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Knowledge, attitude, practice, and barriers among physicians in the Middle East and North Africa region toward influenza vaccination for the high-risk group of patients: a cross-sectional study

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Abstract

Background The influenza vaccine is a cost-effective measure to reduce morbidity and mortality, especially for high-risk patients. Healthcare providers have an essential role in patients' education about vaccines. This study aims to examine physicians' understanding, perceptions, and practices regarding influenza vaccination in the Middle East and North Africa (MENA) region for high-risk patients.

Methods We conducted a multinational cross-sectional study in 21 countries in MENA region from July 10th to September 10th, 2023. Data were collected using an online self-administered survey distributed through different social media platforms. We used a valid questionnaire designed to determine the knowledge, attitude, and practice of physicians toward influenza vaccination. A multivariable binomial logistic regression analysis was conducted to identify significant predictors for offering the influenza vaccine.

Results In this study, which involved 2017 physicians (the mean (SD) age was 29 (± 6.2); 52% were males), the majority expressed a low to medium level of knowledge about influenza vaccination, with only 4% displaying a high level of knowledge. Regarding attitude, the majority ($n = 1511$, 74.9%) were quite concerned. However, only ($n = 509$, 25.4%) offered the vaccine to patients. The main predictors for offering the vaccine were age (adjusted odd ratio (AOR) = 1.036, 95%CI = 1.003–1.07, $p = 0.031$), male sex (AOR = 1.39, 95%CI = 1.09–1.77, $p = 0.007$), living in upper-middle-income countries (AOR = 3.14, 95%CI = 2.1–4.7, $p < 0.001$), having PhD degree (AOR = 3.15, 95%CI = 1.47–6.71, $p = 0.003$), being a senior resident (AOR = 2.005, 95%CI = 1.147–3.5, $p = 0.015$), working two to five shifts per week (AOR = 1.55, 95%CI = 1.02–2.35, $p = 0.04$), working more than five shifts per week (AOR = 1.75, 95%CI = 1.06- 2.88, $p = 0.027$), attitude (AOR = 1.33, 95%CI = 1.243- 1.44, $p < 0.001$), following these practices regarding influenz vaccination with the other office staff: Encourage and offer (AOR = 5.73, 95%CI = 4.11- 8.007, $p < 0.001$), require but do not offer (AOR = 3.73, 95%CI = 2.59- 5.38, $p < 0.001$), and require and offer the influenza vaccine (AOR = 6.79, 95%CI = 4.88- 9.45, $p < 0.001$) to the office staff. The main barriers to influenza vaccination were unawareness of vaccine availability (32%), cost (25%), and forgetfulness (23.4%).

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Conclusions Approximately half of the physicians were knowledgeable about the flu vaccine, but practice was deficient and impeded by barriers like unawareness and forgetfulness.

Keywords Influenza vaccines, Knowledge, Attitudes, Practice, Barriers, Middle East, North Africa, Physicians, High-risk

Introduction

Seasonal influenza is a preventable infectious disease with mostly respiratory symptoms. Every year, millions of people get infected by the influenza virus [1]. Influenza is associated with a broad spectrum of symptoms ranging from mild symptoms confined to the upper respiratory tract to severe and even fatal pneumonia owing to the influenza virus or secondary bacterial infection of the lower respiratory tract [2, 3]. Moreover, influenza virus infection can also lead to non-respiratory complications affecting the heart, central nervous system, and other body systems [4]. Characterized by yearly epidemics and sporadic pandemics, the World Health Organization estimates that influenza results in 3 to 5 million severe cases and 290,000 to 650,000 respiratory-related deaths each year [5].

High-risk individuals for complications from infections include young children with no prior exposure, elderly individuals with immunosenescence, those with concurrent chronic illnesses, and certain occupations [6, 7]. The influenza vaccine, recognized as the most cost-effective preventive measure, is particularly crucial for these high-risk groups, significantly reducing morbidity and mortality [8].

Healthcare providers, especially physicians, are pivotal in educating patients about the vaccine, influencing both patient knowledge and vaccination rates [9].

