Submitted: 09 September, 2023 Accepted: 30 October, 2023 Published: 08 April, 2024 DOI:10.22514/sv.2024.022

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Signa Vitae

ORIGINAL RESEARCH

The knowledge, confidence and attitudes of medical students in managing in-flight medical emergencies

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Abstract

In-flight medical emergencies (IMEs) are common during commercial airline flights. These events occur once every 100 to 1000 flights with pressurization corresponding to an altitude of 5000 to 8000 feet during the flight, low oxygen partial pressures and low humidity. This study was designed to evaluate the knowledge, confidence and attitudes of medical students in Saudi Arabia with regards to managing in-flight medical emergencies. A cross-sectional study targeting all medical students in Saudi Arabia was conducted using an online questionnaire. In total, we analyzed 378 medical students and interns; only 18% possessed an adequate perception of knowledge relating to IMEs; 36.8% felt assured in their IME response, 36.5% believed they could provide competent care, and only 34.5% considered their medical education was adequate for the treatment of IMEs. Our analyses showed that medical students in Saudi Arabia have inadequate confidence and knowledge in managing IMEs. Consequently, there is a significant gap in current medical school curricula in the Kingdom of Saudi Arabia that could be filled by implementing focused training on the management of IMEs.

Keywords

Emergency medicine; Medical emergencies; Medical students; Curricula

1. Introduction

In the United States, in-flight medical emergencies (IMEs) occur once in every 100 to 1000 flights [1]. IMEs are estimated to occur in 24 to 130 per one million passengers and are common during short- and long-haul commercial airline flights, both domestic and international [1, 2]. The factors that contribute to the high number of IMEs include the growth of the airline industry, a rise in the popularity of commercial flights coinciding with the aging traveler demographic, often with accompanying health issues or comorbidities [3, 4]. IMEs challenge healthcare professionals to apply limited treatment resources in cramped spaces with limited access and equipment [1–5]. These emergencies occur in a distinctive setting characterized by a cabin pressurization equivalent to altitudes of 5000 to 8000 feet, reduced oxygen levels, and low humidity conditions, while healthy individuals are usually able to ascend to an altitude of 7800 feet without difficulty [6, 7]. Individuals with cardiopulmonary comorbidities may face challenges in altitude variations. Various conditions, such as chronic obstructive pulmonary disease, pulmonary hypertension, or interstitial pulmonary disease, can increase the likelihood of experiencing hypoxia-related symptoms with increasing altitude [8]. Common IMEs include syncope or presyncope, respiratory symptoms, and gastrointestinal symptoms such as nausea or vomiting, along with cardiovascular symptoms [9, 10].

Many IMEs arise due to a combination of factors, including patient comorbidities, the flight environment as well as alcohol and drug use or withdrawal [8]. The Federal Aviation Administration (FAA) requires the presence of an automatic external defibrillator (AED) and an emergency medical kit in all American commercial airlines weighing 7500 pounds or more and serviced by at least one flight attendant [11]. The use of an AED during commercial flights has been validated as both safe and effective [12]. In addition, flight attendants must be trained to perform cardiopulmonary resuscitation (CPR); this training is usually valid for two years and must be renewed regularly [13]. In accordance with Saudi Arabian law, medical professionals, such as physicians and nurses, who are passengers on a flight, are expected to provide medical assistance in the event of an IME if requested by the crew. While Good Samaritan laws generally protect these healthcare providers from legal liability, they are still expected to act within the scope of their training and expertise. Previously, it has been reported that doctors are generally reluctant to respond to medical emergencies due to the fear of medico-legal concerns [8].

A considerable proportion of IMEs take place when no certified physician, nurse or paramedic is on board. In these instances, flight crews may benefit from the assistance of non-certified passengers such as medical students [14]. A study

conducted by Katzer *et al*. [5] in the US reported that 27% of medical students had encountered an IME, but only 3% offered their assistance. Moreover, another American study reported similar findings in that medical students, even in their final year of training, did not feel confident or competent in the management of in-flight medical emergencies [4]. No studies have yet been conducted in Saudi Arabia with regards to the knowledge of medical students' knowledge of IMEs. Therefore, this study aimed to assess the knowledge of Saudi Arabian medical students with regards to in-flight medicine, as well as their confidence and attitudes with regards to managing IMEs. Our findings will help to identify knowledge gaps and help inform curricula with regards to IMEs in the Kingdom's medical schools.

