In December 2006, a Bell 412SP EMS helicopter was destroyed and the pilot and two medical crewmembers on board perished when the aircraft impacted the side of a ridgeline during conditions of darkness and reduced visibility due to fog. They had just delivered a patient to a hospital in central California and were returning to their base through a narrow mountain pass when the accident occurred. The details of the accident investigation are available on the National Transportation Safety Board (NTSB) website at http://www.ntsb.gov/ntsb/query.asp (enter LAX07FA056 as the accident number).

This accident had an unfortunate similarity to too many other helicopter EMS (HEMS) accidents that have occurred in the U.S. across the years. Many of these controlled flight into terrain (CFIT) accidents appear to be the result of a pilot who elected to attempt to continue flight under visual flight rules (VFR) into conditions of reduced visibility that were below the minimums established by aviation regulations and by the policies of the organization providing the air medical service. We are also forced to deduce that the medical crewmembers on board were uncaring, unwilling, unempowered, or simply unable to dissuade the pilot from continuing flight into the deteriorating conditions.

A careful examination of NTSB accident investigation reports suggests that there is no clear profile for HEMS pilots who have been involved in CFIT accidents. These pilots include many highly experienced and respected pilots, as well as a sprinkling of less experienced pilots with fewer total flight hours. The reports suggest that there is a need for shared agreement and joint responsibility for all air medical crewmembers regarding the limits when operating in adverse weather and night conditions, as well as in other circumstances of elevated risk that may be encountered during HEMS flight operations. This need forms the basis for an increased emphasis on the importance of training medical crewmembers to be vigilant and assertive in reacting to circumstances when conditions encountered in flight do not meet the standards established for the program.

On April 14 of this year, I had the pleasure of traveling to Hannover, Germany, to present an air medical crew resource management (ACRM) training seminar to the staff of Christoph Life, an air medical training simulator at the St. Johns Rescue Academy (Figure 1). It was supposed to have been a 4-day whirlwind visit: 2 days of travel, 2 days for instruction, along with a few stolen hours for sightseeing and for my hosts to provide me with an overview of their air medical transport system and their innovative training facility. At the risk of seeming insensitive to the serious personal and financial consequences of the Icelandic volcano, I considered

HEMS Simulator Training for Safety and Clinical Proficiency

William T. Winn, MA

Photo courtesy of the St. Johns Rescue Academy
it fortunate that I was forced to stay over an additional 3 days while all airports in Germany were closed.

ACRM is the label that the European air medical transport community has placed on what we in the US call AMRM (commonly pronounced “am-ram”) or air medical resource management. Both terms refer to the specialized training that enables air medical crewmembers to communicate effectively and to coordinate their distinct roles and responsibilities as pilots or medical caregivers in a manner that ensures the coordination and teamwork required to manage any in-flight situation, whether routine or emergent.

There were two reasons that the air medical community felt compelled to adopt the new terms to replace the more generic tag crew resource management (CRM). First, there were frequent reminders from the US Federal Aviation Administration (FAA) that our medical crewmembers are not crewmembers in accordance with federal aviation regulations. FAR Part 65 specifies the requirements for certification for aircrew members other than pilots and flight engineers and applies to persons such as dispatchers, air traffic controllers, and even parachute riggers. The FAA neither evaluates nor certifies our medical caregivers, ergo they are not crewmembers at all. But I know better than that, and you probably do, too, so I will continue to refer to them as crewmembers in this article.

The second reason for a special label for CRM for air medical crews is to emphasize the unique demands for structured communication and coordination placed on medical aircrew members, particularly on helicopter crewmembers. Apart from actual military combat operations, it is difficult to identify any other civil aviation operation that is routinely expected to be airborne within minutes of receiving a flight request. Rescue helicopters are often in the air and headed in the general direction of their destination even before they know exactly where they are going. In addition, it is not at all uncommon for the pilot and crew to have no specific knowledge of the suitability of the intended landing area until they arrive and perform their own reconnaissance before landing. All this is further complicated by the unique pressures to fly in marginal weather conditions and with a crew that may be feeling fatigued at the end of a long and busy 12- or 24-hour shift.

Although there are notable exceptions (such as in Canada), the majority of air medical providers perform single-pilot operations during which properly trained medical crewmembers can and should provide vital assistance to the pilot in identifying and avoiding conflict with other air traffic while en route and in remaining clear of obstacles during landing and take-off in primitive areas. ACRM provides pilots and medical crewmembers with a set of shared expectations and a shared model of each person’s roles and responsibilities for each flight. It should also provide a standardized terminology to use when communicating critical information.

The discussions that we held in Hannover constituted an ACRM Train-the-Trainer course presented to the lead physician and the most senior and experienced paramedics associated with the newest addition to the St. Johns Rescue training academy. They, in turn, will serve as ACRM instructors for air medical crewmembers who receive training at Christoph Life. They are also part of the transport team of Christoph-4, the EC-135 air ambulance stationed at the Hannover University Hospital.

The training environment at the academy uses a BK-117 fuselage mounted on a customized motion platform (shown at the beginning of the article), which provides realistic noise, motion, and vibration for the crew on board the simulator. The interior of the aircraft is configured and equipped similar to the EC-135 helicopters located at many of the Christoph bases.

In order to integrate realistic training and evaluation of essential medical protocols, a selection of METI simulators is provided to serve as adult, pediatric, or infant patients. These high-tech manikins present the students with realistic human vital signs and respond appropriately to the medical protocols they perform. The whole process is controlled and monitored by instructors in a control room adjacent to the simulator (Figure 2).

In preparation for a simulator session, the entire flight is pre-flown and recorded using Microsoft Flight Simulator software. Flight data are then fed to the simulator during the
training session where each previously recorded maneuver will be translated into motion by the 2-axis motion platform.

