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HISTORY AND MEMORY

Helicopter Aeromedical Transport of Critically Patients: recent past and present history

A Pessoa em Situação Crítica Helitransportada: história do passado recente e panorama atual

El Paciente Crítico Transportado en Helicóptero: historia del pasado reciente y panorama actual

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Abstract

Background: Emergency Medicine has its modern roots in the First World War. In Portugal, the first medical emergency system dates back to 1965. The Helicopter Emergency Medical Service of the National Institute of Medical Emergency (INEM) started operating in 1997.
Objective: To inform about the history and current situation of the helicopter aeromedical transport of critically ill patients through the two major institutions in Portugal: the INEM and the Portuguese Air Force (FAP).
Methodology: A qualitative historical study was conducted through documental analysis of the primary sources provided by the Portuguese Air Force and the National Institute of Medical Emergency, as well as the secondary sources.
Results: The results suggest that the creation of a model for sharing air assets between various institutions leads to a more effective and efficient transport of critically ill patients.
Conclusion: Further studies should be conducted to reveal the historical role played by the teams of physicians, nurses, commanders and pilots in Portugal.

Keywords: history of nursing; aeromedical transport; helicopter; critically ill patient.

Resumo

Contexto: A Medicina de Emergência moderna tem as suas raízes na Primeira Guerra Mundial. Em Portugal o primeiro sistema de emergência médica data de 1965, tendo sido inaugurado o Serviço de Helicópteros de Emergência Médica pelo Instituto Nacional de Emergência Médica (INEM) em 1997.
Objetivo: Dar a conhecer a história e o panorama atual no que se reporta ao transporte aéreo do doente crítico por helicópteros, através das duas principais entidades em Portugal, o INEM e a Força Aérea Portuguesa (FAP).
Metodologia: Estudo de natureza histórica, de abordagem qualitativa, recorreu-se a análise documental através de fontes primárias fornecidas pelo Estado Maior da Força Aérea e pelo Instituto Nacional de Emergência Médica, bem como fontes secundárias.
Resultados: Os resultados sugerem que a criação de um modelo de partilha de meios aéreos entre as diversas entidades resulta na eficácia e eficiência no que diz respeito ao transporte do doente crítico.
Conclusão: Sugerem-se outros estudos que dêem a conhecer historicamente o papel desempenhado pelas equipas de médicos, enfermeiros, comandantes e pilotos em Portugal.

Palavras-chave: história da enfermagem; transporte aeromédico; helicóptero; doente crítico

Resumen

Marco contextual: La medicina de emergencia moderna tiene sus raíces en la Primera Guerra Mundial. En Portugal, el primer sistema de emergencia médica se remonta al año 1965, después de que el Instituto Nacional de Emergencia Médica (INEM) abriese el servicio de helicópteros de emergencia médica en 1997.
Objetivo: Dar a conocer la historia y la situación actual en lo que respecta al transporte aéreo de pacientes en estado crítico en helicóptero, a través de las dos entidades principales en Portugal, el INEM y la Fuerza Aérea Portuguesa (FAP) .
Metodología: Estudio de carácter histórico, de enfoque cualitativo, en el que se recurrió al análisis documental de fuentes primarias provistas por el Estado Mayor de la Fuerza Aérea y el Instituto Nacional de Emergencia Médica, así como de fuentes secundarias.
Resultados: Los resultados sugieren que la creación de un modelo de intercambio de medios de transporte aéreo entre las diferentes entidades mejora la eficacia y eficiencia del transporte de pacientes críticos.
Conclusión: Se sugieren otros estudios que den a conocer históricamente el papel desempeñado por los equipos de médicos, enfermeros, comandantes y pilotos en Portugal.

Palabras clave: historia de la enfermería; transporte aeromédico; helicóptero; paciente crítico.

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Introduction

Accidents are the leading cause of death among young people. Portugal has one of the highest mortality rates from road accidents in Europe, and the transport of critically ill patients, both medical and surgical, to major specialised centres at a technical and human level is becoming increasingly frequent.

The choice of the means of transport has to be well thought out and depends on the severity of the critically ill patient, the distance between the accident location and the receiving Hospital, the resources available and access conditions, all of them having both advantages and disadvantages. In Portugal, the transport of critically ill patients has evolved and diversified over the last century, and the first medical emergency system was created in the 1960s in Lisbon. It gradually spread throughout the country, reaching the most remote areas.

