Original Article

The Characteristics of Aeromedical Transport Missions at Bangkok Hospital, Thailand

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OBJECTIVE: Increasing numbers of foreign tourists, expatriates, and patients seeking medical care in Thailand have resulted in a significant increase in aeromedical transport activity, both evacuation and repatriation over the past decade. However, there is little epidemiological data currently available on the diagnoses, costs and transport characteristics in Thailand and Southeast Asia. We therefore performed a descriptive analysis of evacuation and repatriation cases in order to compare helicopter and fixed-wing transport in various ways such as flight time, distance and economic aspects.

MATERIAL AND METHODS: A retrospective review of medical records of patients in 2011 evacuated or repatriated by the Aviation Medicine Department, Bangkok Hospital. Demographic information, diagnoses, modes of transport, type of aircraft, flight time and financial detail were analyzed.

RESULT: Three hundred and two patients were included in the study, 201 male (66.5 %) and 101 female (33.5%). Patients' ages ranged from 1 day to 105 years, the average age was 50.2 years. (Median 54 years). The top three nationalities of patients were Thai (n = 93, 30.8 %), Myanmar (n = 29, 9.6%) and British (n = 19, 6.3%). The top four diagnoses were Stroke (n = 51, 16.6%), Multiple trauma (n = 41, 13.40%), Acute myocardial infraction (AMI) (n = 30, 9.8%), Cancer (n = 27, 8.9%). Transports were carried out by air ambulance (n = 104, 34%, $202.5/min), helicopter (n = 84, 28%, $87.55/min), scheduled aircraft with regular seating (n = 60, 20%, $9.37/min) and a stretcher in a scheduled aircraft (n = 54, 18% $40.1/min).

CONCLUSION: By comparing the costs per flight time, we showed that a stretcher in a scheduled aircraft is significantly cheaper than an air ambulance. Ideally the most appropriate medical response would be the main criteria when choosing a form of air transportation; however cost-effectiveness is also of considerable importance when selecting from the alternatives available. It is the main role of the physician who is in charge of transport planning to communicate the evaluation of mode of air medical transport.

Thailand is located at the center of the Indochina peninsula in Southeast Asia, bordered to the north by Myanmar and Laos, to the east by Cambodia and to the south by Malaysia. There are many migrants in this region, and the countries have also attracted a number of expatriates from developed countries. In 2007, Thailand had 14.5 million visitors, excluding those from neighboring countries. According to the Tourism Authority of Thailand, 55% of the tourists in 2007 came from the Asia Pacific region. The largest groups of Western tourists come from the United Kingdom, Australia, Germany, the United States and Scandinavia. Medical tourism has become a growing segment of Thailand's tourism and health-care sectors too. When travelers or expatriates become ill or injured, urgent air evacuation to the nearest well equipped medical

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facility is needed, to preserve function and save lives as well as subsequent repatriation to the patient's home country.

Fewer than 0.5% of all travelers actually require medical evacuation.[1] It is estimated that in Thailand thousands of aeromedical evacuation and repatriation are performed annually. The decision-making process surrounding emergency aeromedical transport is based not only on the patient's clinical condition but on many other factors as well.[2] Due to rapid increasing fuel prices over the last decade, the costs of aeromedical transport have increased.[3] Analysis of epidemiological data of aeromedical transportation will support efficacious decision-making of the modes of transport and health care facilities. In a certain subgroup of relatively stable, ventilated patients, transport on commercial airlines offers advantages in terms of cost effectiveness and reduced transport time and acceleration/deceleration trauma as a result of multiple fuel stops.[4] Former literature indicated using helicopters was economically unjustified for transport exceeding 100 miles when an efficient fixed-wing service exists.[5]

Materials and Methods

Data was collected from the Aviation Medicine Center of our tertiary care hospital which operates a helicopter and fixed-wing aeromedical transport service. While handling the data, the regulations of the Ethics Commission of Bangkok Hospital Group were fully respected. Institutional review board approval was obtained, and informed consent was waived. A retrospective electronic medical record review was performed, and the epidemiological data of medical evacuation and repatriation cases were collected from January-December 2011. Data included age, sex, nationality, diagnosis, flight time, mode of transportation, type of aircraft, and cost per flight hour. Data were collected and entered onto a standard spreadsheet format. The median value was calculated.

Results

Patient data

Three hundred and two patients were included in the study, 201 male (66.5 %) and 101 female (33.5%). There were no exclusion criteria. Patient's age ranged from 1 day to 105 years, the average age was 50.2 years (y) (median 54 y). The top five nationality of patients were Thai (n = 93, 30.8 %), Myanmar (n = 29, 9.6%), British (n = 19, 6.3%), German (n = 18, 6%) and Cambodian (n = 16, 5.3%) as shown in Figure 1.

