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Original Research

Is Helicopter Really Faster Than Ambulance? The Padua Helicopter Emergency Medical Services Station Experience

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A B S T R A C T

Objective: Helicopter transport plays a fundamental role in modern health systems, and, yet, it is not been the focus of scientific research, especially in Italy. Our objective was to analyze Padua helicopter emergency medical services (HEMS) station operations to discover whether this resource has been used correctly and advantageously.
Methods: The study was conducted considering 115 helicopter air ambulance operations minutes in 2018. Additionally, using geographic information systems and estimated ambulance data, a comparison was drawn between air and ground emergency medical services.
Results: Interfacility transports involved mainly adults. There were 65 (56.52%) “acute transports,” 49 (42.61%) “back transports,” and 1 “hyperspecialized care transport” (0.87%). The average route distance was 44.23 km; the modal class was 25 to 30 km. The average mission time was 1 hour 26 minutes; the modal class was 1 hour to 1 hour 15 minutes. The Pearson correlation coefficient between flying/traveling time and the route length was 0.92 for helicopter and 0.94 for ambulance, and between mission time and route length, it was 0.05 for helicopter and 0.94 for ambulance.
Conclusion: Helicopters are not always the fastest mode of transporting patients, and journey time is variable. Because of the importance of rapid response in emergency situations, we propose not to use helicopters for transports less than 50 km in distance.

Helicopter emergency medical service (HEMS) was meant to be integrated within the already existing emergency medical service. It spread in Italy in the 80s, but even now the situation is not homogeneous, and an exhaustive literature search is still missing.[1-4] In Italy in June 2019, according to official region and autonomous province websites, there were 52 HEMS stations managed by related 118 operation centers in adherence with national and regional laws.[1,3,5]

In this study, we focused on the experience of Padua HEMS station, 1 of the 4 HEMS stations located in the Veneto region. The station has been operational since 2000, covers an area of approximately 393,000 km^2 in central-southern Veneto, and performs HEMS and helicopter air ambulance (HAA) flight operations.[6] The operating team, as in the majority of HEMS stations in Italy, is composed of a physician (anaesthesiologist-intensivist), a critical care nurse, and the flight crew (pilot and an aeronautic technician).[3] The helicopter in use is an AgustaWestland AW 109S Grand.

Interfacility transport plays a fundamental role in a hospital referral system, which is the situation that is being studied. The service is activated on the basis of clinics and situational criteria and should be considered an option in case of urgency transports (to be carried out within a few hours) and always in case of emergency transports (to be carried out within 30 minutes).[7] The decision to use air transport instead of ground transport to transfer patients between 2 hospitals should contemplate different aspects. In particular, the time needed should be considered because helicopter transport is not always the fastest mode of transport.[8-11] In addition, in recent years, the aim of the medical community has been to promote the correct use of the service to meet an affordable risks/costs/benefits ratio.[12-15]

The aim of this study, the first of its kind in our HEMS station, was to analyze interfacility transfers performed by Padua Urgency and

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Emergency Medical Service (SUEM 118), focusing in particular on routes and flying times. Additionally, using geographic information systems (GIS), a comparison was drawn between air emergency medical service−collected data and estimated ground emergency medical service data to understand if and when there is a correct and advantageous use of this resource.

Methods

This observational retrospective study was approved by the ethics committee. The operative minutes, kept between January 1, 2018 and December 31, 2018, and detailing Padua helicopter medical service operations were analyzed, providing patient data and the following course. Data regarding departure and the destination hospital department and hospital care−level grade (hub or spoke hospital) were collected.

The mission time and flying time were deduced from data provided directly by the operation center. HAA operations were classified into 3 groups: acute transport, back transport, and hyperspecialized care transport. In the first group, transports of patients with acute disease who needed a care-level upgrade, a place in the intensive care unit, or were transported to a spoke hospital to receive treatment in order not to overload the hub center were included. The second group, back transport, was composed of already treated patient transports performed to make room in the hub hospital or to transfer patients to rehabilitation centers. In the last group, hyperspecialized care transport, transports performed to give patients specific care in specialized centers were included.