More specifically, air transport began in a scenario of war, and it was back in the 19th century that it took its first steps. Due to technical and scientific advances, this means of transport extended to the civil society and the number of evacuations never stopped increasing ever since. Air transport also has its risks, and requires material, health professionals trained in flight physiology, safety rules during helicopter transport and at heliports, as well as huge amounts of money to cover hour/flight prices. The risks associated with this type of transport depend very much on the severity of the patient's condition, the type of aircraft, whether or not it is pressurised and heated, and its maximum reachable altitude. The increase in altitude leads to a decrease of atmospheric pressure, humidity, partial pressure of oxygen, and temperature. There is also an increase in gas volume. Acceleration and deceleration interfere with the redistribution of body fluids. Noise and lights decrease the patient's well-being and hinder communication. Vibrations may cause changes in material fixation and contribute to increasing fatigue. The provision of care is focused on the patient's changes and on controlling the effects of the flight on the patient, both physically and psychologically, which requires the professionals' continuous surveillance.

This study aimed to inform about the recent past history in the transport of critically ill patients, ever since the first medical emergency system, in 1965, until today, with particular emphasis on the helicopter aeromedical transport of critically ill patients operated by the two major Portuguese institutions: the *Instituto Nacional de Emergência Médica* (National Institute of Medical Emergency - INEM) and the Portuguese Air Force (FAP).

Selection of the theme

The air transport of critically ill patients in increasingly demanding conditions has been a cause for reflection for the different health professionals and entities involved, such as the Portuguese Air Force (FAP), the Ministry of Internal Administration (Civil Protection) and the National Institute of Medical Emergency (INEM). Therefore, it is important for health professionals to know its recent past history and current situation.

Focus and formulation of questions or hypotheses

According to the World Health Organization (World Health Organization, 2013), more than 1.24 million people die each year as a result of road traffic crashes and 20 to 50 million people suffer injuries and incur a disability. Trauma the leading cause of death and disability, with an immeasurable impact on the affected families, whose lives are often irrevocably changed by such tragedies, as well as the communities in which those people live and work. In Europe, traumatic brain injury is also the leading cause of death in people aged up to 44 years, with the most important etiological factors being road traffic accidents, accidents in the workplace, falls, suicide attempts, and interpersonal violence.

Portugal tops the list of European countries in terms of trauma and mortality, of which road accidents are the main cause. In 2010, 937 people died in road accidents, which is equivalent to 11.8 deaths per 100,000 people. This is the second highest rate among the 15 Western European countries, preceded only by Greece, with 12.2 deaths per 100,000 people. Both countries are followed by Belgium (8.1) and Italy (7.2), with Sweden (3.0) and the United Kingdom (3.7) at the bottom as the Western European countries with the lowest traffic-related death rate (World Health Organization, 2013).

Document gathering and data collection

This qualitative historical study is part of a broader training and research project on Nursing to the Critically Ill Patient. A documental analysis was performed in primary sources provided by the Portuguese Air Headquarters (*Estado Maior da Força Aérea*) and the National Institute of Medical Emergency, as well as in secondary sources: electronic online support, "Missão e Organização" (Mission and Organisation) and "Aeronaves" (Aircrafts) available on the webpage of the Portuguese Air Force (www.emfa); "Histórico de Notícias" (News Archive), "Notas à Imprensa" (Press Releases) and "Legislação" (Legislation) available on the webpage of the INEM (www.inem.pt). These documents were consulted between November 2012 and July 2013, and refer to the period of 1965-2012. The original spelling and syntax were preserved during transcription to maintain the richness of the text and the meaning of the discourse.

Data analysis, criticism and interpretation

In Portugal, the first medical emergency system was on October 13, 1965, by joint order of the Minister of the Interior and the Minister of Health and Welfare, in Lisbon. It aimed at creating a "service of first aid, lifting and transportation of injured and ill patients to hospitals provided by the Public Security Police (PSP). This service quickly became popular under the name of "115", by reference to the telephone number that triggered it and put it into action. It started operating in that same month of October and, in May 1967, it extended to the cities of Porto and Coimbra and, in May 1970, to the cities of Aveiro, Setúbal and Faro. It is expected to extend to the other district headquarters." (Decree-Law no. 511, 1971, p. 1789). In 1971, the *Serviço Nacional de Ambulâncias* (SNA) (Portuguese Ambulance Service) was created by Decree-Law no. 511/71, issued on November 22nd, which aimed at ensuring "the guidance, coordination and effectiveness of the activities related to the provision of first aid care to injured people and patients, and their transportation" (p. 1789). The SNA took over the coordination of the 115 service and the provision of emergency medical services by other entities, in addition to its own ambulances, which continued to be operated by the PSP.

