Critical Care Transport

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ABSTRACT

Critical care transport (CCT) is the segment of the Emergency Medical Services (EMS) system that transports patients who are critically ill or injured. Nearly 1,000 medical helicopters affiliated with over 300 transport programs, hundreds of fixed-wing aircraft, and many, many ground ambulances assisting adult, pediatric and neonatal CCT teams are operating in the United States.[1] This article reviews the history of and indications for CCT, team qualifications, vehicle options, safety, CCT system design, and physician involvement in CCT. It concludes with a brief review of CCT services in Rhode Island.

KEYWORDS: emergency medical services, helicopter, ambulance

INTRODUCTION

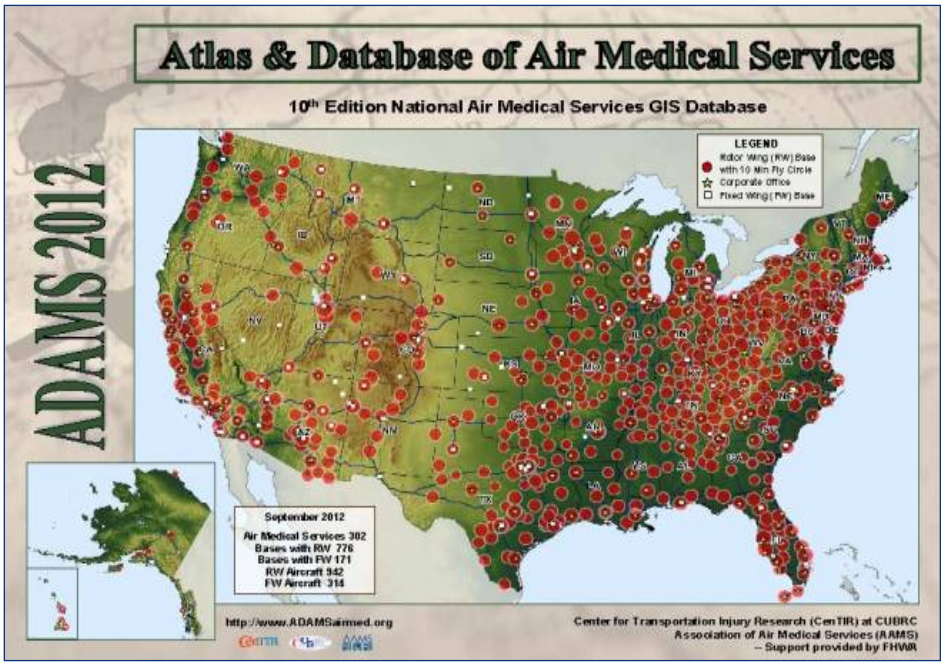
The popular impression of a helicopter ambulance landing on the highway to transport a victim from the crash scene to the trauma center is an inadequate picture of critical care transport (CCT) services. Nearly 1,000 medical helicopters affiliated with over 300 transport programs, hundreds of fixed-wing aircraft, and many, many ground ambulances assisting adult, pediatric and neonatal CCT teams are operating in the United States.[1] (**Figure 1**) Together, these services transport over 550,000 patients annually by aircraft, and an unknown but likely larger number by ground ambulance, including about 68,000 neonates.[2] However, the vast majority of these CCT patients are transported between hospitals, not from the scene of injury or illness to the hospital. A full understanding of critical care transport includes both scene and interhospital transports.

Critical care transport is the segment of the Emergency Medical Services (EMS) system that transports patients who are critically ill or injured. These patients are unstable, or are likely to become unstable, during transport. Specialized staff training, scope of practice, and equipment, often accompanied by purpose-built ambulances (air or ground), facilitate safe CCT operations and account for an equivalent description, specialty care transport (SCT). This article reviews the history of and indications for CCT, team qualifications, vehicle options, safety, CCT system design, and physician involvement in CCT. It concludes with a brief review of CCT services in Rhode Island.

History

The first pediatric hospital in the United States, Children's Hospital of Philadelphia, began operations in 1855, and the first neonatal ICU opened in 1961 at Vanderbilt University.[3]

Figure 1. National View of 15-Minute Rotor Wing Response Areas as of September 2012.



Status as of September 2012. http://www.aams.org/AAMS/Media_Room/ADAMS_Database/aams/MediaRoom/ADAMSDatabase/ADAMS_Database.aspx?hkey=4cccf748-2bc7-4bb9-b41a-c710366c51dc. (Accessed August 20, 2013) The map above shows the locations of Air Medical rotor and fixed wing bases providing emergency response to medical & trauma scenes. The blue circles are 10-minute rotor wing fly circles around each base. These circles represent a nominal 15-minute response area (5 minute for RW launch + 10 minutes flight time). The white squares represent fixed wing bases.