Helicopter route data elaboration was performed with GIS (using QGIS software) by the University of Udine Geomatic Laboratory, Udine, Italy. Hospitals were considered the departure and arrival locations.

Regarding ground emergency medical service, the travel time and route length estimation were performed with Google Maps (Google, Mountain View, CA), considering the usual ambulance route and date and time of the transport. Statistical data analysis was descriptive.

Results

Between January 1, 2018, and December 31, 2018, Padua air medical service was activated 578 times, 77.51% (448) for HEMS operations and 22.49% (130) for HAA operations. In terms of HAA operations, they all were completed.

Regarding the 130 transports performed in 2018, 88.46% (115) were eligible for the study; 52.31% of patients were males, 37.69% were females, and 10.00% lacked personal data. Interfacility transports involved adults in 80.77% of the transports and pediatric patients in 6.92% of the transports; 12.31% were lacking data. The age cutoff was set at 14 years old.

Sixty-five (56.52%) transports were described as acute transports and 49 (42.61%) as back transports; there was only 1 case (0.87%) of a patient transferred to receive hyperspecialized care. All of the patients were affected by a severe morbid state or had compromised vital functions.

GIS elaboration data permitted us to analyze helicopter transfer routes (Fig. 1). The frequency distribution of the helicopter route length is depicted in Figure 2; every class is 5 km wide (left-open and right-closed). The average route distance was 44.23 km; the shortest was 15.99 km, and the longest was 209.95 km (the only transport longer than 150 km in Fig. 2). The modal class was 25 to 30 km. Despite the fact that distribution reached values higher than 100 km, HAA flights were used mainly between 25 and 40 km (58.26% of the transports).

Regarding mission times, we focused on 2 specific time-lapses: flying time and mission time. Flying time was defined as the time between takeoff and landing, and mission time was the time between operation center alert and patient arrival at the hospital.

