added empirical factors based on our medical teams' experiences transporting single patients in a pressurized cabin (Table 1). Items obtained from the literature are referenced. A .5 point was assigned for patient factors that carry the potential for instability. These include neurosurgical interventions (eg, intracranial pressure monitor, ventriculostomy, craniotomy, craniectomy, and ventriculoperitoneal shunt), recent cardiac arrest, unset long bone or pelvic fracture, a rescinded do not resuscitate (DNR) order, and age 75 years or older. One point was assigned for patients' medical conditions or treatments requiring more intensive care that were noted upon initiation of patient contact. These include the necessity of a continuous cardiac drip to maintain hemodynamic status, mechanical ventilation, noninvasive positive-pressure ventilation (bilateral positive airway pressure [BiPap]), and suspected or diagnosed brain death. An additional .5 was assigned if the planned flight involved more than 2 technical/fuel stops. The medical team, by consensus, hypothesized that a cumulative score of 2.5 or greater would predict an untoward transport outcome.

Table 1
Acuity Scale Factors

Score 1 Factors	Patient Score	Score .5 Factors	Patient Score
Continuous cardiac drip[5,6]		Neurosurgical intervention	
Mechanical ventilation[5,6]		Recent cardiac arrest[2]	
BiPap		Unset long bone or pelvic fracture[5]	
Suspected or diagnosed brain death		Rescinded DNR	
		Age > 75 years[2]	
		>2 en route technical/fuel stops	
Total			

BiPap = bilateral positive airway pressure; DNR = do not resuscitate.