2. Methods

A cross-sectional study was conducted between March and April 2022 using a self-administered online questionnaire. The targeted sample was medical students (second to sixth year) and interns (seventh year) in Saudi Arabia. The questionnaire was adapted from a previously published research article [4]. The main part of the questionnaire was unchanged; only suitable minor modifications were applied on the section relating to demographic data. The questionnaire was reviewed for face validity by two expert physicians and piloted on 10 medical students to validate clarity. Next, the questionnaire was entered into Google Forms and distributed electronically *via* social media platforms through the medical student groups in Saudi Arabia, including WhatsApp (WhatsApp, Inc., Mountain View, CA) and Twitter (Twitter, Inc., San Francisco, CA). Although there were no pre-programmed restrictions in the number of responses from the same person, there were no repeated responses observed from the same respondent when checked by data collectors. Based on the most recent national statistics (published in February 2022), there are 20,436 medical students in Saudi Arabia [15]. The questionnaire was restricted to one response to avoid multiple attempts from the same user. The minimum sample size required for this study was calculated to be 378 assuming a confidence interval (CI) of 95%, as determined by the Raosoft sample size calculator. A self-assessed Knowledge, Attitudes and Practices (KAP) questionnaire was used to gather demographic data and general information, as well as information related to IMEs. The questionnaire was in English, the language of instruction at medical schools in Saudi Arabia and could be readily understood by the participants. The survey included multiple choice questions, true and false questions, and 5-point Likert-scale statements. All questions had to be answered. After verification, data was transferred to a statistical database. After extraction, data were revised, coded and entered into the statistical software IBM SPSS version 22 (SPSS, Inc. Chicago, IL, USA). Statistical analyses were performed using two-tailed tests; 60% of respondents were considered to have a sufficient knowledge level; this cut-off is in line with a similar study conducted in the US which yielded a mean correct percentage of 64% [1]. Students with a score $<$60% of the total score were considered to have a poor and insufficient knowledge level; this was in line with a previously conducted study based on Bloom's cut off point [11].

Descriptive analysis, based on frequency and percentage distribution, was performed for all variables including socio-demographic data, academic study, and the completion of Basic Life Support (BLS). In addition, the knowledge and attitude of students relating to the management of IMEs were shown in frequency tables and graphs. Cross-tabulation was used to assess factors associated with the knowledge of medical students with regards to managing IMEs. Relationships were tested using Pearson's chi-squared test and the exact probability test for small frequency distributions.

3. Results

3.1 Demographic analysis

A total of 6900 medical students received the study survey *via* social media platforms and 400 completed the questionnaire. Of these, 124 (31%) were in their pre-clinical study years (1st to 3rd years), 259 (64.8%) were in their clinical study years (4th to 6th years) while 17 (4.3%) were interns (7th year) (Table 1).

Student age ranged from 18 to 29 years, with mean age of 22.1 $\pm$ 5.9 years; 228 (57%) were female. The distribution of the students with regards to year of study was as follows: 16 in 1st year (4%), 33 in 2nd year (8.2%), 75 in 3rd year (18.8%), 81 in 4th year (20.2%), 100 in 5th year (25%), 78 in 6th year (19.5%) and 17 interns (4.4%). The distribution of students over different regions was as follows: 22 in the eastern region (5.5%), 142 in the western region (35.55%), 98 in the northern region (24.5%), 89 in the southern region (22.3%) and 49 in the central region (12.3%). A total of 312 (78%) students reported that they had completed a BLS course. These students most commonly reported completing BLS (77.6%), CPR (46%), and first aid (43.5%) courses. Few students had completed Emergency Medical Technician Basic (7%) or Advanced Cardiovascular Life Support (0.6%) courses. A total of 39 (9.8%) students had worked as a healthcare provider (emergency medical technician or nurse) and 18 (4.5%) held or had previously held a pilot's license from the FAA or other agency. Of the students, 56 (14%) had read a book about or attended a lecture on IMEs, 60 (15%) had been on an aircraft during an IME, and 22 (36.7%) assisted with an emergency (Table 2).

3.2 Attitude and confidence towards managing IMEs

More than half of respondents (58%) agreed or strongly agreed that their formal medical education had given them adequate knowledge and skills to render assistance during a medical emergency. However, only 36.8% reported that they felt confident responding to an IME, with 36.5% believing that they would currently provide competent care and 34.5% reporting that their medical education had given them adequate knowledge and skills (Table 3).