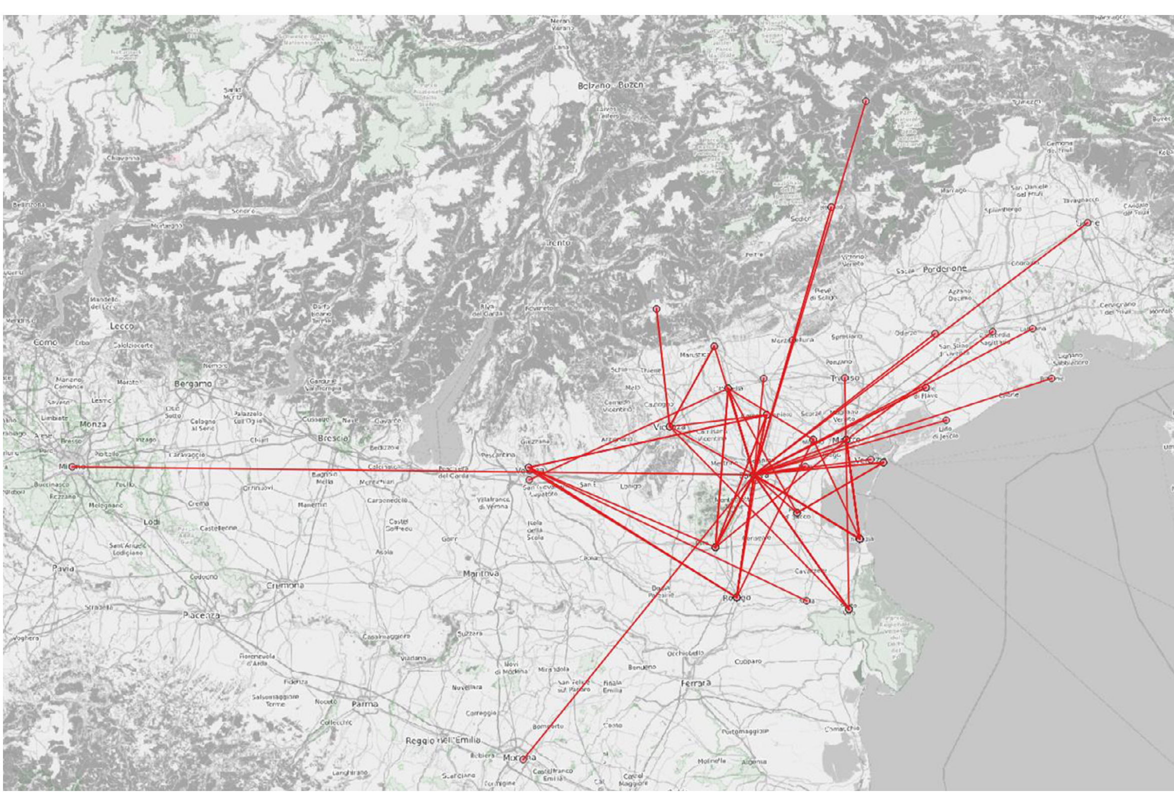

Figure 1. The helicopter air ambulance flight operation routes. Elaboration on OpenStreetMap map. (© OpenStreetMap contributors. https://www.openstreetmap.org/copyright)

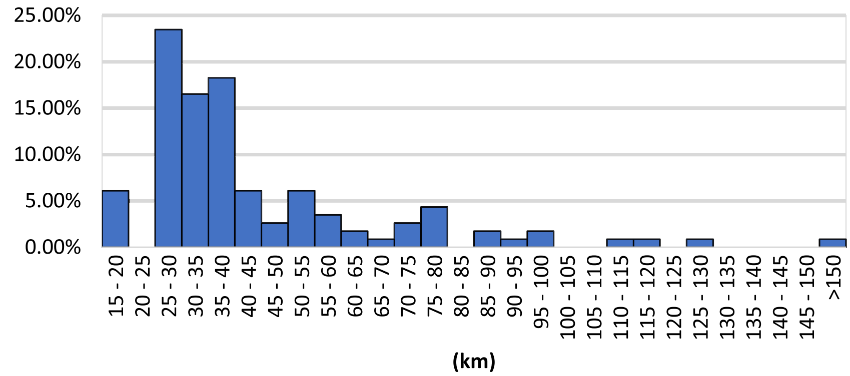

Figure 2. The frequency distribution of the helicopter route length. Every class is 5 km wide (left-open and right-closed).

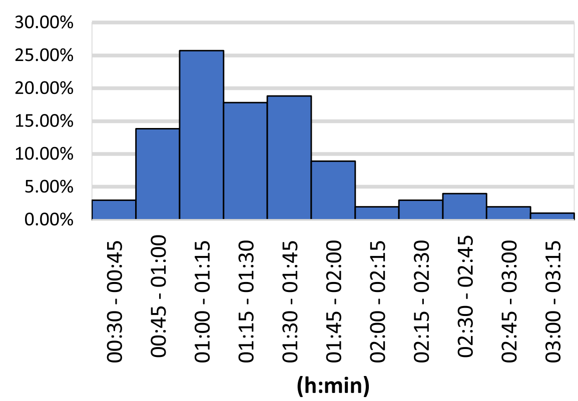

Figure 3. The frequency distribution of the helicopter mission time. Every class is 15 minutes wide (left-open and right-closed).

The frequency distribution of helicopter mission times is represented in Figure 3; every class is 15 minutes wide (left-open and right-closed). The average time was 1 hour 26 minutes. The shortest time was 36 minutes, and the longest was 3 hours 36 minutes; 85.15% of the operations lasted between 45 minutes and 2 hours. The modal class was 1 hour to 1 hour 15 minutes.

Distance and time data were plotted on a scattergraph to make a comparison. In Figure 4, helicopter flying time (orange) and estimated ambulance traveling time (blue) as a function of route length were plotted. The Pearson correlation coefficient between the 2 variables was 0.92 for helicopter and 0.94 for ambulance.

In Figure 5, helicopter mission time (orange) and estimated ambulance mission time (blue) as a function of route length were plotted. The Pearson correlation coefficient between the 2 variables was 0.05 for air transport and 0.94 for ground transport.