Despite this, vaccination coverage in the Middle East and North Africa (MENA) region remains suboptimal [10], which may be related to the complications of the region's situation due to the lack of widespread vaccination and the recent surge in fatal influenza cases [11] compounded by the increasing flu vaccine hesitancy after the COVID-19 pandemic [12]. All that necessitates research to understand and address the low uptake. This study aims to elucidate the knowledge, attitudes, practices, and barriers of MENA region physicians regarding influenza vaccination for high-risk patients, especially in the variation of policies according to vaccination among these countries. By identifying and understanding the barriers healthcare providers face in promoting the vaccine, which may range from economic and logistical to knowledge-based and perceptual, this research seeks to strengthen the role of healthcare providers in vaccine advocacy, enhancing patient education, and improving vaccination rates among vulnerable populations.

Methods

Study design and participants

A multinational cross-sectional study was conducted, including participants from 21 countries of the MENA region throughout the period from July 10th to September 10th, 2023. The included countries were classified as low-income (Somalia, Sudan, Syria, and Yemen), lower-middle-income (Algeria, Egypt, Jordan, Lebanon, Mauritania, Morocco, and Tunisia), upper-middle-income (Iraq, Libya, West Bank and Gaza, and Turkey) or high-income (Bahrain, Kuwait, Kingdom Saudi Arabia, Oman, Qatar, and United Arab Emirates) according to the World Bank classification [13]. An online self-administered survey was distributed among physicians' groups through social media platforms (Facebook, Telegram, WhatsApp, and Twitter).

The study was conducted according to the Helsinki Declaration of Medical Research Ethics and was approved by the Ethics Committee of Alexandria University's Faculty of Medicine in Egypt, with an IRB number of "00012098." A cover page summarizing the study's objectives, confidentiality, anonymity, and voluntary participation was presented to each participant. Participants were requested to provide their consent to participate in the study, and only participants who agreed to participate could proceed with the survey. No identifying information were collected from participants to maintain the anonymity of the survey. We limited each participant's response on the Google form to one to prevent duplicate entries.

We used both convenience sampling and snowball sampling methods to recruit the participants with the following inclusion criteria: Physicians who were in the practice of clinical medicine and had direct contact with patients at the time of the study, worked in the MENA region, and aged between 24 and 60 years. Only respondents who met these criteria (2017 participants) were included in the final analysis.

Study tool and variables

A questionnaire developed by the principal investigator was used for this study. The questionnaire was divided into multiple sections:

> The first section collected data on socio-demographic items as follows: age, sex, country of residence, highest educational degree, seniority rank, specialty, aver-

age working hours per shift, average working hours per week, and average working shifts per week.

The second section was a checklist of 19 items regarding health and age factors that are known to increase a person's risk of getting serious influenza complications according to the Centers for Disease Control and Prevention (CDC) (Supplementary Table 1), to determine the awareness of the participants about these factors (determine their ability to distinguish high-risk groups) [14].

The last section involved a valid questionnaire created by Vora et al. (Supplementary Table 2) to determine the knowledge, attitude, and practice of physicians toward influenza vaccination. The questionnaire involved three domains: the first one was designated to determine the level of knowledge and consisted of 26 questions; the second domain was to determine the attitude and consisted of 9 questions; and the last one consisted of 4 questions to determine the current practice of physicians toward influenza vaccination.

The interpretation of the questionnaire was done as follows:

For the knowledge domain, 1 point was given for each correct answer and 0 points for unsure or incorrect answers, for a total of 26 points. The total score was categorized as high (≥ 22 points), medium (17–21 points), or low (≤ 16 points).

For the attitude domain, responses were rated on a 5-point Likert scale. The agreement was defined as a strongly agree, agree, and correct response to positive statements and a strongly disagree, disagree, and incorrect response to negative statements. It was categorized as extremely concerned (agreement for 9 questions), quite concerned (agreement for 4–8 questions), little concerned (agreement for 1–3 questions), or not concerned (if there was no agreement at all).

Sample size

The primary outcome of this study was to determine the level of knowledge, attitude, and practice among physicians in the MENA region toward influenza vaccination for the high-risk group of patients. Due to a lack of similar studies in this region, the sample was calculated based on a previous study by Vora et al. which suggests that 82.95% of physicians held a strong attitude that vaccination prevents severe complications among high-risk patients [15]. To detect a similar effect with a 5% acceptable margin of error, a design effect of 1.5, and a 95% confidence level, a minimum sample of 326 participants was required for this study. The sample size was calculated using EPI Info software version 7.2.5.0.