Recognising the need to extend the scheme set up by the SNA and to include in it the hospital emergency services, the *Gabinete de Emergência Médica* (Medical Emergency Office - GEM) was created by Resolution of the Council of Ministers no. 84/80, issued on March 11, 1980. This Office was obliged to present a study on a coordinating body for an integrated medical emergency system, thus contributing to improve the provision of emergency care. On August 3, 1981, following the Decree-Law no. 234/81, the National Institute of Medical Emergency (INEM) was created, which extinguished the SNA and the GEM. Therefore, the INEM emerged as the coordinating body of an Integrated Medical Emergency System (SIEM). The main tasks of the INEM are to provide care in loco, to provide assisted transportation by ambulance to an appropriate hospital and to act as a link between the different organisations in the SIEM. The SIEM is composed of entities which cooperate with a single purpose: to provide assistance to the victims of accidents or sudden illnesses (INEM, 2012b). Those entities are the Public Security Police (PSP), the National Republican Guard (GNR), the National Institute of Medical Emergency (INEM), the Fire Department, the Portuguese Red Cross, and the Hospitals and Health Care Centres.

The adoption of an international emergency symbol

Figure 1. Star of life
Source: www.inem.pt [online].
(Cons. 10th June 2013]

The blue Star of Life (fig. 1) is one of most recognised symbols worldwide and it represents the pre-hospital medical emergency service. It was created by Leo R. Schwartz in 1973. Each point of the star represents one emergency care intervention, forming a cycle (going clockwise, starting at the top): (1) to detect

the emergency; (2) to report the emergency; (3) to send the most adequate team and equipment; (4) care on the scene; (5) care in transit; and (6) transfer and definitive care. The snake and the staff symbolise medicine since the 16th century.

The emergency system is activated when someone calls 112 - the European Emergency Number. At an early stage, emergency calls were managed by the Ministry of Internal Administration and emergency centres were located at the PSP or GNR stations. Nowadays, they are managed only by the PSP. Whenever calls are health-related, they are forwarded to the *Centros de Orientação de Doentes Urgentes* (Guidance Centres for Urgent Patients - CODU) of INEM (cons. elec. on November 18, 2012).

The transportation of critically ill patients is inevitable in health care systems and requires the maintenance of life support care in unfavourable environments from the start. The *critically ill patient* is defined as "the patient whose survival is dependent on advanced monitoring and therapeutic resources due to the dysfunction or failure of one or more organs or systems" (Ordem dos Médicos, Comissão da Competência em Emergência Médica, & Sociedade Portuguesa de Cuidados Intensivos, 2008). The risk and benefit of a transfer shall be assessed during the planning phase, which may lead to the sub-optimisation of the level of care provided to the patient. The failure to prepare the victim to be transported and/or the transportation team may represent a risk for patients, as well cause undesirable experiences/incidents leading to stressful situations and/or a possibility of post-traumatic stress among healthcare providers. This is true because most teams rescue victims from hazardous, hostile, uncontrolled and very demanding environments which hamper the provision of care (Martins, & Martins, 2010). As regards the necessary means of transport, there are two types of transport: the nonmedical and the medical support. The non-medical means of transport are the ambulances, whether of Basic Life Support (BLS) or Immediate Life Support (ILS), and the Medical Emergency Motorcycle. The medical means of transport are those which include a physician in the team, as is the case of the Emergency and Resuscitation Medical Vehicle (VMER) - a differentiated means of transport with Advanced Life Support - and the Medical Emergency Helicopter (Helis).

Results

Although there are reports in the literature indicating that the first aeromedical evacuations using hot air balloons (Austin, 2002) occurred in a scenario of war during the siege of Paris - Franco-Prussian War (from 1870 to 1871), in fact, there is no mention of wounded people or patients in the 67 hot air balloons that are known to have left Paris during the siege of the Prussian troops. The origin of this myth is uncertain, but it may result from an error in the translation of French records. During the First World War (from 1914 to 1918), the transportation of physicians, equipment and medicines was already made using the rudimentary aircrafts of the time, and the transportation of patients and the wounded was limited to only extreme cases, since the accommodation was very restricted. During the Second World War (from 1939 to 1945), the technological development of aeronautics expanded, and it became possible to evacuate patients and the wounded and transport them over long distances to large health care centres located in military bases or improvised airports (Austin, 2002). In 1942, based on the concept of vertical flight, Arthur Young and Larry Bell developed the Model 47. This was the prototype of current helicopters. In December 1946, they obtained the first commercial license for civil use to fly in the U.S. airspace.

In 1950, during the Korean War (from 1950 to 1953), approximately 20 000 wounded soldiers were evacuated by helicopter. This number increased to more than 370 000 soldiers during the Vietnam War (from 1959 to 1975) (Austin, 2002).

In Portugal, the first helicopter transport missions of critically ill patients date back to the Colonial War (fig. 2), with the FAP using the Alouette III Helicopters in the three battlefields - Guinea, Angola and Mozambique, and evacuating the wounded from combat locations to hospitals with the presence of a parachute nurse.