Medical Data

The top five diagnoses were Stroke (n = 51, 16.6%), Multiple trauma (n = 41, 13.40%), Acute MI (n = 30, 9.8%), Cancer (n = 27, 8.9%), and Cerebrocranial trauma (n = 26, 8.6 %) as shown in Table 1 and Figure 2.

The most frequent types of cases were classified according to the following specialties: cardiology (n = 58, 19%), neurology (n = 55, 18%), trauma surgery (n = 41, 14%), orthopedic (n = 32, 11%), cancer (n = 27, 9%) as shown in Figure 3.

Operational Flight Data

The average flight time for air ambulance was 1.1 hours, for helicopter 1.3 hours, for a regular seating 7.36 hours and for a stretcher 4.1 hours respectively, as shown in Figure 4. Most cases of stretcher and regular seat on a commercial flight were repatriation cases and the flight times ranged from 1 hour to 25 hours. All of the helicopter and air ambulance cases were evacuation cases. Most evacuation sites were in Thailand and Indochina countries such as Myanmar and Cambodia.

Mode of transportation

Of the total 302 cases, 209 were evacuation cases (69%) and 93 repatriation cases (31%). Most cases were transported by air ambulance (n = 104, 34 %) but the helicopter (n = 84, 28%), scheduled aircraft with regular seating (n = 60, 20%) and a stretcher in a scheduled aircraft (n = 54, 18%) were also used, as shown in Figure 5.

Type of aircraft

Five different types of aircraft were used in air ambulance cases. The top three were ATR-72 (n = 66, 63.5%), Caravan (n = 12, 11.5%) and Beechjet400 (n = 12, 11.5%) as shown in Figure 6.

Financial Data

The cost per flight minute (min) were calculated for an air ambulance to be $ 202.5/min, for a helicopter $ 87.55/min, for a stretcher in a scheduled aircraft $ 40.1/min, and for a scheduled aircraft with regular seating $ 9.37/min respectively as shown in Table 2 and Figure 7.

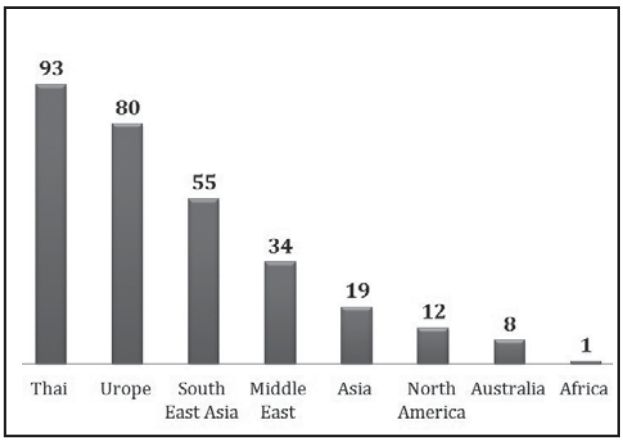

Figure 1: *Nationality of cases*

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Table 1: Diagnosis of transported cases (n = 302)

Diagnosis	n
1. Stroke	51
2. Multiple trauma	41
3. Acute myocardial infarction (AMI)	30
4. Cancer	27
5. Cerebrocranial trauma	26
6. Fracture of lower extremity	14
7. Heart failure	11
8. Sepsis	10
9. Thoraco-Lumbar spine fracture	9
10.Fracture cervical spine	9
11.Pneumonia	8
12.Chronic obstructive pulmonary disease (COPD)	7
13.Coronary artery disease (CAD)	7
14.Acute respiratory distress syndrome (ARDS)	6
15.Post arrest	6
16.Liver failure	6

Diagnosis	n
17.Renal failure	5
18.Abdominal aortic aneurysm (AAA)	4
19.Epilepsy	4
20.Pulmonary embolism	3
21.Psychosis	3
22.Appendicitis	2
23.Acute pancreatitis	2
24.Gut obstruction	2
25.Burn	2
26.GI Bleed	1
27.Tetanus	1
28.Liver abscess	1
29.Thyroid toxicosis	1
30.Anal abscess	1
31.Acute cholecystitis	1
32.Bleeding per vagina	1