TABLE 1. Demographic details of the respondents included in the analysis.

Characteristic	n	%
Age in years		
<20	29	7.3%
20–24	332	83.0%
25–29	39	9.8%
Sex		
Male	172	43.0%
Female	228	57.0%
Academic phase		
Pre-clinical	124	31.0%
Clinical	259	64.8%
Intern	17	4.3%
Completed a course in Basic Life Support such as CPR, Emergency Medical Technician Basic (EMT-B) or first aid		
Yes	312	78.0%
No	88	22.0%
Which of these courses have you taken before?		
Basic Life Support—BLS	243	77.6%
Cardiopulmonary resuscitation—CPR	144	46.0%
First aid	136	43.5%
Advanced Trauma Life Support—ATLS	44	14.1%
Emergency Medical Technician Basic—EMT-B	22	7.0%
Advanced Cardiovascular Life Support—ACLS	2	0.6%

TABLE 2. Student experience with emergency medicine.

	n	%	n	%
Have you ever worked as a healthcare provider (emergency medical technician, nurse, *etc.*)?	39	9.8%	361	90.3%
Do you hold or have you ever held a pilot's license from the Federal Aviation Administration or any other agency?	18	4.5%	382	95.5%
Have you ever read a book about or attended a lecture on in-flight emergencies?	56	14.0%	344	86.0%
Have you ever been on an aircraft during a medical emergency?	60	15.0%	340	85.0%
If so, did you assist with the emergency?	22	36.7%	38	63.3%

3.3 Knowledge perception of medical students with regards to the management of IMEs

Only 7% of students correctly identified that the percentage of oxygen in the atmosphere does not decrease as altitude or elevation increases (Table 4). Almost one third of students (31.8%) were aware that the humidity in commercial aircraft cabins is relatively low when compared to typical ground-level building interiors, while only 7.3% were aware that the pressurization inside commercial aircraft cabins is equal to an altitude of approximately 8000 feet. Of the students, 36.3% knew that vasovagal attacks (syncope, fainting, dizziness) were the most common IMEs and 7.8% knew that licensed physicians are not required to respond to IMEs. Furthermore, 39.3% of the students knew that all flight crews are trained in the use of the AED, while only 16% knew about the presence of the medical kit. Only 29.8% of students were aware that the enhanced emergency kit required by the FAA does not have to contain a laryngoscope. Few of the students (13.3%) knew that the captain has the final say on flight diversion in case of an IME, and approximately a third (34.8%) believed that a minority of IMEs led to a diversion (Table 4).

Overall, only 72 students (17%) had sufficient understanding of the topic, while 328 (82%) had insufficient knowledge (Fig. 1).

3.4 Factors associated with the knowledge of medical students with regards to the management of IMEs

Almost one third of students (31.8%) were aware that the humidity in commercial aircraft cabins is relatively low compared to typical ground-level building interiors, while only

TABLE 3. Attitudes of medical students with regards to the management of IMEs.

	Strongly agree		Agree		Neutral		Disagree		Strongly disagree	
Attitude items	n	%	n	%	n	%	n	%	n	%
My medical education has given me adequate knowledge and skill to render assistance during a medical emergency	70	17.5%	162	40.5%	90	22.5%	54	13.5%	24	6.0%
My medical education has given me adequate knowledge and skill to render assistance during an in-flight medical emergency	28	7.0%	110	27.5%	114	28.5%	79	19.8%	69	17.3%
I have an adequate understanding of what medical supplies are required on commercial airplanes	36	9.0%	93	23.3%	81	20.3%	105	26.3%	85	21.3%
I have an adequate understanding of the level of training of commercial air crew in managing in-flight medical emergencies	33	8.3%	99	24.8%	81	20.3%	99	24.8%	88	22.0%
I have an adequate understanding of the manner in which the air crew, ground-based medical control, and the on- board volunteer healthcare providers work together to manage an in-flight medical emergency	38	9.5%	90	22.5%	85	21.3%	101	25.3%	86	21.5%
I would currently feel confident responding to an in-flight medical emergency	43	10.8%	104	26.0%	83	20.8%	82	20.5%	88	22.0%
I would currently provide competent care while responding to an in-flight medical emergency	45	11.3%	101	25.3%	89	22.3%	83	20.8%	82	20.5%

TABLE 4. Knowledge of medical students with regards to the management of IMEs.