Discussion

In 56.52% of cases, interfacility transports concerned patients with urgent and emergent pathologies whose need for treatment was acute, and, in 42.61% of the cases, they were used for back transport due to clinic, logistic, and managing reasons. The transport of patients with acute pathologies and their consecutive transfer toward a spoke hospital play a fundamental role in a referral hospital system; on the one hand, it ensures access to specialized care, and, on the other hand, it prevents the overload of hub centers.[7]

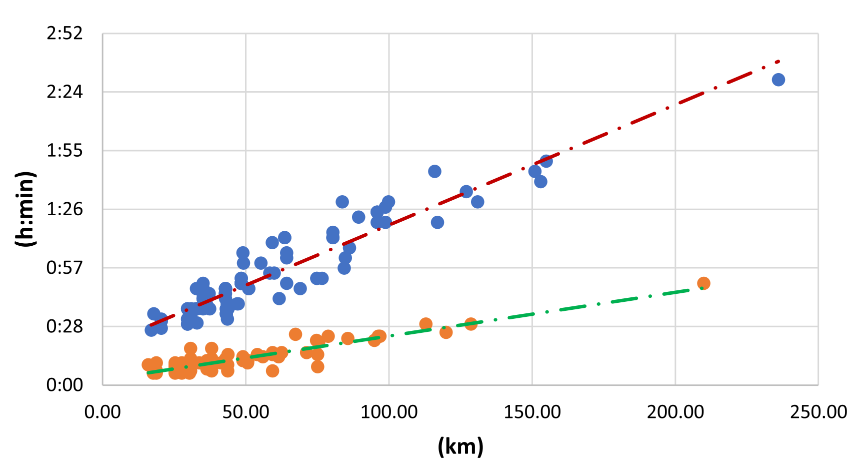

Figure 4. The helicopter flying time (orange) and the estimated ambulance traveling time (blue) as a function of route length with respective trend lines.

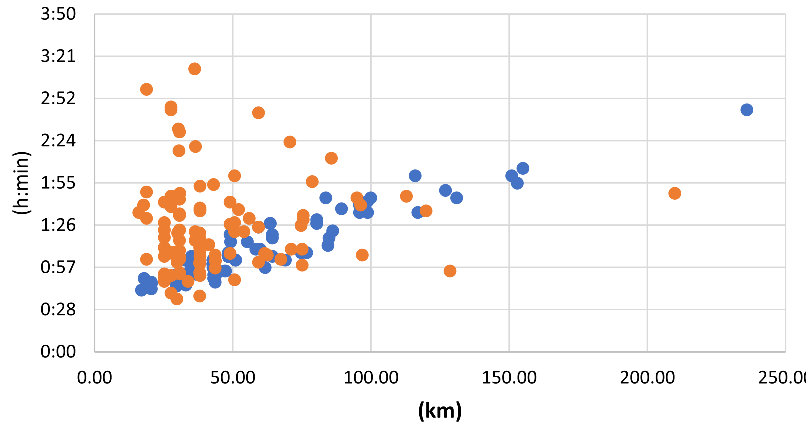

Figure 5. The helicopter mission time (orange) and the estimated ambulance mission time (blue) as a function of route length.

Patient transport is the prerogative of SUEM 118 only if the helicopter is needed or in case of specific, but not ordinary, agreements between hospitals. Helicopter use, practicable only if activation criteria are satisfied, is an opportunity only for urgency and emergency transports.[7] The decision to use or not to use a helicopter for transports should also consider patient condition, pathology, costs, the need of the helicopter for another mission, and ultimately the time gained flying rather than driving.[9,16]

In our experience, HAA regards patients with a severe condition or compromised vital functions. In adherence to regional laws, the care level needed during transfers depends on organizational details and the patient's clinical condition. In cases of patients with critical conditions, the presence on board of a doctor and not only a nurse is needed. An anesthesiologist-intensivist physician or an emergency one is always required if the patient has unstable vital signs or needs intensive care.[7] This highly specialized level of care could be assured during transport both on board of a helicopter or an ambulance. The HAA operations analysis performed in this study focused mainly on 2 elements: space and time.