Hospitals and systems dedicated to specialized care of trauma patients first developed in the United States in the 1960s and 1970s.[4] More recently, specialized centers for cardiac, stroke, burn, organ transplantation, and other resource and time-intensive medical problems have developed. This concentration of tertiary care and specialty services at designated hospitals necessitates transport of patients from other hospitals, and argues for direct transport from the scene to specialty centers, bypassing other hospitals in some cases. For patients who meet criteria, direct transport for trauma,[5] ST segment elevation myocardial infarction (STEMI),[6] and stroke patients[7] is advantageous.

Ambulance systems dedicated to delivering patients to these specialty centers from referral hospitals began to appear in the 1970s and 1980s, paralleling the development of many hospital specialty systems. The first civilian hospital-based helicopter program in the US began operations in 1972, modeled after military helicopter medical operations that started in 1944.[8] Rapid growth in the helicopter ambulance segment occurred early, and then again in the 1990s when reimbursement adjustments made for-profit services viable. Many CCT teams use ground ambulances for all transports, and some use both ground and air ambulances.

Due to this combination of increased ambulance service capability and the concentration of specialty medical services at the center of "hub-and-spoke" system models, it became possible to safely transport critically ill and injured patients from outlying facilities and scenes to lifesaving care at these specialty centers. Thus, patients who had been "too sick to transfer" became "too sick to stay" as CCT teams became available.

CCT Team Composition

CCT team composition varies, requiring a blend of EMS, emergency department, and intensive care unit skills and therefore significant training beyond each provider's baseline in most cases. There is general agreement that CCT patients should be attended by a minimum of two providers while a third team member drives or pilots the ambulance. The most common CCT team composition is nurse/paramedic, but nurse/respiratory therapist, paramedic/physician, and other crew compositions exist.

In many cases, particularly where call volume is low (i.e., less than 1 mission every 24 hours), CCT teams are "unit-based," meaning that they are situationally assembled from staff already performing clinical tasks on a patient care unit (typically an ICU or ED), or are on call from home. This provides efficient use of resources, but response time is delayed while team members sign out patient care to their peers or drive to the hospital. In addition, if system volume increases, this model can lead to inefficient staff use and animosity, as CCT team members are often absent from expected unit duties. Other CCT teams are "dedicated," meaning that CCT is their primary assignment. Team members, if located at a hospital or other clinical setting (instead of an airport, fire station, or other non-clinical site), can assist with clinical tasks but avoid assignments that are difficult to leave promptly. Dedicated CCT teams respond rapidly to missions, have time to maintain their vehicles and their own clinical competence while being perceived as extra help in patient care units when the system is managed properly.

CCT Vehicles

Some CCT teams are self-contained; they provide all staff and equipment necessary for patient care, and contract with an ambulance provider or general CCT team to provide an adequate vehicle and support for each mission. Many neonatal and pediatric transport teams, and subspecialty (transplant, stroke, intra-aortic balloon pump, etc.) teams use this system. In other cases, CCT teams use custom-designed air or ground vehicles. Ground CCT vehicles tend to be large ambulances, providing room for multiple providers, centrally-mounted patient cot, significant electrical power for CCT equipment, often via an accessory generator, point-of-care testing equipment, medication refrigerator and fluid warmer, intravenous pumps, ventilator, and other typical equipment. By comparison, most air medical helicopters offer small patient care areas and more limited equipment space, necessitating more patient "packaging" prior to transport.[9]

Location

Many CCT patients have conditions that are both time and level of care critical. Therefore, CCT services should be located where they can provide both rapid and high-quality care. Unfortunately, these can be conflicting requirements. Transport time is reduced if the team is located close to the referral source (scene or hospital), but care quality is best maintained by frequent experience and training, both most often available at the receiving specialty care center. In addition, a single CCT team based at a receiving center would have to be replaced by multiple "satellite" teams to reduce transport time from all geographic directions, increasing system cost and training complexity. An efficient alternative is a combination of centrally located ground (covering the local area) and helicopter air (covering more distant referrals) CCT teams, augmented by 911 EMS systems that include specialty destination protocols and mechanisms to intercept CCT teams while en route to the specialty center when indicated.[10] Unfortunately, there is insufficient regulatory control of CCT providers in the United States to organize such an efficient system. In particular, there is considerable inequity in the distribution of helicopter CCT programs (**Figure 1).**[11] However, there are efforts to accredit CCT programs, primarily by the Commission on Accreditation of Medical Transport Systems[12] and by the Commission on Accreditation of Ambulance Services.[13]

Safety

CCT operations must prioritize patient, provider, and public safety. Safety is enhanced by proper design, restraint of people

and objects inside the ambulance, and careful vehicle operation. Helicopters must meet stringent design and restraint requirements, vehicle maintenance and pilot qualifications, and yet there have been a concerning number of crashes and deaths involving helicopter ambulances.[14] Ground ambulances in the United States are not so vigorously regulated regarding design and equipment / personnel restraint, or driver training, but crashes, although much more frequent, are less likely to cause serious injury or death. Nevertheless, there is significant need for improved ground ambulance design and operational safety.[15] In addition, there is concern that some areas of the country have too many CCT systems, particularly those operating helicopter ambulances, and that these systems are often not utilized properly.[16] In New England, by contrast, appropriate utilization is almost universal.[17]

Indications for CCT

Three decisions guide the use of a CCT team to transport a patient.