Early civilian attempts to use helicopters to rescue critically ill patients date back to the 1990s during the Rally of Portugal. Some of the first professionals to provide this service were the first ones to conduct evacuations between Faro and Lisbon, through a precursor partnership for the creation of the *Serviço de Helicópteros de Emergência Médica* (Helicopter Emergency Medical Service - HEMS) between the Opel company, the air operator OMNI – Aviação

e Tecnologia Lda., the INEM and the Hospital São Francisco Xavier. The latter was responsible for managing clinical supplies and training/coordinating the team of physicians and nurses who would ensure the evacuation of the wounded and urgent patients to southern Portugal. In 1997, the HEMS was inaugurated by the INEM. Initially, it worked with two Bel 222 helicopters (other models that were used in the HEMS: Agusta A109, Bell 412 and Bell 430) located in Lisbon (Tires aerodrome) and Porto (Espinho aerodrome). In 2000, the helicopter located in Espinho was moved to Hospital Pedro Hispano in Matosinhos, where it remained until 2010.

Figure 2. Alouette III Model
Source: www.emfa.pt [online]. [Cons. June 10, 2013]

The INEM's medical emergency helicopters are used to transport severe patients between health care units (secondary transportation) or between the location of occurrence and the health care unit (primary transportation). They are usually equipped with Advanced Life Support material, and the team is composed of a physician, a nurse, and two pilots.

On October 16, 2002, the Helicopter Emergency Medical Service of the INEM became available 24 hours/day, instead of the previous 12 hours/day (8a.m.-8p.m.). On April 1, 2010, following the Requalification of the Urgency/Emergency Network, three new helicopters were added, thus allowing for the provision of better extra-hospital emergency medical services to the most distant areas from the reference hospitals. These helicopters were located in Macedo de Cavaleiros (district of Braganza); Santa Comba Dão (district of Viseu) until March 2011 and then were relocated to Aguiar da Beira (district of Guarda) and Loulé (district of Faro). The three new helicopters started operating with the support of each respective City Hall and Fire Brigade, with particular emphasis on the voluntary firefighters of Loulé, who welcomed one of the new helicopters.

The aircrafts selected for the purpose were the Agusta 109 due to characteristics related to lightness and easiness of manoeuvre which allowed for easier access to and better landing at incident sites.

In October 2012, as a way to maximise the efficiency of air transport and its better geographical distribution, the Ministry of Health, through the INEM (with five helicopters at the time), jointly with the Ministry of Internal Affairs (with nine helicopters, owned by the *Empresa de Meios Aéreos* - EMA), decided to create a model for sharing air assets, looking for synergies with greater effectiveness and efficiency gains. Medical emergency helicopters, with a capacity to intervene in rescue and assistance missions for citizens, were then divided as follows:

I. During the "Charlie" phase to fight forest fires, between June 1st and September 30th, the INEM will have four light helicopters with medical teams in the following locations: Vila Real (district of Vila Real); Santa Comba Dão (district of Viseu); Loures (district of Lisbon) and Loulé (district of Faro);

II. In the remaining eight months of the year, the INEM will have five helicopters (2 KAMOV and 3 light helicopters) with medical teams in the previously mentioned locations and also in Beja (district of Beja). In addition to these, it will also have a helicopter (a Eurocopter AS-350 B3 Ecureuil) in Ponte de Sor (district of Portalegre), with no medical team. This will allow accessing the location and, if necessary, taking the victim with the INEM's land team to the receiving Hospital, thus improving the ability to quickly evacuate by air a significant part of the population of Alentejo. Besides these resources, the INEM may also use any other aircraft available from the Ministry of Internal Administration, based on a true sharing of assets. According to information of the INEM (INEM, 2012a), thanks to this ongoing sharing of air assets, the INEM will manage to reduce its costs in approximately two million Euros, which will be used to continue developing the Institute through the acquisition of new resources the replacement of ambulances and medical vehicles, investments in new technologies, among others.

On July 8, 2013, Dr. Luís Meira, coordinator of the HEMS, provided the statistical data on the HEMS' activity between 2001 and 2012. Table 1 shows its activity in terms of secondary transportation (the

transportation of severe patients between health care units) and primary transportation (between the location of occurrence and the health care unit), starting in 2001, with a total of 554 missions, and showing a steady increase until it reached 1.304 missions in 2012, when the HEMS already shared its air assets with the FAP and Civil Protection. In relation to the transported patients, approximately 421 patients were transported in 2001, reaching a total of 1011 patients in 2012 (Table 1).