Statistical analysis

Statistical analysis was performed using the Jamovi software, version 2.3.2 for Windows. The sample was described using mean and standard deviation, median and interquartile range, or mode and minimum and maximum for continuous data. Besides, frequencies and percentages were used to describe the categorical data. Student's t-test, Wilcoxon rank sum test, and Kruskal–Wallis one-way analysis of variance to compare continuous variables and chi-squared tests for categorical variables. Additionally, Spearman's rank correlation coefficient was used for correlation analysis. A multivariable binomial logistic regression analysis was performed to assess the significant predictors for offering the influenza vaccine. Analysis was conducted using adjusted odds ratios (AOR), and a confidence interval of 95% (95% CI) was reported. All *P* values and 95% CI were two-sided, and a p-value < 0.05 was considered statistically significant.

Results

Sociodemographic characteristics

Among the 2017 respondents involved in the final analysis, the mean (SD) age was 29 (± 6.2); ($n = 1048$, 52%) were males and ($n = 969$, 48%) were females. The majority of them had a bachelor's degree as their highest educational degree ($n = 1549$, 76.8%). About ($n = 732$, 36.3%) were interns, ($n = 421$, 20.9%) were general practitioners, ($n = 274$, 13.6%) were junior residents, ($n = 246$, 12.2%) were specialists, and ($n = 343$, 17.1%) were senior residents, sub-senior residents, and consultants. Concerning the workload, the median number of working shifts per week was 4 [1–10], and the mean number of working hours per shift was 11.8 ± 8.3 h, and the mean number of working hours per week was 39.8 ± 26.3. More than half of the participants work 2–5 h per shift ($n = 1314$, 18.7%) work more than 5 shifts per week, and ($n = 325$, 16.1%) work less than 2 shifts per week. ($n = 1173$, 58.2%) work for less than 12 h per shift, ($n = 801$, 39.7%) work for 12–24 h per shift, and only ($n = 43$, 2.1%) work for more than 24 h per shift. The sociodemographic characteristics of the study sample are shown in Table 1.

Awareness of the high-risk groups of patients

Regarding the awareness of the participants with risk factors that are known to increase the likelihood of serious influenza complications, as established by the Centers for Disease Control and Prevention (CDC), the median number of known items was 13 items,

Table 1 Sample characteristics

Variables	Overall (*N* = 2017)
Age	
Mean (SD)	29.0 (6.2)
Range	24.0—60.0
Sex	
Female	969 (48.0%)
Male	1048 (52.0%)
World Bank classification	
Low-income economies	403 (20.0%)
Lower-middle income economies	1088 (53.9%)
Upper-middle-income economies	395 (19.6%)
High-income economies	131 (6.5%)
Highest educational degree:	
Bachelor's degree	1549 (76.8%)
Diploma	49 (2.4%)
Master's degree	157 (7.8%)
PhD degree	128 (6.3%)
Fellowship or board	134 (6.6%)
Seniority rank	
Intern	732 (36.3%)
Not resident (general practitioner)	421 (20.9%)
Junior resident	274 (13.6%)
Sub-senior resident	113 (5.6%)
Senior resident	121 (6.0%)
Specialist	246 (12.2%)
Consultant	110 (5.5%)
Specialty	
Intern/General Practitioner	1153 (57.2%)
Anesthesiology	37 (1.8%)
Cardiology	50 (2.5%)
Dermatology	17 (0.8%)
Emergency Medicine	34 (1.7%)
Endocrinology	15 (0.7%)
Family Medicine	85 (4.2%)
Gastroenterology	23 (1.1%)
General Surgery	65 (3.2%)
Hematology	21 (1.0%)
Infectious Disease	11 (0.5%)
Intensive Care Unit	8 (0.4%)
Internal Medicine	110 (5.5%)
Nephrology	15 (0.7%)
Neurology	9 (0.4%)
Obstetrics And Gynecology	46 (2.3%)
Oncology	12 (0.6%)
Ophthalmology	34 (1.7%)
Orthopedic Surgery	30 (1.5%)
Otolaryngology (Ear, Nose, And Throat)	8 (0.4%)
Pediatrics	66 (3.3%)
Psychiatry	19 (0.9%)
Pulmonology	24 (1.2%)
Radiology	39 (1.9%)
Rheumatology	11 (0.5%)
Urology	17 (0.8%)
Others	58 (2.9%)
Working hours/shift	
Mean (SD)	11.7 (8.3)
Range	4.0—72.0
Working hours/shift	
Less than 12 h/shift	1173 (58.2%)
12–24 h/shift	801 (39.7%)
More than 24 h/shift	43 (2.1%)
Working shifts/week	
Mean (SD)	3.7 (1.9)
Range	1.0—10.0
Working shifts/week	
Less than 2 shifts/week	325 (16.1%)
2–5 shifts/week	1314 (65.1%)
More than 5 shifts/week	378 (18.7%)
Average working hours/week	
Mean (SD)	39.8 (26.3)
Range	10.0—144.0
Average working hours/week	
Less than 40 h/week	1089 (54.0%)
40–80 h/week	792 (39.3%)
More than 80 h/week	136 (6.7%)