1] Does the CCT team vehicle provide unique advantages? For example, helicopter or fixed- wing aircraft, or a custom ground ambulance with bariatric capabilities, may be indicated depending on patient location, weather, or size, regardless of clinical needs.

2] Does the patient need, or potentially need, the specialized capabilities of the CCT team? Patients who are unstable, require significant respiratory support, are receiving multiple intravenous medications, and/or who have a condition that may deteriorate during transport (e.g., acute myocardial infarction, intracranial hemorrhage, gastrointestinal hemorrhage, sepsis) may be best served by a CCT team.

3] Is there a better alternative to the CCT team? For example, in some cases the time necessary for the CCT team to arrive at the referring facility may be prolonged and the referring facility can better serve the patient by sending hospital staff (properly trained and equipped) in a rapidly available local ambulance. In other cases, telemedicine or teleradiology may facilitate consultation and reduce the need for transport. In many areas, there are several CCT systems available. "Shopping" for a CCT system when the weather precludes safe transport (air or ground) is not advised, and a better alternative is local patient stabilization until safe transport is possible.

In summary, CCT is indicated when a patient needs the team's vehicle, crew, or both, and there is no better safe transport alternative.

Physicians and CCT

Physicians interact with CCT services in three ways:

1] Physicians may use CCT services to send or receive a patient. Although specialty dependent, most physicians should be aware of CCT services in their area, the qualifications and capabilities of their crews, and the vehicle types available to them. This familiarity will improve interaction with the CCT system, speed patient transport, and assure compliance with EMTALA and other regulations.

2] Some CCT teams include physicians as crew members. These transport physicians must be aware of the unique circumstances involved in critical care transport, including medical management, vehicle operations and altitude

Figure 2. LifePACT 1 at RIH Anderson Emergency Center.

Figure 3. LifePACT 2 at Hasbro Children's Hospital.

Figure 4. LifePACT 1 & 2 at RIH Anderson Emergency Center.

Figure 6. Rhode Island Congressional delegation dedicates LifePACT 1.

Figure 5. LifePACT 1 interior, with high fidelity simulation manikin and Paramedic Scott Francis.

Figure 7. UMASS LifeFlight and Boston Med Flight helicopters land at Rhode Island Hospital.

physiology (if aircraft are involved), the EMS systems in the operational area, and relevant protocols, regulations, and laws. At Rhode Island Hospital / Hasbro Children's Hospital, senior emergency medicine residents, EMS fellows, and pediatric residents serve as transport physicians aboard LifePACT, the hospital's critical care transport program and the only physician-staffed pediatric and adult CCT program in New England. These transport physicians are supervised by emergency physician or pediatric intensivist medical directors depending on patient age and condition.

3] CCT systems, given their complex and high level of care, require physician oversight. All CCT teams should have a physician medical director who is thoroughly familiar with all aspects of CCT operations, including the topics listed above. In addition, the CCT medical director must be a good leader, be able to facilitate research and quality assurance activities, represent the CCT system as indicated, and have authority to manage system medical operations. The Air Medical Physician Association (www.AMPA.org) and the National Association of EMS Physicians (www.NAEMSP.org) provide significant support and resources for physicians interested in CCT systems, including courses for medical directors and suggested curricula.

CCT in RI

Rhode Island has two critical care transport teams. Women & Infant's Hospital operates a unit-based NICU team, staffed by a neonatologist and a respiratory therapist. They bring a neonatal isolette, patient support equipment, and all necessary medications on ambulances provided by a contracted provider. The W&I NICU team serves an established catchment area around Providence. Rhode Island Hospital / Hasbro Children's Hospital operates LifePACT (mentioned briefly above), a dedicated pediatric and adult critical care transport team. LifePACT has two custom ambulances staffed by specially trained paramedics, nurses, physicians, and respiratory therapists as indicated. (**Figures 2-6**) The LifePACT team members are dedicated to transport duty 24/7/365, and between missions they inventory equipment, maintain competency, perform quality assurance and training functions,

and support Express Care (transfer and access center) and the RIH MedCom Center (paramedic-staffed EMS communications center). LifePACT serves all hospitals in Rhode Island, and surrounding areas in Connecticut and Massachusetts as requested, transporting an average of 4 patients every day. Three helicopter CCT services (Hartford LifeStar, UMASS Memorial LifeFlight, and Boston MedFlight) border Rhode Island, and provide support when requested by Rhode Island EMS agencies and hospitals. (**Figure 7**)

SUMMARY

Critical Care Transport (CCT) is an important part of the health care system, safely providing the ability to move critically ill or injured unstable patients between hospitals (and occasionally from the incident scene to an appropriate hospital). While there are hundreds of CCT programs in the United States, operating nearly 1,000 medical helicopters and many other specialized ground and air ambulances, there are only 2 CCT services based in Rhode Island, one providing neonatal transport, and the other pediatric and adult transport. There is no helicopter CCT program based in Rhode Island.

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