Knowledge items	No	%
The percentage of oxygen in the atmosphere decreases as your altitude or elevation increases		
True	278	69.5%
False	28	7.0%
Don't know	94	23.5%
The humidity in cabin air on a commercial airline flight is typically relatively when compared to typical ground-level building Interiors		
Low	127	31.8%
High	70	17.5%
Don't know	203	50.8%
The pressure inside a commercial airplane cabin is typically equal to the pressure of		
Not pressurized	18	4.7%
Sea level	50	13.1%
2000 feet	16	4.2%
8000 feet	28	7.3%
15,000 feet	28	7.3%
Don't know	242	63.4%

TABLE 4. Continued.

Knowledge items	No	%
The most common in-flight medical emergency is		
Vasovagal (syncope, fainting, dizziness)	145	36.3%
Seizures	25	6.3%
Myocardial infarction (MI)	52	13.0%
Stroke	33	8.3%
Don't know	145	36.3%
Licensed physicians are required to respond to in-flight medical Emergencies		
True	224	56.0%
False	31	7.8%
Don't know	145	36.3%
All of the following equipment is required by the Federal Aviation Administration as part of the enhanced emergency kit, EXCEPT		
Aspirin	22	5.5%
Laryngoscope	119	29.8%
Inhaled bronchodilator	14	3.5%
Epinephrine 1:10,000	21	5.3%
Nitro-glycerin	19	4.8%
Don't know	205	51.3%
Flight crews are all trained in the use of the automated external Defibrillator		
True	157	39.3%
False	27	6.8%
Don't know	216	54.0%
Regarding the enhanced medical kit, flight crew members are required to		
Know the indications of its medications	64	16.0%
Take it out only on request	55	13.8%
Always take it out	36	9.0%
Always open it	22	5.5%
I don't know	223	55.8%
Who has the final say on whether the plane will be diverted because of an in-flight medical emergency?		
The responding physician	103	25.8%
The pilot in charge (captain)	53	13.3%
Ground-based medical control	37	9.3%
The patient	16	4.0%
Don't know	191	47.8%
Only a minority of in-flight medical emergencies result in the diversion of the plane		
True	139	34.8%
False	34	8.5%
Don't know	227	56.8%

7.3% were aware that the pressurization inside commercial aircraft cabins is equal to an altitude of approximately 8000 feet. Among the students, 36.3% knew that vasovagal attacks (syncope, fainting, dizziness) were the most common IMEs and 7.8% knew that licensed physicians are not required to respond to IMEs. In addition, 39.3% of students knew that all flight crews are trained in the use of the AED; only 16% knew about the presence of the medical kit. Only 29.8% of students were aware that the enhanced emergency kit required by the FAA does not have to contain a laryngoscope. Few of the students (13.3%) knew that the captain has the final say on flight diversion in case of an IME, and approximately a third of students (34.8%) believed that a minority of IMEs led to a diversion. Overall, only 72 students (17%) had sufficient understanding of the topic, while 328 (82%) had insufficient knowledge (Fig. 1). Significantly more students who completed a BLS course had a sufficient knowledge level when compared with those who did not take a course (20.5% *vs.* 9.1%; $p = 0.014$). No other variable significantly affected knowledge levels (Table 5).

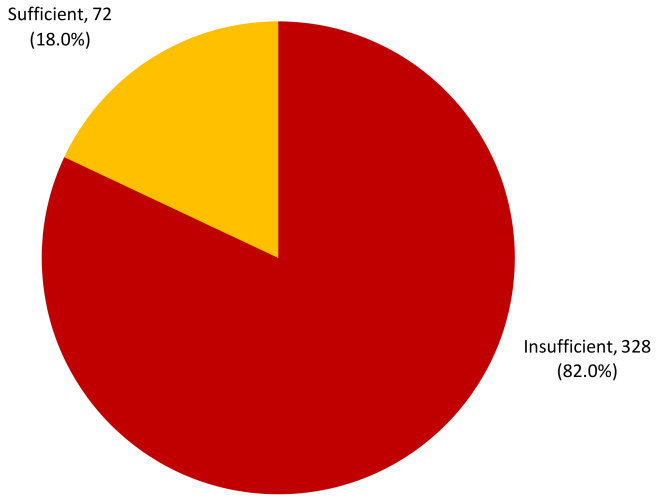

FIGURE 1. Overall self-reported knowledge of medical students with regards to the management of IMEs.