with a minimum number of 0 and a maximum known number of 19 items. The item 'adults 65 years of age and older' was the highest item reported to be known by participants ($n = 1916$, 95%), followed by chronic lung disease ($n = 1897$, 94.1%), weakened immune system people ($n = 1887$, 93.6%), and asthmatic people ($n = 1853$, 91.9%). The item that was the least reported to be known by participants was 'people younger than 19 years old on long-term aspirin- or salicylate-containing medications' ($n = 806$, 40%). The distribution of participants' awareness of the risk factors is shown in Fig. 1.

Physicians' knowledge and attitude toward influenza vaccine

Participants had a mean knowledge score of 16.6 ± 3.2, about half of the participants ($n = 1006$,49.9%) had a medium knowledge level, ($n = 931$, 46.2%) had a low knowledge level, and only ($n = 80$, 4%) had a high knowledge level.

Physicians had a mean attitude score of 4.7 ± 1.8. The majority ($n = 1511$, 74.9%) were quite concerned, ($n = 468$, 23.2%) were little concerned, ($n = 20$, 1.4%) were not concerned, and only ($n = 9$, 0.4%) were extremely concerned toward the influenza vaccine. In addition, there was a significant correlation between the total knowledge score

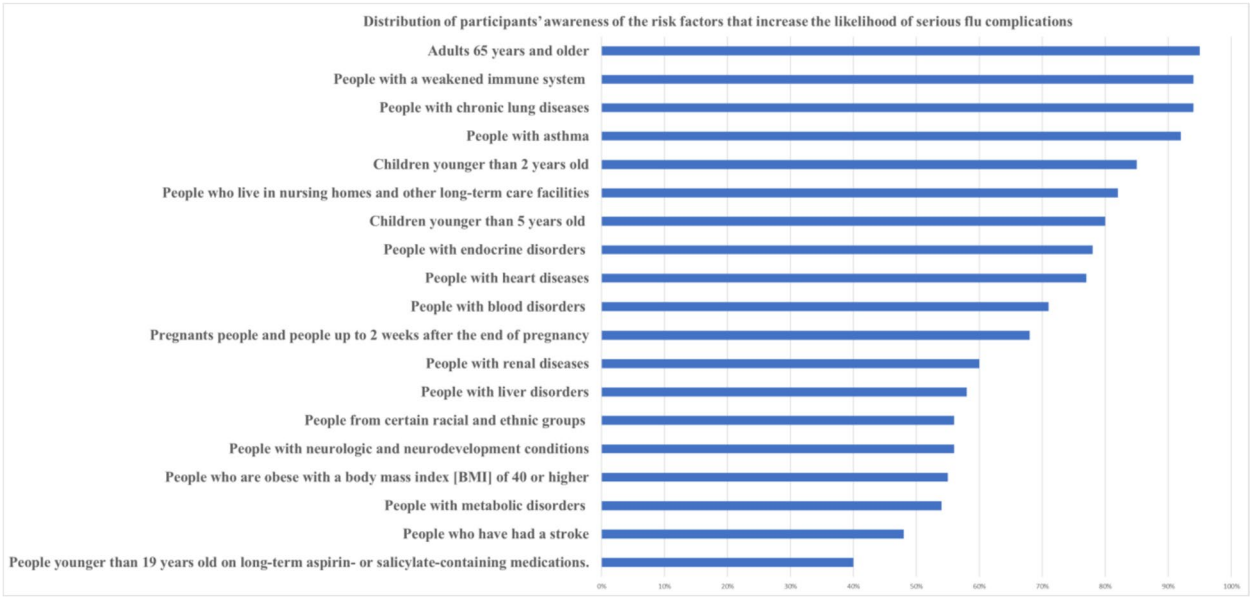

Fig. 1 The distribution of participants' awareness regarding different high-risk groups

and the total attitude score of the participants ($r = 0.326$, $p = < 0.001$) (Fig. 2).