The flight segment from the helicopter base to the patient’s location typically is shortened (approximately 3 minutes) and might be used by the students to discuss any patient condition information that was provided in advance, if any.

After landing, the simulation goes into the real-time mode. The crew disembarks and may find the patient waiting in a nearby ambulance (Figure 3) or on the floor to simulate a primitive landing zone with limited or no access for surface vehicles. Also adjacent to the simulator are realistic mock-ups of other typical accident scenarios, including sets for a traffic accident, construction worksite, residential accident, fire, or drowning. After performing a brief assessment of the patient’s status (which is controlled by the instructor in the control room), the crew may perform any protocols required to medically stabilize the patient before loading and for the duration of the flight to the hospital.

During the return flight with the patient, the crew monitors the patient’s vital signs and performs additional treatments or administers drugs as indicated. This phase of the simulation may be quite routine or quite demanding, at the discretion of the instructor in the control room. If the intent of the current simulation is to have the team perform more advanced or aggressive treatments, this will be indicated by changes in the METI simulator’s status. If the instructor is feeling particularly bored or whimsical on any given day, the ensuing activity may provide some entertaining video for the post-mission review.

Within the control room, an array of video monitors displays what is seen and recorded by four cameras mounted in the simulator cabin. Other monitors display the status of the METI simulator and record the dynamic status of the patient. A slightly larger monitor at one end of the array displays the aircraft flight data.

Just outside the entrance to the control room, a very large monitor mirrors the displays within the control room for students who are not directly involved with the current simulation. These students may conduct a running critique of the performance of the crew on board the simulator. In case of a particularly challenging scenario, I suspect bets are made on the odds that the patient will make it to the hospital alive.

Several benefits may derive from conducting air medical crew training in such a realistic environment.

- **Protocols that may be routine** in a stable terrestrial environment can become problematic in the cramped, noisy, and unstable environment of a small aircraft. Practicing protocols in a simulator can help them become routine there also.

- **Protocols that require a high degree of teamwork**, such as inserting a chest drain or performing a rapid sequence intubation, will benefit from practice in this more demanding environment.

- **An important subtask** for air medical crews is the rapid transfer and “packaging” of a patient in preparation for loading and transport on the aircraft. The Christoph Life simulator facility also provides opportunities to refine these tasks.

- **“What-if?” scenarios.** Murphy’s Law states that, if it is possible for something to go wrong, sooner or later it will. In a simulator environment, a large variety of malfunctions or other adverse events can be presented and handled without any risk to crew or patient. This kind of practice should result in better response and more nimble decision making in the case of an actual event for students who have received this kind of training.

- **ACRM.** Among the important keys to the prevention of human-error accidents in air medical transport are awareness, vigilance, communication, and teamwork. These principles are included in the training provided at Christoph Life, both in the classroom and during simulator sessions.
Models of Air Medical Programs

The importance of training to ensure a high level of teamwork for HEMS providers may also depend on the program’s organizational model. The structure of HEMS flight programs ranges from organizations where every member of the team works for the same agency to programs where personnel for each distinct role comes from a separate entity. Other models are structured between these extremes. Good examples of successful HEMS providers at opposite ends of this spectrum are the hospital-based Life Flight program that I work for in Utah and the crewmembers of Christoph-4, whom I visited in Hannover. In my program, all players in the system are employed by the same company. In Hannover, the system that supports the services provided by Christoph-4 includes personnel and resources from 5 different agencies. These two models are illustrated in Figure 4.

Since the goal of ACRM/AMRM training is to create unity, synergy, and a shared mental model for all aspects of air medical operations, we might be tempted to suspect that the challenge would be much greater for the flight teams in Germany. In a study published in 1990 comparing HEMS accident rates in the US and the Federal Republic of Germany, there was no significant difference between the two systems. In fact, the rate for fatal accidents was slightly lower in Germany. The study also showed that the accident rates for HEMS operations in both countries were significantly higher than the rate for non-HEMS air taxi helicopter operations. The unavoidable fact is that medical helicopters operate in an environment that is more hazardous than other helicopter operations, with the possible exception of aerial application (crop dusting).

ACRM/AMRM training is a necessary element in recognizing and mitigating this increased risk. When HEMS crews are properly trained and committed to the principles taught in this training, the accident rates for HEMS operations will decline toward the goal of zero preventable accidents that we all seek.

On one of the days in Hannover that I enjoyed while the airports were closed, one of my hosts, Justin Bender, drove me through the countryside to the Federal Police air base and aircraft maintenance facility that supports Christoph-4. I was introduced to Dietmar, the commander of the 16 Federal Police pilots who rotate duty shifts on the EC 135 helicopter. I asked Dietmar how well the pilots, medics, and physicians got along during the performance of their responsibilities. He responded that they got along quite well. When I suggested that perhaps some combinations of personnel got along better than others, he laughed and replied, “I could tell you some stories.” After 14 years of working as a pilot in close association with nurses, paramedics, physicians, and other pilots, I could tell a few stories about headbutting, too.

Teamwork and a shared vision of operational safety are key ingredients for change. As members of their respective fields, aviators and medical professionals both have more than their share of Type-A personalities. A few may need assertiveness training; most don’t. What I sensed in the few days while I visited with members of the Christoph Life team was the same sense of family that I enjoy in my own organization and that I have felt from other members of the nationwide and international air medical community that I have had the opportunity to visit and to work with in recent years.

The implementation of new technology or a new teaching tool such as the HEMS simulator in Hannover is not an end of itself. It is the way that creative and dedicated men and women will continuously adapt the tool to meet the dynamic needs of their mission that provides the real potential for continuous improvement in clinical proficiency and operational safety.

Reference


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