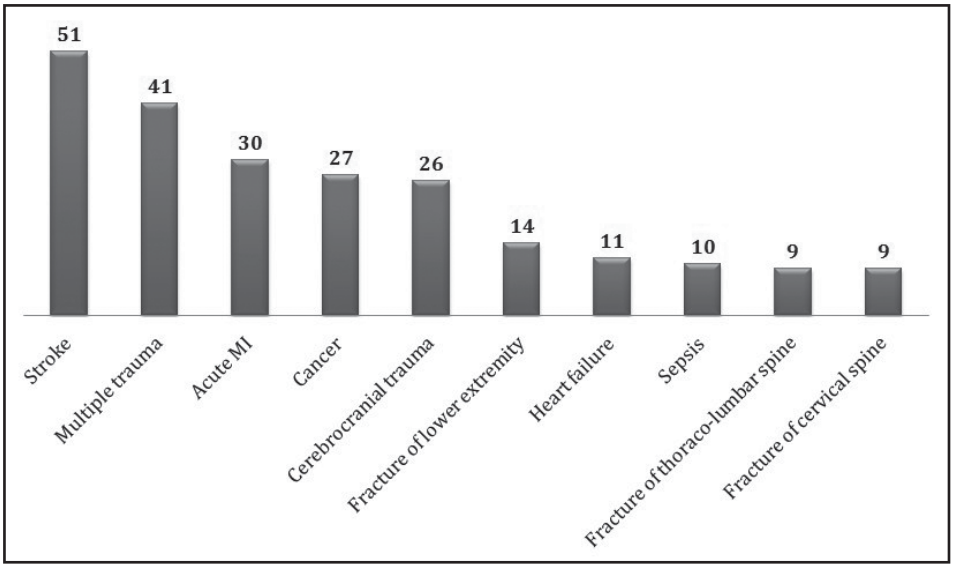

Figure 2: *Diagnosis of transported cases. (n = 302)*

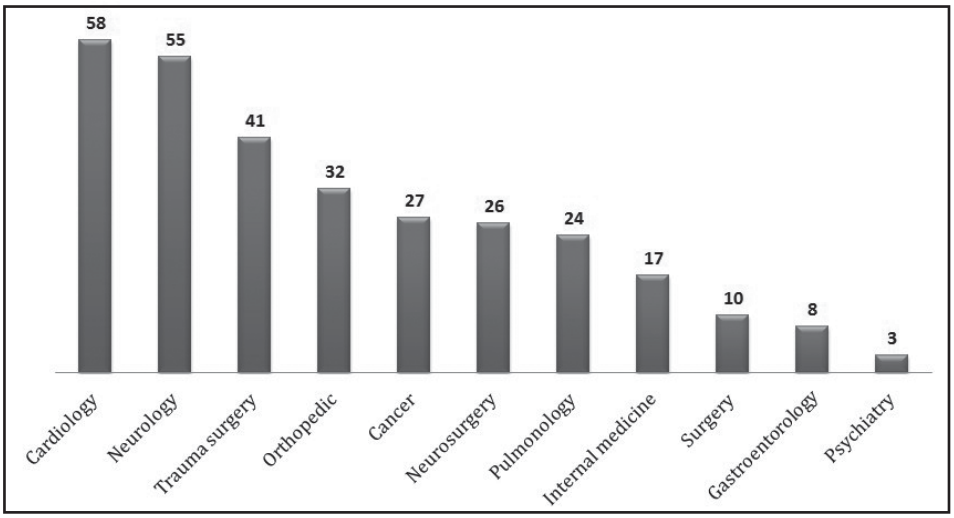

Figure 3: *Diagnosis classified according to the specialty of transported patients (n = 302)*

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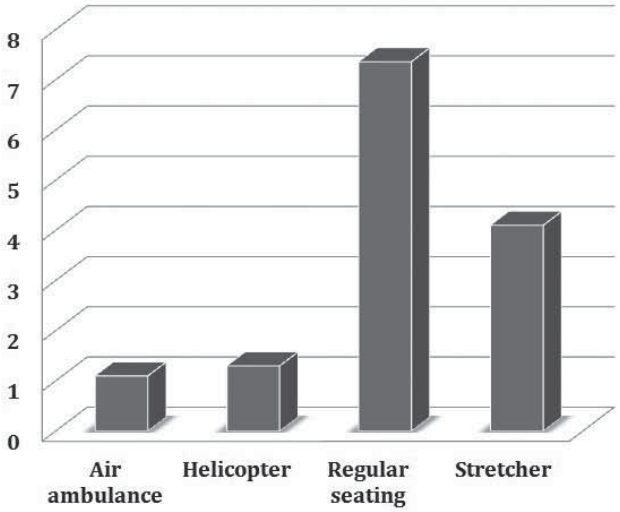