Most of the participants answered the questions regarding the signs of influenza and coughing and sneezing as the primary modes of transmission correctly ($n = 1930$, 95.7%) and ($n = 1922$, 95.3%), respectively. However, about one-third only answered the questions regarding the difference between subunit and split influenza vaccines, the specific guidelines on preventive care for influenza, the latent period of influenza, and the

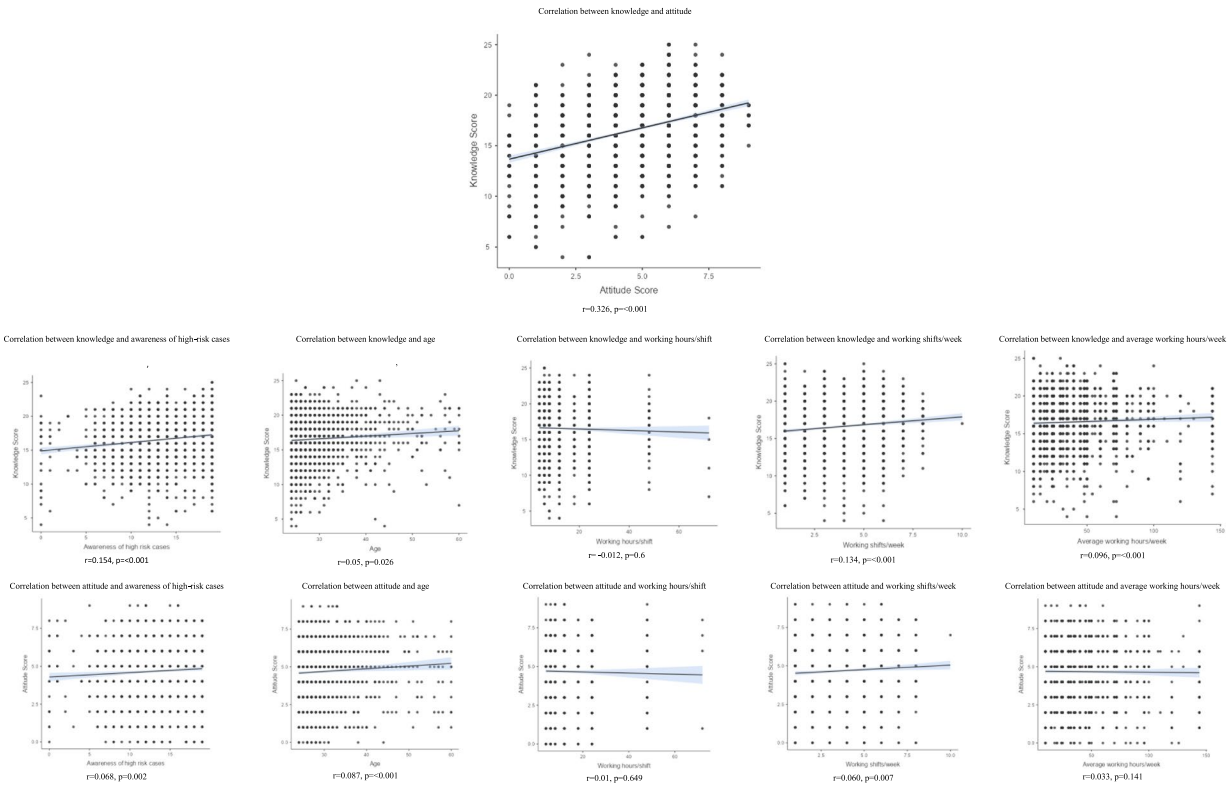

Fig. 2 Correlation analysis

difference between trivalent and quadrivalent influenza vaccines correctly. Physician awareness toward influenza and influenza vaccination is shown in Table 2.

Correlated factors with the physician's knowledge and attitude

There was a significant correlation between the knowledge total score of the participants and the number of known risk groups, age, average working hours/week, and the number of working shifts/week. ($p < 0.05$).

In addition, there was a significant correlation between their attitude total score and their number of known risk groups, age, and number of working shifts/week ($p < 0.05$) as shown in Fig. 2.

Association between the physicians' knowledge levels and different characteristics

Table 3 shows the association between knowledge levels and different characteristics of the participants. About ($n = 552$, 52%) of the male participants had a medium level of knowledge, while ($n = 485$, 50%) of the female participants had a low knowledge level. There was a significant association between the knowledge level and the sex of the participants ($p < 0.05$).

Besides, there was a significant association between the participants' knowledge level and their countries' income ($p < 0.05$).