Regarding distance, 58.26% of the interventions performed by the Padua HEMS team in 2018 were between 25 and 40 km. Several authors have tried to set a kilometric cutoff for helicopter use, but there is no consensus, and values spread from 30 to 100 km.[9,16-18] However, these studies consider very different contexts (eg, highly urbanized spaces like in South Korea or those with long distances between hospitals as in Norway).[17,18] For these reasons, they have not been considered a suitable comparison with our data.

Although distance is an integral part of deciding whether to use or not to use a helicopter, time does not play a secondary role. Considering the graphic with flying time over route length (Fig. 4), the helicopter Pearson correlation coefficient between the 2 variables was 0.92. Time and length are related, approximately positively and linearly. The helicopter (with a cruise speed of about 300 km/h for the aircraft used in Padua) travels almost at constant speed and in a straight line. The estimated ambulance traveling times have been always longer than detected helicopter flying times.

Air transport is quicker than ground transport if we consider exclusively traveling and flying time. In Figure 5, in which we plotted mission times (ie, the total time the helicopter was used) as a function of distance, the situation is clearly different. Values are scattered, and, for the same distance, mission times have various values. In this case, the helicopter Pearson correlation coefficient had a value of 0.05. Considering all these elements, the total mission and route length time seem not to be related, and other factors play a role.

Helicopter transport, in terms of the total mission time, is not always the fastest way to move a patient (a fact that is supported by medical literature on the subject).[8-10] An HAA mission consists of different phases, each of them with a specific duration.[8] After the operation center alert, there is the dispatch time to activate the service followed by the time to reach the departure hospital. The patient should be prepared suitably for air transport and, on arriving at the hospital, should be discharged from the rotorcraft and brought to the proper department.[8] Additionally, preparing a patient for the flight requires more procedures than for ground transport.[8,9] For example, in our experience, helicopter and ambulance barrels are not the same. Takeoff and landing are longer than the time required to start and turn off an ambulance engine.[9] In addition, helipads are usually located on hospital roofs (or on buildings close to them), whereas emergency rooms have a direct access for ambulances.[9] This may result in longer operations for air transports.

All of these steps extend the duration of the mission, and delays or accidents could also affect the total mission time. On the other hand, the flying time only marginally affects the transport duration. When it comes to the estimated ground transport times, the Pearson correlation coefficient was 0.94, and the values overlapped the lower part of the helicopter mission time distribution.

This is undoubtedly also because the data are hypothetical, not experimentally observed, and any delays or unexpected events have been not considered. Investigation of these data should take this background into consideration. On the other hand, it is important to notice that during ground transport, operations are quicker with fewer steps. There are less factors that could influence the total transport time, such as there is no transfer between 2 vehicles, a change of barrel, or the participation of a third institution such as SUEM 118 (helicopter medical transport in the Veneto region is performed by SUEM 118, whereas interfacility ground transport is managed directly by each hospital).[7,9,10]

Limitations

One of the study's main problems was the accuracy of the data in the minutes. The minutes were compiled by different physicians, often in emergency situations. In such situations, it is not always possible to carry out correct identification of the patient. Ground transport data, unlike that of the helicopter, have been estimated. This gives only an idea of ambulance transfers and does not claim to be a full representation of the real state of the service.

Conclusion

Helicopter medical service shows itself as a significant and integrated element in the emergency medical service in the Padua SUEM 118 operation area in the Veneto region. It has a role in this referral hospital system, both in upgrading and downgrading care level. In deciding whether to use or not to use a helicopter for HAA operations instead of ground transport, the real benefit to the patient should be evaluated. It is important to consider that helicopter intervention is not always the fastest mode of transportation, and journey time is variable. Looking at our data, we suggest not to use a helicopter for transports shorter than 50 km, especially if they are not defined as "acute."

The use of a rotorcraft without an effective advantage in time or in the absence of logistic requirements on one hand deprives patient of the fastest way of transport (often in time-dependent situations), and on the other hand, it deprives SUEM 118 of an important resource in prehospital rescue and care. In addition, it could place the HEMS team and patient at risk without a real advantage.[19] To our knowledge, this is the first study on this topic. Further research should be conducted on real and experimentally detected ground times.

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