Table 1
Activity of the HEMS - between 2001 and 2012

	Secondary Missions	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Drives	H1 - Lisbon	220	237	226	211	265	256	291	187	202	93	143	184
	H2 - Porto	192	215	265	167	151	171	261	217	194	105	92	74
	H3 - Macedo										95	94	157
	H4 - S. Comba/Aguiar Beira										81	98	90
	H5 - Loulé										44	65	65
	H INEM Beja/Loulé												15
	SNBPC/ANPC - S. Comba	105	98	92	55	52	23	17	11	5	4		
	H INEM/ANPC - S. Comba												29
	H INEM/ANPC - Loulé												19
	H INEM/ANPC Ponte Sor												2
	Total	517	550	583	433	468	450	569	415	401	422	492	635
	Primary Missions	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
	H1 - Lisbon	29	30	47	72	45	75	157	131	101	93	111	84
	H2 - Porto	7	36	47	42	50	114	167	229	160			
	H3 - Macedo										146	155	168
	H4 - S. Comba/Aguiar Beira										188	255	209
	H5 - Loulé										80	142	86
	H INEM Beja/Loulé												11
	SNBPC/ANPC - S. Comba	1	2	5	8	10	3	5	1	4	1		
	H INEM/ANPC - S. Comba												34
	H INEM/ANPC - Loulé												8
	H INEM/ANPC Ponte Sor												0
	Total	37	68	99	122	105	192	329	361	265	632	755	669
	Missions - Total	**554**	**618**	**682**	**555**	**573**	**642**	**898**	**776**	**666**	**1054**	**1247**	**1304**

Transportations	Transported Patients	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
	H1 - Lisbon	180	209	252	237	288	253	361	247	255	144	201	229
	H2 - Porto	163	169	183	173	179	232	292	260	197	131	135	122
	H3 - Macedo										158	201	277
	H4 - S. Comba/Aguiar Beira										183	229	175
	H5 - Loulé										94	150	115
	H INEM Beja/Loulé												21
	SNBPC/ANPC - S. Comba	78	59	55	40	40	19	199	8	7	5		
	H INEM/ANPC - S. Comba												48
	H INEM/ANPC - Loulé												22
	H INEM/ANPC Ponte Sor												2
	Total	**421**	**437**	**490**	**450**	**507**	**504**	**672**	**515**	**459**	**715**	**916**	**1011**

Source: Meira (2013) [Online] [Consult. July 8, 2013]

Key:

H1 - Lisbon	initially in Tires (Cascais). Currently in Salemas (Loures)
H2 - Porto	initially in Espinho. Then in Matosinhos. Then in Baltar. Disabled in October 2012
H3 - Macedo	since April 2010
H4 - S. Comba/Aguiar Beira	since April 2010. Initially in S. Comba Dão. Then in Aguiar da Beira. Currently in S. Comba Dão.
H5 - Loulé	between April 2010 and October 2012
H INEM Beja/Loulé	since October 2012 (during the summer, it stays in Loulé)
SNBPC/ANPC - S. Comba	until 2010 (with the possibility of night use by the INEM)
H INEM/ANPC - S. Comba	sharing of air assets since October 2012 (except "Charlie" phase to fight forest fires - Summer months)
H INEM/ANPC - Loulé	sharing of air assets since October 2012 (except "Charlie" phase to fight forest fires - Summer months)
H INEM/ANPC Ponte Sor	sharing of air assets since October 2012 (except "Charlie" phase to fight forest fires - Summer months)

Whenever critically ill patients are at sea, both in the Portuguese area of influence or on the islands, either in national or foreign vessels, the Centro de Orientação de Doentes Urgentes Mar (Guidance Centre for Urgent Patients Sea - CODU-Mar) is triggered via radio or the 112 number. The Centre was created in 1989 and aims at providing medical advice in emergency situations that occur on board vessels. The CODU-Mar ensures continued support, by defining the type of care, procedures and therapy to administer to the victim, and it may also trigger patient evacuation, prepare land reception, and redirect the victim to the appropriate hospital service. Once the decision to evacuate the patient has been taken, the CODU-Mar comes into contact with the Centros de Coordenação de Busca e Salvamento Marítimo (Maritime Rescue Coordination Centres - MRCC Lisbon, MRCC Ponta Delgada or SubMRCC Funchal), which are responsible for assessing the appropriate and necessary means and resources for the intervention required. Thus, the MRCC may ask the appropriate entities for the necessary means and resources. In the case of the Portuguese Air Force (FAP), this coordination takes place through the Centros de Coordenação de Busca e Salvamento (Rescue Coordination Centres - RCC Lisbon and RCC Lajes), which enable the appropriate air resources in accordance with the specificity of each mission (Decree-Law no. 15, 1994).