More than half of the general practitioners, senior residents, and consultants had a medium level of knowledge, while about half of the junior residents, the sub-senior residents, and the interns had low knowledge levels. Those differences among the seniority groups were statistically significant ($p < 0.05$).

($n = 216$, 57.1%) of the participants who worked for more than 5 shifts per week had a medium level of knowledge, and ($n = 661$, 50%) of those who worked for 2–5 shifts per week had a medium level of knowledge, while ($n = 183$,56.3%) of the participants who worked for less than 2 shifts per week had a low level of knowledge. There was a significant association between the number

Table 2 Shows the physicians knowledge questionnaire percentage of correct answers

Knowledge Questions	Correct answers	
	N	%
Influenza is more serious than a "common cold"	1742	86.4
The signs and symptoms of influenza include fever, headache, sore throat, cough, nasal congestion, and aches and pains	1930	95.7
Symptoms typically appear 8 to 10 days after a person is exposed to influenza	650	32.2
Influenza is transmitted primarily by coughing and sneezing	1922	95.3
Influenza is transmitted primarily by contact with blood and body fluids	1497	74.2
People with influenza can transmit the infection only after their symptoms appear	1200	59.5
Not everyone in the general public is familiar with influenza vaccination"	1535	76.1
What do you think is the most effective way of publicizing influenza vaccine? (you may state multiple answers for this question)"	1562	77.4
Influenza vaccines can be live or inactivated"	1499	74.3
In case of mismatch of virus strains, the influenza vaccine efficacy may be reduced"	1144	56.7
I believe influenza vaccine is tolerable"	1413	70.1
The inactivated influenza vaccine contains live viruses that may cause some people to get influenza"	905	44.9
How often do you think the influenza vaccine should be administered?"	1626	80.6
How long do you think influenza vaccine can protect?"	1257	62.3
What is the appropriate time to give influenza vaccine?"	1835	91.0
As per your opinion, which are the high-risk groups associated with influenza?"	1625	80.6
Influenza vaccine needs to be taken on an annual basis"	1696	84.1
As a physician, do you feel you are at risk to get influenza and should get vaccinated annually?"	1611	79.9
Can physicians spread influenza to their patients?"	1844	91.4
Are you familiar with any specific guidelines on preventive care for influenza? "	651	32.3
Does the Center for Disease Control (CDC) recommend that health care practitioners should receive the flu shot?"	1146	56.8
Do you know the difference between trivalent and quadrivalent influenza vaccines?"	761	37.7
A quadrivalent flu vaccine offers broader protection over a trivalent flu vaccine"	1123	55.7
There is a difference between subunit and split influenza vaccines"	614	30.4
A subunit flu vaccine is less reactogenic"	736	36.5

Table 3 Association between the levels of knowledge and different sample characteristics

Variables	Low Knowledge $n=931$ (46.2%)		Medium Knowledge $n=1006$ (49.9%)		High Knowledge $n=80$ (4%)		*p*-value*
	N	%	N	%	N	%	
Sex							
Female	485	50.1%	454	46.9%	30	3.1%	
Male	446	42.6%	552	52.7%	50	4.8%	$p=0.001$
World Bank classification							
Low-income economies	277	68.7%	120	29.8%	6	1.5%	
Lower-middle income economies	429	39.4%	604	55.5%	55	5.1%	
Upper-middle-income economies	176	44.6%	205	51.9%	14	3.5%	
High-income economies	49	37.4%	77	58.8%	5	3.8%	$p<0.001$
Highest educational degree							
Bachelor's degree	741	47.8%	749	48.4%	59	3.8%	
Diploma	23	46.9%	25	51.0%	1	2.0%	
Master's degree	68	43.3%	81	51.6%	8	5.1%	
PhD degree	46	35.9%	79	61.7%	3	2.3%	
Fellowship or board	53	39.6%	72	53.7%	9	6.7%	$p=0.066$
Seniority rank							
Intern	368	50.3%	333	45.5%	31	4.2%	
Not resident (general practitioner)	193	45.8%	215	51.1%	13	3.1%	
Junior resident	136	49.6%	129	47.1%	9	3.3%	
Sub-senior Resident	55	48.7%	54	47.8%	4	3.5%	
Senior resident	51	42.1%	66	54.5%	4	3.3%	
Specialist	89	36.2%	141	57.3%	16	6.5%	
Consultant	39	35.5%	68	61.8%	3	2.7%	$p=0.006$
Working hours/shift							
Less than 12 h/shift	525	44.8%	601	51.2%	47	4.0%	
12–24 h/shift	387	48.3%	383	47.8%	31	3.9%	
More than 24 h/shift	19	44.2%	22	51.2%	2	4.7%	$p=0.636$
Working shifts/week							
Less than 2 shifts/week	183	56.3%	129	39.7%	13	4.0%	
2–5 shifts/week	601	45.7%	661	50.3%	52	4.0%	
More than 5 shifts/week	147	38.9%	216	57.1%	15	4.0%	$p<0.001$
Average working hours/week							
Less than 40 h/week	550	50.5%	497	45.6%	42	3.9%	
40–80 h/week	326	41.2%	429	54.2%	37	4.7%	
More than 80 h/week	55	40.4%	80	58.8%	1	0.7%	$p<0.001$