4. Discussion

IMEs pose unique challenges to healthcare professionals due to the confined environment and limited resources in aircraft cabins. Despite the relative frequency of IMEs and the need for medical assistance, most countries do not include IME management in their medical school curricula. This disregards the potential lifesaving contributions that even medical students could provide in such situations. To the best of our knowledge, this is the first study from the Middle East to assess the knowledge and attitudes of medical students with regards to the management of IMEs. Our findings showed that 15% of participants had been present during an IME and that 36.7% of them assisted in the emergency. Despite their importance, few studies have investigated the knowledge, confidence and attitudes of medical students with regards to the management of IMEs. A study conducted by Katzer *et al.* [5] in the US reported that 27% of medical students had encountered an IME, but only 3% offered their assistance. Another American study also reported similar findings [4]. The present study detected a greater willingness among Saudi medical students to assist in IMEs, thus aligning with the willingness levels reported for other Saudi healthcare professionals. For example, a study conducted by AlShamlan *et al.* [8] reported that one third of Saudi physicians had encountered an IME, with almost two-thirds assisting in the emergency. This greater willingness of physicians can be attributed to clinical training and confidence in their abilities. Previous research has shown that young doctors who encountered IMEs were hesitant to declare that they were physicians [14]. However, a lack of experience is not the only reason for hesitancy; other factors, such as medical liability issues, and whether someone else was already assisting, have also been described in the literature [16, 17]. Our analyses also showed that the majority (78%) of participants had completed a Basic Life Support (BLS) course. BLS training has been associated with an improvement in the knowledge and skills of healthcare providers in managing emergencies [19]. Only 36.8% of the students reported feeling confident in responding to IMEs despite completing BLS courses. Medical students must develop clinical skills and knowledge that can make them feel confident when dealing with emergencies. In this study, 39.3% of students knew that flight crews were well trained in the use of the Automated External Defibrillator (AED), but only 16% were aware that medical kits are available during flight. These findings are contradictory to those reported by Katzer *et al.* [5] who found that 94% of medical students were aware that American flight crews were trained in the use of the AED. However, Katzer *et al.* [5] included only final-year medical students, whereas almost a third of participants in our present study were preclinical students and only 4.3% were interns.

In the Katzer *et al.* [5] study, relatively few respondents agreed that formal medical education had adequately equipped them with the knowledge and skills to assist in a medical emergency. However, in the present study, more than half of our respondents (58%) believed that their formal medical education had equipped them for IMEs. Furthermore, a third of our respondents demonstrated an adequate knowledge of the training of commercial aircrew and the medical supplies required on every aircraft. Our results are consistent with those from a study conducted among medical students in the US [5]. Vasovagal attack (syncope, dizziness, fainting) is the most frequently encountered IME, accounting for 70% of all flight diversions [20]. This was correctly identified by 36.3% of participants in our study. Our analysis also revealed a relatively low level of knowledge regarding the percentage of oxygen in the atmosphere and cabin pressure when compared to medical students in the US. In the present study, there was no significant difference between male and female students with regards to managing IMEs. This finding is in contrast to a previous study of physicians in Saudi Arabia which found that male physicians had a higher willingness (12.7% *vs.* 7.9%) and confidence (18.3% *vs.* 12.4%) in managing IMEs than female physicians ($p = 0.01$); however, they the authors of this study did not assess the discrepancies regarding knowledge level among different genders [8]. Although this previous study reported that duration of experience (in years) as a physician

TABLE 5. Factors associated with the knowledge of medical students with regards to the management of IMEs.