On April 16, 2013, the statistical data relating to the Search and Rescue and Medical Evacuations were kindly provided by the Air Force Chief of Staff, General José António de Magalhães Araújo Pinheiro. Data regarded the Air Force statistical yearbooks dating between 2008 – 2012, and are mentioned hereunder: Between January 1st and December 31st, 2008, 316 missions of medical evacuation (MEDEVAC's) took place in mainland Portugal, in the Azores, Madeira, and São Tomé and Príncipe, in a total of 608h35m of flight for the transportation of 361 patients. In the same period, 14 organ transport missions were also completed in a total of 47h35m (Table 2).

Table 2
Search and Rescue: activity in the flight information region of Lisbon (LPPC-FIR), 2008

AIRCRAFT	MEDICAL EVACUATIONS	MISSIONS	H/V	EVACUATED PATIENTS	ORGAN TRANSPORT (MISSIONS)	H/F	Price hour/ flight excl. VAT
 FIGURE 4 – C212 – AVIOCAR Source: www.areamlitar.net [online]. [Cons. June 10, 2013]	AZORES	59	159:50	66			
	MADEIRA	141	119:50	171			
	SÃO TOMÉ AND PRÍNCIPE	316	608:35	361	7	23:55	------
 FIGURE 5 – EH 101 – MERLIN Source: www.emfa.pt [online]. [Cons. June 10, 2013]	MAINLAND	3	11:20	2			
	AZORES	48	116:55	51			
	MADEIRA	7	07:20	7			
	SHIP OPERATORS	32	120:20	33	--------	-------	6.216,85€
 FIGURE 6 – FALCON 50 Source: www.emfa.pt [online]. [Cons. June 10, 2013]	MAINLAND	2	11:40	2	7	23:40	5.673,00€
 FIGURE 7 – SA330 - PUMA Source: www.emfa.pt [online]. [Cons.June 10, 2013]	AZORES	22	58:00	24	-------	------	------

Source: Secretariat of the GABCEMFA (2013) [Online Message] [Consult. April 16. 2013

Between January 1st and December 31st, 2009, 83 missions of medical evacuation (MEDEVAC's) took place in mainland Portugal, in a total of 241h35m of flight for patient transportation. In the same period, 28 missions were also completed in the islands in a total of 166h55m (Table 3).

Table 3

Search and Rescue: activity in the flight information region of Lisbon (LPPC-FIR) and Santa Maria, 2009

LPPC FIR	ENTITY	STATION	AIRCRAFT	MISSIONS	H/F	TOTAL MISSIONS	TOTAL H/F
FLIGHT INFORMATION REGION OF LISBON	MRCC LISBON (MRCLX)	401	C-212	10	35:20	70	205:40
		502	C-295	3	28:00		
		55S DAO	ALIII	18	44:15		
		601	P-3P	3	14:55		
		751	EH-101	27	67:35		
		751 DAM	EH-101	9	15:35		
	RCC LISBON COSPAS-SARSAT (RCCLX)	751	EH-101	1	1:45	1	1:45
	RCC LISBON CIVIL AIRCRAFTS (RCCLX)	552	ALIII	1	1:45	2	3.10
		751	EH-101	1	1:25		
	RCC LISBON MILITARY AIRCRAFTS (RCCLX)	601	P-3P	2	7:45	3	8:25
		751	EH-101	1	0:40		
	RCC LISBON (ANPC)	751	EH-101	1	3:15	1	3:15
	OTHER ENTITIES EXMOR	401	C-212	1	3:00	6	19:20
		502	C-295	3	11:10		
		751	EH-101	1	1:50		
		751 DAM	EH-101	1	3:20		
TOTAL OF MISSIONS AND HOURS OF FLIGHT						**83**	**241:35**
FIR							
SANTA MARIA	**TOTAL OF MISSIONS AND HOURS OF FLIGHT**					**28**	**166:55**

Source: Secretariat of the GABCEMFA (2013) [Online Message] [Consult. April 16th, 2013]

Between January 1st and 31st December, 2010, 102 missions of medical evacuation (MEDEVAC's) took place in mainland Portugal, in a total of 381h05m of flight for patient transportation. In the same period, 29 missions were also completed in the islands in a total of 123h05m (Table 4).