* Pearson's Chi-squared test

of shifts per week and the level of knowledge of the participants. ($p<0.05$).

Association between the physicians' attitude levels and different characteristics

Table 4 shows the association between the participants' attitudes and the different characteristics of the participants. ($n=786$, 75%) of the male and female participants had quite concerned attitudes. However, there was no significant association between the attitude level and the sex of the participants.

Regarding the highest educational degree of the participants, there was a significant difference between the attitude level and the educational degree of the participants, and the majority of each group were of quite concerned attitude regarding the influenza vaccine ($p<0.05$). Besides, the number of hours that the physicians used to

Table 4 Association between the levels of attitude and different sample characteristics

Variables	Not Concerned $n=20$ (1.4%)		Little Concerned $n=468$ (23.2%)		Quite Concerned $n=1511$ (74.9%)		Extremely Concerned $n=9$ (0.4%)		*p*-value*
	N	%	N	%	N	%	N	%	
Sex									
Female	14	1.4%	226	23.3%	725	74.8%	4	0.4%	
Male	15	1.4%	242	23.1%	786	75.0%	5	0.5%	$p=0.996$
World bank classification									
Low-income economies	7	1.7%	102	25.3%	293	72.7%	1	0.2%	
Lower-middle income economies	18	1.7%	257	23.6%	807	74.2%	6	0.6%	
Upper-middle-income economies	3	0.8%	88	22.3%	302	76.5%	2	0.5%	
High-income economies	1	0.8%	21	16.0%	109	83.2%	0	0.0%	$p=0.428$
Highest educational degree									
Bachelor's degree	26	1.7%	369	23.8%	1150	74.2%	4	0.3%	
Diploma	0	0.0%	9	18.4%	40	81.6%	0	0.0%	
Master's degree	1	0.6%	43	27.4%	108	68.8%	5	3.2%	
PhD degree	2	1.6%	17	13.3%	109	85.2%	0	0.0%	
Fellowship or board	0	0.0%	30	22.4%	104	77.6%	0	0.0%	$p<0.001$
Seniority rank									
Intern	9	1.2%	182	24.9%	540	73.8%	1	0.1%	
Not resident (general practitioner)	8	1.9%	91	21.6%	321	76.2%	1	0.2%	
Junior resident	7	2.6%	73	26.6%	192	70.1%	2	0.7%	
Sub-senior resident	1	0.9%	30	26.5%	82	72.6%	0	0.0%	
Senior resident	1	0.8%	22	18.2%	96	79.3%	2	1.7%	
Specialist	1	0.4%	48	19.5%	194	78.9%	3	1.2%	
Consultant	2	1.8%	22	20.0%	86	78.2%	0	0.0%	$p=0.122$
Working hours/shift									
Less than 12 h/shift	13	1.1%	268	22.8%	887	75.6%	5	0.4%	
12–24 h/shift	16	2.0%	183	22.8%	599	74.8%	3	0.4%	
More than 24 h/shift	0	0.0%	17	39.5%	25	58.1%	1	2.3%	$p=0.036$
Working shifts/week									
Less than 2 shifts/week	6	1.8%	81	24.9%	236	72.6%	2	0.6%	
2–5 shifts/week	17	1.3%	304	23.1%	988	75.2%	5	0.4%	
More than 5 shifts/week	6	1.6%	83	22.0%	287	75.9%	2	0.5%	$p=0.921$
Average working hours/week									
Less than 40 h/week	16	1.5%	268	24.6%	801	73.6%	4	0.4%	
40–80 h/week	7	0.9%	159	20.1%	622	78.5%	4	0.5%	
More than 80 h/week	6	4.4%	41	30.1%	88	64.7%	1	0.7%	$p=0.002$

* Pearson's Chi-squared test

work per shift has a statistically significant association with the level of attitude of the physicians. ($p<0.05$).

