Critical Care Transport Time Differences Between Ground, Helicopter VFR, and Helicopter IFR Transports

Tovy H. Kamine; Leah Thomas; Collin Davis; Jason Cohen

BACKGROUND: In helicopter critical care and emergency medical services (HEMS) transportation, organizations aim for efficiency of the dispatch process. Most HEMS organizations do not provide transport under instrument flight rules (IFR), due to equipment and training cost. Boston MedFlight (BMF) provides IFR HEMS transport. We set out to determine if response time of IFR transport was superior to ground transport.

METHODS: A retrospective analysis of quality improvement data was performed. Data was collected by two observers sitting in the BMF control room in varying shifts. A process map of the dispatch process, from the dispatch call to the vehicle en route was developed. Critical points in the dispatch process were determined and a variety of time differences to determine the length of processes in the dispatch calculated. We compared median time differences between visual flight rules (VFR) flight and IFR flight, between IFR flight and ground transport, and between VFR and Ground for these points using a Mann-Whitney *U*-test.

RESULTS: During the study collection period, 443 transports occurred, of which 109 transports happened while the observers were present: 37 ground, 57 VFR, and 15 IFR. Due to weather, six IFR transports were declined. The overall time from dispatch call to vehicle en route was significantly increased for IFR flights [median: 30 min:8 s (interquartile range 19:06–49:04)] over both VFR flights [11:36 (9:24–17:06); *P* vs. IFR: 0.001] and ground transports [9:39 (6:59–14.51); *P* vs. IFR: 0.001]. Most of this increase was accounted for by increases in the time from dispatch to crew acceptance, and from rotor start to vehicle en route.

DISCUSSION: IFR conditions resulted in significantly increased dispatch times over both VFR flight and ground transport. The increase is likely a result of weather check, filing an IFR flight plan, and IFR release. Dispatch algorithms should be adjusted for this time delay of IFR transports.

KEYWORDS: helicopter emergency medical services transport, critical care transport, instrument flight rules.

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In the care of critically ill patients, transport time can affect the patient's outcome. However, when a request for critical care transport arrives, critical care transport services must weigh multiple factors before deciding to transport by ground or air. Helicopter emergency medical services (HEMS) can transport patients faster than ground transportation, leading to a 13% overall reduction in mortality when compared to ground-transported patients.[6] Traumatic brain injured patients, in particular, have been associated with significantly increased survival in patients transported by helicopter compared to ground.[2] However, air transport is not always the better option for patients. One study of nearly 8000 ground transportations and 1075 helicopter transportations found ground ambulances to provide the fastest transportation from the call to hospital arrival when the distance to the hospital was less than 10 mi. Beyond 10 mi, helicopter transportation was faster.[4]

One particular instance when helicopter transport is more complicated is during bad weather or instrument meteorological conditions (IMC). In order to safely fly into IMC, both the helicopter and the pilot must be rated to fly under instrument

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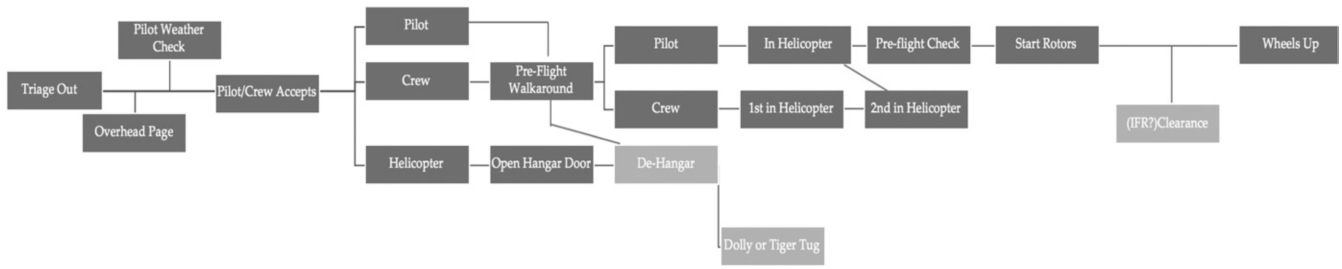

Fig. 1. Rotor process map.

flight rules (IFR). Though IFR-capable helicopter programs are less likely to be involved in mishaps than programs without IFR capability,[7] due to the significant requirements for helicopters to fly under IFR,[1,5,9] only a small portion of HEMS services fly under IFR.[9] Indeed, it has been reported that up to 24% of HEMS flights are missed because of IMC.[8]

Boston Medflight (BMF) is the nonprofit organization that provides critical care transport primarily to the Boston area and southwest New England via both HEMS and ground transport. All its pilots and its aircraft are IFR equipped.[3] Because BMF flies under both visual flight rules (VFR) and IFR and performs critical care ground transport, we set out to determine the effect of IFR transports on the dispatch process and, in particular, the amount of time required to dispatch IFR transports.