Table 4

Search and Rescue: activity in the flight information region of Lisbon (LPPC-FIR) and Santa Maria, 2010

LPPC FIR	ENTITY	STATION	AIRCRAFT	MISSIONS	H/F	TOTAL MISSIONS	TOTAL H/F
FLIGHT INFORMATION REGION OF LISBON	MRCC LISBON (MRCLX)	502	C-295	9	58:45	89	339:00
		502 DAM	C-295	1	2:55		
		552 DAO	ALIII	25	91:40		
		601	P-3P	3	17:15		
		751	EH-101	46	152:40		
		751 DAM	EH-101	5	15:45		
	RCC LISBON MILITARY AIRCRAFT (RCCLX)	502	C-295	2	6:50	7	33:25
		601	P-3P	5	26:35		
	RCC LISBON (ANPC)	751	EH-101	4	6:20	4	6:20
	AIRCRAFT SUPPORT FAP	751	EH-101	2	2:20	2	2:20
TOTAL OF MISSIONS AND HOURS OF FLIGHT						**102**	**381:05**
FIR							
SANTA MARIA	**TOTAL OF MISSIONS AND HOURS OF FLIGHT**					**29**	**123:05**

Source: Secretariat of the GABCEMFA. (2013) [Online Message] [Consult. 16th April 2013]

Between January 1st and December 31st, 2011, 68 missions of medical evacuation (MEDEVAC's) took place in mainland Portugal, in a total of 201h15m of flight for patient transportation. In the same period, 16 missions were also completed in the islands in a total of 131h10m (Table 5).

Table 5
Search and Rescue: activity in the flight information region of Lisbon (LPPC-FIR) and Santa Maria, 2011

LPPC / FIR	ENTITY	STATION	AIRCRAFT	MISSIONS	H/F	TOTAL MISSIONS	TOTAL H/F
FLIGHT INFORMATION REGION OF LISBON	MRCC LISBON (MRCLX)	502	C-295	8	38:30	59	174:40
		502 DAM	C-295	4	15:50		
		552 DAO	ALIII	12	37:20		
		401	C-212	1	5.30		
		751	EH-101	27	63:50		
		751 DAM	EH-101	7	13:40		
	RCC LISBON MILITARY AIRCRAFT (RCCLX)	502	C-295	5	15.20	5	15:20
	AIRCRAFT SUPPORT FAP	502	C-295	1	3:05	4	11:15
		601	P-3P	2	6:15		
		751	EH-101	1	1:55		
TOTAL OF MISSIONS AND HOURS OF FLIGHT						68	201:15
FIR							
SANTA MARIA	TOTAL OF MISSIONS AND HOURS OF FLIGHT					16	131:10

Source Secretariat of the GABCEMFA (2013) [Online Message] [Consult. April 16, 2013]

Between January 1st and December 31st, 2012, 43 missions of medical evacuation (MEDEVAC's) took place in mainland Portugal, in a total of 128h55m of flight for patient transportation. In the same period, 31 missions were also completed in the islands in a total of 163h55m (Table 6).

Table 6
Search and Rescue: activity in the flight information region of Lisbon (LPPC-FIR) and Santa Maria, 2012

LPPC / FIR	ENTITY	STATION	AIRCRAFT	MISSIONS	H/F	TOTAL MISSIONS	TOTAL H/F
FLIGHT INFORMATION REGION OF LISBON	MRCC LISBON (MRCLX)	501	C130			32	98:05
		502	C-295	3	21:30		
		502 DAM	C-295				
		552 DAO	ALIII	6	8:20		
		601	P3C	1	1:55		
		SP SAR	FKR/SA330				
		751	EH101	20	61:30		
		ANPC	KA32				
		751 DAM	EH101	2	4:50		
	RCC LISBON CIVIL AIRCRAFT (RCCLX)	552	ALIII	1	0:55	4	6:35
		502	C-295	1	2:30		
		601	P3C				
		751	EH101	2	3:10		
	RCC LISBON MILITARY AIRCRAFT (RCCLX)	502	C-295	4	14:05	6	22:05
		502 DAM	C-295	2	8:00		
	RCC LISBON SRPCM	751 DAM	EH101	1	2:10	1	2:10
TOTAL OF MISSIONS AND HOURS OF FLIGHT						43	128:55
FIR							
SANTA MARIA	TOTAL OF MISSIONS AND HOURS OF FLIGHT					31	163:55

Source: Secretariat of the GABCEMFA (2013) [Online Message] [Consult. April 16, 2013]

Information regarding prices per flight hour was also requested and promptly provided (Table 7):

Table 7
Price per flight hour 2011

FLEET	PUBLIC ENTITIES
ALIII	448.85€
C-130	5.726.30€
F-16	5.934.52€
FALCON50	5.673.00€
P-3C ORION	5.308.18€
EH-101	6.216.85€
C-295M	2.471.50€

Excl. VAT
Source: Secretariat of the GABCEMFA (2013) [Online Message] [Consult. April 16, 2013]

Under no circumstances should economic problems impede the transfer of critically ill patients to where they may be provided with better care (Ordem dos Médicos. Comissão da Competência em Emergência Médica, 2008). Some of the most important aspects to promote and guarantee the safety of critically ill patients during their transportation are the technical qualification, training and clinical experience in Intensive Care Medicine and the various Medical Emergency-related skills. In the case of air transportation, monitoring should only be made by skilled professionals in advanced life support, who are specifically trained for this type of transport, with training in flight physiology and safety rules during helicopter transport and at heliports (Ordem dos Médicos. Comissão da Competência em Emergência Médica, 2008).