Figure 4: *Average Flight Time (hour) of transported cases*

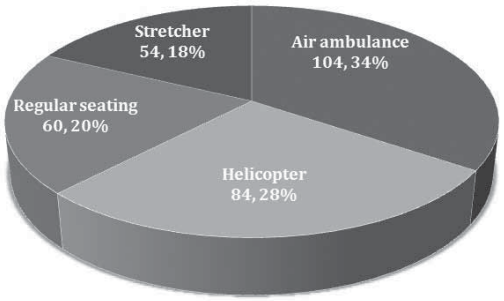


Figure 5: *Mode of transport of transported cases*

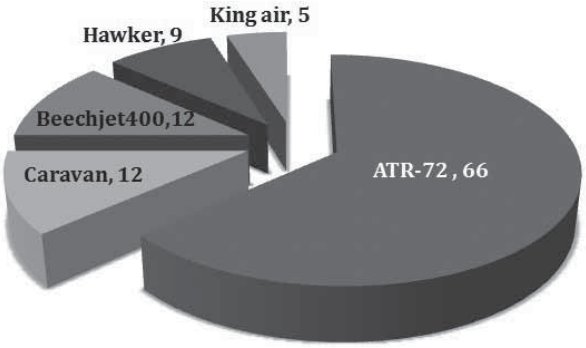
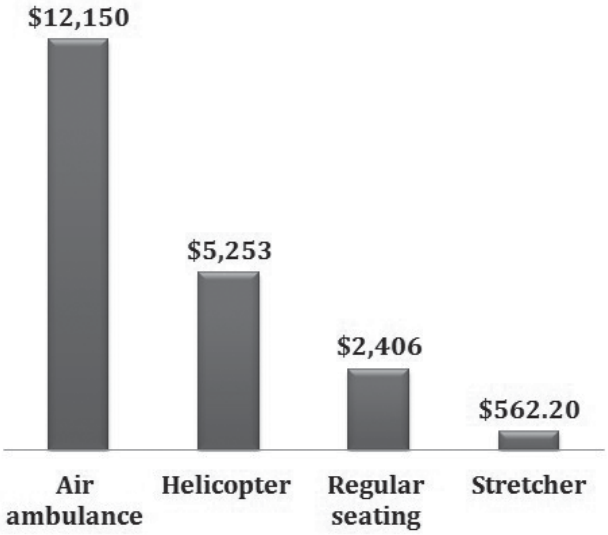


Figure 6: *Type of aircraft in air ambulance cases (n = 104)*



Note: *Some Helicopter missions were in cooperation with the Ministry of Public Health of Thailand (discounted cost).*

Figure 7: *The cost per flight hour of transported cases*

Table 2: The cost per flight minute and flight hour.

Type	Cost per minute (US)	Cost per hour (US)
Air ambulance	202.50	12,150.00
Helicopter	87.55	5,253.00
A stretcher in a scheduled aircraft	40.10	2,406.00
A scheduled aircraft with regular seating	9.37	562.20

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Discussion

As the demand for medical air transportation is likely to continue to go up in the future due to increased globe trotting and medical tourism,[3] skilled physicians and nurses must be available at all times. Monitoring devices (ECG, blood pressure, pulse oximetry, capnography), defibrillators, pacing devices, ventilators, aeronautical oxygen systems, infusion devices, mattresses, medication including resuscitation drugs must be available 24 hours a day.[2] All equipment must be certified for aeronautical use, and a permanent logistics team ensures its preventive maintenance.[6] Cost-effectiveness is likely to be of the utmost importance for insurance companies and health care systems when determining appropriate form of air transportation. The flight physician has to determine that the patients not only receive quality medical care but the mode of transportation is most effective in terms of safety, time and cost-effectiveness, even though the most appropriate medical response should be the the main factor in the selection of an appropriate form of air transportation. Patients with neurologic conditions need even more timely and careful aeromedical transport than those with other diseases.[7]

From our data, neurologic diseases comprised 25% of the patients that required medical transportation. Most cases of evacuation were transported by helicopter or air ambulance and flight time was about one hour; most cases of repatriation were transported by stretcher or regular seat in commercial aircraft. Most evacuation sites were in Thailand and Indochina countries such as Myanmar and Cambodia. The diagnosis of cases varied from diseases to trauma but most cases (n = 99, 33%) were from accident and trauma, with multiple or severe injuries that needed surgery.

By comparing the costs per flight time, we showed that a stretcher in a scheduled aircraft is significantly cheaper than air ambulance and a scheduled aircraft with regular seating (first, business and economy class) was cheapest. The data also showed that the helicopter was significantly cheaper than air ambulance especially in the context of air evacuation within one hour.

Limitation: Data was collected from only one aviation medical center in the year 2011.

Conclusion

Transport of patients with various diseases or trauma, either by air ambulance or commercial flights, can only be safely performed by well-trained medical escorts and with comprehensive logistic arrangements. Medical air transportation is very costly, and continuing the trend of the last decade, its frequency is likely to further increase. The physician who is in charge of transport planning must communicate effectively with the patient, with the physician on-site, with the patients' relatives and with the patients' insurance company to determine and evaluate needs and determine the most suitable mode of air medical transport.

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