METHODS

Times of various parts of the dispatch process were collected as part of a quality improvement project at Boston MedFlight's bases in Bedford, Plymouth, Lawrence, and Mansfield, MA, from July–August 2018. These data were all deidentified when collected, as only the last two digits of the run number were collected to collate the data. Communications were conducted by radio, telephone, and pages. We conducted a retrospective analysis of this previously collected quality improvement data. As this was a quality improvement project with no identifiable data collected, IRB approval was not required.

In the first phase of the data collection, observation was conducted over a period of 1 wk to develop process maps for rotary and ground calls by two observers. After the process maps were developed, the two observers sat in the dispatch center for Boston Medflight in varying shifts to collect data from all times of day. While there, they recorded times for the various nodes on the process map using a Google Form. Run numbers were recorded to compare our time and data collection to the call documents from the communications center to ensure internal validity of our instrument.

Time points in the call process included: call in, dispatch takes, vehicle triage out, vehicle triage back, dispatch hangs up, vehicle en route, and call cancelled. Time points in the rotor process included: call goes out, pilot accepts, hangar starts opening, helicopter is outside, first crew enters helicopter, rotor starts, pilot closes door, and wheels up (en route) (**Fig. 1**). Time points in the ground process included: call goes out, crew accepts, drug crew enters truck, equipment crew enters truck, driver in truck, and truck leaves (en route) (**Fig. 2**).

We evaluated the overall time from dispatch call to en route for rotor IFR, rotor VFR, and ground transport. We then evaluated the time from dispatch call to pilot acceptance for ground, rotor IFR, and rotor VFR and from rotor start to en route, as these on preliminary analysis were the areas most affected in IFR transports. The data was found to not be normally distributed. As such, data comparisons were performed using a Mann Whitney *U*-test. A *P*-value < 0.05 was considered significant.

RESULTS

The process maps for rotor and ground transports are displayed in Fig. 1 and Fig. 2, respectively. The process of dispatching a rotor transport is more involved than a ground transport, but both have nodes for call taken, acceptance of call, crew entrance to the vehicle, and en route.

During the study period Boston Medflight dispatched 233 Ground transports, 175 Rotor VFR flights, and 35 Rotor IFR flights. The observers reviewed 109 calls: 37 ground transports, 57 rotor VFR flights, and 15 rotor IFR flights, of which 9 were accepted and 6 declined due to weather. Results of the time comparisons are displayed in **Table I**. For overall time (dispatch

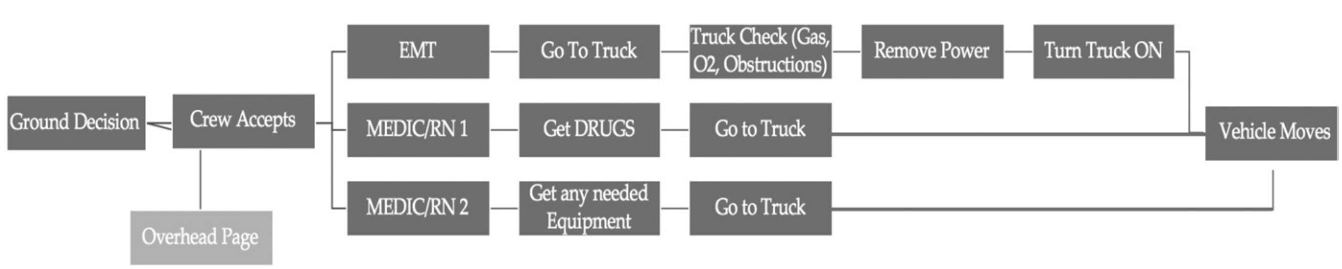

Fig. 2. Ground process map.

Table I. Measured Time Difference (Minutes:Seconds): Medians with Interquartile Ranges.