The airborne critically ill patient

The fact that the human body is not used to staying at such high altitudes makes it more vulnerable when it needs to travel by air. It is important to note that the altitude effects are not felt with total accuracy when travelling in the so-called commercial aircrafts (*fixed wing*). This is because these aircrafts are pressurised and artificially air-conditioned so that the person feels as comfortable as possible (Almeida, 2001). On the contrary, helicopters (*rotor wing*) and small propeller planes are not pressurised and, therefore, the effects of atmospheric changes are more strongly felt whenever the helicopter gains or loses altitude. The increase in altitude causes a decrease in the atmospheric pressure, which leads to a decrease in the partial pressure of gases, temperature and expansion of gases (Sheehy, 2001). Few changes are observed between 0 and 6000 feet, except in patients with trauma, shock, and pneumothorax. In the event that these patients require drains, these must be unclampled and freely draining. Similarly, with the endotracheal intubation, the air should be replaced with distilled water to fill the cuff (INEM, 2012c).

Between 10,000 and 22,000 feet, the haemoglobin saturation drops from 98% (sea level) to 87%, and it may reach 60% at 22,000 feet (Schweitzer et al., 2011). As a result of these changes, hypoxia is one of the serious complications that may arise or worsen during the flight, which may cause changes such as confusion, disorientation, lethargy and tachycardia.

As the helicopter rises, the atmospheric pressure decreases and gases expand because the volume of gases is inversely proportional to pressure. This effect is more strongly felt above 12,000 feet and it leads to the expansion of gases in the hollow cavities of the body, thus causing discomfort and pain in the hollow organs (Almeida, 2001). Another effect is the decrease in temperature. For every 1,000 feet, the temperature drops 2 degrees Celsius and, given the patient's proximity to the aircraft fuselage, he/she tends to lose heat and should, therefore, be protected and kept away from it (Schweitzer et al., 2011). If the patient requires the administration of intravenous fluids, perfusion cooling may worsen his/her hypothermia. Exposure to cold causes chills, changes the heart rate and decreases consciousness.

Despite the so-called G-forces (acceleration/deceleration) and the fact that their effects are felt especially when taking-off and landing, those forces are smaller in helicopters, hence their advantage for

the transportation of critically ill patients. This is though the choice of the aircraft type (*fixed wing vs rotor wing)* results mainly from the distance travelled. The vibrations felt, especially when taking-off and landing, cause discomfort to the patient and require him/her, as well as the material transported, to be well immobilised. Trepidation and noise, which may reach up to 110-130 decibels, hinder communication and the clinical evaluation. In addition to all these changes, there may also be a feeling of sickness. Balance changes, the expansion of stomach gases, the increase of visual stimuli, stress, fear, and unpleasant smells may contribute to the onset and worsening of the state. The patient's condition and the altitude effect require a continuous monitoring of the problem. However, its focus is often hampered by the small space inside the aircraft, making the provision of care and emergency intervention difficult.

Conclusion

In Portugal, trauma is an important cause of mortality and morbidity, especially among the youngest age groups of the population. In 2010, 937 people died in road accidents, which is equivalent to 11.8 persons per 100,000 inhabitants, this being the second highest rate among the 15 Western European countries. It may be said that pre-hospital emergency care (a concept that is implicit in the blue "star of life" symbol) aims mainly at quickly helping critically ill patients, intervening in loco to keep them stabilised and then safely redirecting them to the nearest hospital. Whenever critically ill patients are rescued by air, which may cost 6,216.85$ per hour/flight, economic issues should under no circumstances impede the patients' transfer to where they may be provided with better care. Although, in air rescue missions, the INEM may ask the Portuguese Air Force for collaboration, the sharing of air assets adopted in 2012 between the Ministry of Internal Administration and the Ministry of Health, through the National Authority for Civil Protection and the INEM, became a valuable contribution to the effectiveness and efficiency of interventions with critically ill patients.

Other studies are suggested to disseminate the historical role played by the teams of doctors, nurses, commanders and pilots in Portugal in the emergency air transport system, thus contributing to a better and deeper knowledge in the area and, consequently, a better coordination and intervention between the parties involved.

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