Factors	Knowledge level				
	Insufficient		Sufficient		*p*-value
	n	%	n	%	
Age in years					
<20	22	75.9%	7	24.1%	
20–24	275	82.8%	57	17.2%	0.588
25–29	31	79.5%	8	20.5%	
Sex					
Male	142	82.6%	30	17.4%	0.801
Female	186	81.6%	42	18.4%	
Academic phase					
Pre-clinical	103	83.1%	21	16.9%	
Clinical	211	81.5%	48	18.5%	0.929
Intern	14	82.4%	3	17.6%	
Completed a course in Basic Life Support such as CPR, Emergency Medical Technician Basic (EMT-B), first aid, *etc.*					
Yes	248	79.5%	64	20.5%	0.014*
No	80	90.9%	8	9.1%	
Have you ever worked as a health care provider (emergency medical technician, nurse, *etc.*)?					
Yes	29	74.4%	10	25.6%	0.191
No	299	82.8%	62	17.2%	
Do you hold or ever held a pilot's license from the Federal Aviation Administration (FAA) or any other agency?					
Yes	13	72.2%	5	27.8%	0.269$
No	315	82.5%	67	17.5%	
Have you ever read a book about or attended a lecture on in-flight emergencies?					
Yes	43	76.8%	13	23.2%	0.273
No	285	82.8%	59	17.2%	
Have you ever been on an aircraft during a medical emergency?					
Yes	49	81.7%	11	18.3%	0.942
No	279	82.1%	61	17.9%	
If so, did you assist with the emergency?					
Yes	17	77.3%	5	22.7%	0.503$
No	32	84.2%	6	15.8%	

**p < 0.05 (significant); p, Pearson's Chi-squared test; $, Fisher's exact probability test. CPR: cardiopulmonary resuscitation.*

was significantly associated with willingness or confidence ($p = 0.05$), we found no significant association between academic year and experience as a student and willingness or confidence in managing IMEs. Of all factors associated with the knowledge of medical students with regards to managing IMEs, only completion of a BLS course was significantly associated with a sufficient level of knowledge. A previous study on the impact of BLS training concluded that BLS implementation had a significant impact on the general knowledge and skills of medical students [18]. The findings of our study reinforce the benefits of BLS training for medical students in terms of their knowledge and skills in terms of the management of IMEs. Furthermore, the simulation-based nature of BLS courses suggests that simulation training is an effective method for acquiring the necessary skills and knowledge related to IMEs. In addition, Padaki *et al.* [15] previously reported that simulation training improved the knowledge of medical students with regards to the management of IMEs.

5. Strengths and limitations

There are several strengths and limitations to this study that can be considered. First, this is the first study from the Middle East to investigate the knowledge, confidence and attitudes of medical students with regards to the management of IMEs; furthermore, our findings contribute new data to the limited scientific evidence available on this topic. Furthermore, this study had an adequate number of participants and included students with a wide range of experience from pre-clinical students to interns. However, our analyses are limited because of our reliance on self-reported data, which may have introduced bias and subjectivities; thus, our findings should be interpreted with caution. In addition, the medical students may have answered some questions in a manner they considered to be morally correct, which may have impacted our findings. Also, the use of social media could have added another form of bias with regards to the responses. However, this was the only feasible method to distribute the survey across a large geographical area of the kingdom. Finally, the ability to compare our data with the findings of other studies is limited in scope since only two studies have been published so far on the role of medical students in the management of IMEs.

6. Conclusions

Our analysis revealed that of all factors examined, the completion of a basic life support (BLS) course was positively associated with a sufficient level of perceived knowledge with regards to the clinical management of IMEs. It is noteworthy that the majority of participants had completed a BLS course, indicating a relatively high level of preparation among medical students in managing IMEs. This study highlights the importance of BLS training in enhancing the knowledge and skills of medical students with regards to managing IMEs. Moreover, the simulation-based nature of BLS courses suggests that simulation training is an effective method for acquiring the necessary skills and knowledge related to IMEs. Our overall findings underscore the need for ongoing training and education for medical students to ensure that they are well-equipped to manage IMEs effectively.

AVAILABILITY OF DATA AND MATERIALS

The data are contained within this article.

AUTHOR CONTRIBUTIONS

LA, TM, AA—designed the research study. LA, TM, AA, LM, SD, AhadB, AseelB—performed the research & analyzed the data & wrote the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Consent was obtained or waived by all participants in this study. The Biomedical Research Ethics Committee of Umm al-Qura University approved the study (reference number: HAPO-02-K-012-2022- 03-1004). All authors have confirmed that this study did not involve animal subjects or tissue.

ACKNOWLEDGMENT

The authors would like to thank all medical students who work in collecting the data of the research.

FUNDING

This research received no external funding.

CONFLICT OF INTEREST

All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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How to cite this article: Loui Alsulimani, Taha Masri, Aroob Abdulhalim, Lama Maksood, Saif Dahlawi, Ahad Babkier, *et al*. The knowledge, confidence and attitudes of medical students in managing in-flight medical emergencies. Signa Vitae. 2024; 20(4): 59-67. doi: 10.22514/sv.2024.022.