	TIME RECORDED					
	GROUND TRANSPORT (INTERQUARTILE RANGE)	VFR TRANSPORT (INTERQUARTILE RANGE)	IFR TRANSPORT (INTERQUARTILE RANGE)	*P*-VALUE: VFR vs. GROUND	*P*-VALUE IFR vs. GROUND	*P*-VALUE IFR vs. VFR
Dispatch to en route	9:39 (6:59–14:51)	11:36 (9:24–17:06)	30:08 (19:06–49:04)	0.07	0.001*	0.001*
Dispatch to pilot/crew acceptance	0:15 (0:07–0:23)	0:23 (0:08–1:04)	3:29 (0:57–4:11)	0.002*	0.03	0.05
Rotor start to en route	N/A	3:33 (3:03–4:25)	8:10 (5:16–10:58)	N/A	N/A	0.012

P-values from Mann-Whitney *U*-test.
* Significant *P*-values.

to en route), IFR transport [median: 30 min:8 s (interquartile range 19:06–49:04)] was significantly longer than both VFR [11:36 (9:24–17:06); *P* vs. IFR: 0.001] and ground transport [9:39 (6:59–14.51); *P* vs. IFR: 0.001]. VFR overall time was not significantly longer than ground overall time ($P = 0.07$). For dispatch to pilot/crew acceptance both VFR and IFR transports were significantly longer than ground transport, and IFR transport was significantly longer than VFR transport as well. For rotor start to en route, IFR transport was significantly longer than VFR transport [8:10 (5:16–10:58) vs. 3:33 (3:03–4:25)]. All attempted transports were completed. No accidents occurred during the study period.

DISCUSSION

Our small study on HEMS transports illustrates some of the difficulties with providing HEMS transports in IMC. Though the ability to fly IFR does increase the number of transports that can be undertaken, there are significant increases in the dispatch times for these IFR transports compared to either VFR rotor or ground transports. We also note that there is no difference in the dispatch time for VFR rotor transports as opposed to ground transports, suggesting that dispatching the helicopter, per se, does not increase the dispatch time.

It is not surprising that transport under IFR took longer to dispatch than transport under VFR or Ground. The majority of the increased time for IFR flights is accounted for by the dispatch call to pilot acceptance and from rotor start to wheels up. These times are likely prolonged because of the need to perform a weather check and file an IFR flight plan, and then the need for IFR release from the tower, which may be delayed to allow appropriate spacing between IFR aircraft. Unfortunately, as weather is an uncontrollable aspect of flying and strict safety standards are in place from the Federal Aviation Administration, there does not seem to be an obvious solution to reducing this time increase. Though there are many factors that affect a patient's outcome, it is possible that the extra time for IFR transportation may make a difference in their outcome. The increased time for IFR transports as compared to VFR transports should be accounted for in the triage algorithm in any HEMS service that flies under IFR.

Despite the increase in time for IFR transports, we also showed that the ability to fly IFR, while not allowing for every transport call to be dispatched by air, does allow for a decrease in the number of declined transports. Excluding IFR transports, BMF would have been able to accept only 79% of transports, in line with the previous literature.[8] However, the ability to fly IFR increased this acceptance percentage to 92%.

Our study is limited by the single center nature and the small number of overall transports we reviewed. This small size and single center nature may limit the broader interpretation of our data. However, despite the small nature, we did show that dispatches for IFR transports were significantly longer than for either ground or VFR transports. It is possible, however, that this is a localized phenomenon, either to Boston Medflight or to the Boston Air Route Traffic Control Center that controls IFR flights in this area. In addition, there is a risk of selection bias since we captured 33% of rotor VFR flights, 43% of rotor IFR flights, and 16% of ground transports. We attempted to catch a wide variety of transports by having the observers collect data at varying times of day over multiple days in order to mitigate this risk, but we did not obtain an equal sample of transports of the three modalities. Unfortunately, since this was a retrospective analysis of quality improvement data, we are unable to fix this sampling error. To our knowledge, however, ours is the first study to investigate the effects of IFR transport on dispatch times. This is an important consideration for HEMS programs in deciding whether to invest in an IFR program, though perhaps not as important as the potential safety benefits from IFR equipped flight,[7] which we did not investigate in this study.

The clinical utility of our study is limited to those HEMS services that either conduct IFR flights or are considering conducting IFR flights. This significant increase in the dispatch time for IFR flights should be accounted for in the routing and dispatch algorithm for these HEMS services. Routing based on flight distance/time vs. ground distance/time alone may underestimate the time required in IMC and may lead to a delay of care for a critically ill patient.

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