Practice of the physicians towards offering the influenza vaccine to their patients

Regarding the practice of the physicians towards offering the influenza vaccine to their patients, only ($n=509$, 25.4%) of the participants offered the influenza vaccine to their patients. Of those who offer the vaccine, ($n=199$, 39%) offer it to less than 10% of their patients, ($n=127$, 25%) to more than 40%, ($n=117$, 23%) to 10–25%, and ($n=61$, 12%) to 25–40%.

Furthermore, binomial logistic regression analysis was performed to classify physicians' practice of offering the influenza vaccine based on values of a set of predictor factors. The dependent variable (offering influenza vaccine) involved two levels (offer and didn't offer the influenza vaccine). We used "didn't offer influenza vaccine" as a reference level.

Table 5 Regression analysis for offering the influenza vaccine

Predictor		Univariable				Multivariable			
		p	OR	95% Confidence Interval		p	AOR	95% Confidence Interval	
				Lower	Upper			Lower	Upper
Age		< .001	1.0598	1.044	1.0759	0.031	1.03629	1.003	1.07034
Sex	Male	< .001	1.729	1.409	2.122	0.007	1.39073	1.093	1.76902
World Bank classification	Lower-middle-income economies	< .001	1.761	1.277	2.428	0.016	1.57871	1.088	2.2915
	Upper-middle-income economies	< .001	5.141	3.628	7.286	< .001	3.13992	2.095	4.7063
	High-income economies	< .001	4.12	2.618	6.483	0.028	1.79246	1.065	3.01685
Highest educational degree	Diploma	< .001	3.154	1.773	5.613	0.174	1.64066	0.803	3.35076
	Master's degree	< .001	2.087	1.47	2.963	0.544	1.21815	0.644	2.30252
	Doctoral's degree	< .001	5.478	3.774	7.952	0.003	3.14519	1.473	6.71655
	Fellowship or Board	0.002	1.829	1.247	2.683	0.853	1.07394	0.505	2.28607
Seniority rank	Not resident (general practitioner)	0.082	1.308	0.967	1.769	0.711	1.06808	0.754	1.51274
	Junior resident	0.003	1.65	1.184	2.301	0.364	1.20043	0.809	1.78048
	Sub-senior Resident	0.206	1.366	0.842	2.217	0.906	0.96564	0.541	1.72256
	Senior resident	< .001	3.625	2.411	5.45	0.015	2.00518	1.147	3.50415
	Specialist	< .001	3.954	2.883	5.424	0.92	1.03912	0.49	2.20383
	Consultant	< .001	2.642	1.71	4.083	0.278	0.56589	0.202	1.5827
Working shifts/week	2–5 shifts/week	< .001	2.638	1.854	3.753	0.04	1.55104	1.02	2.35897
	More than 5 shifts/week	< .001	3.234	2.176	4.805	0.027	1.75165	1.065	2.88012
Average working hours per week	40–80 h/week	< .001	1.832	1.484	2.263	0.632	1.07061	0.809	1.41599
	More than 80 h/week	< .001	2.042	1.39	3.001	0.11	1.48884	0.913	2.42669
Knowledge score		< .001	1.0897	1.0544	1.126	0.971	1.00075	0.961	1.04205
Attitude score		< .001	1.5035	1.407	1.6066	< .001	1.33863	1.243	1.44213
The practice followed regarding the influenza vaccine	Encourage and offer the influenza vaccine	< .001	7.6014	5.5899	10.337	< .001	5.73807	4.112	8.00735
	Require, but do not offer the influenza vaccine	< .001	5.0074	3.5995	6.966	< .001	3.73686	2.591	5.38909
	Require and offer the influenza vaccine	< .001	8.5474	6.3022	11.593	< .001	6.79509	4.883	9.45558

Table 5 shows the results of binomial logistic regression analysis. In the multivariable model, age was a significant predictor for offering the vaccine (adjusted odd ratio (AOR) = 1.036, 95%CI = 1.003–1.07, $p = 0.031$). Furthermore, males tend to offer the vaccine more than females (AOR = 1.39, 95%CI = 1.09–1.77, $p = 0.007$). The country's income was a significant predictor for offering the vaccine and participants from upper-middle-income countries tended to offer the vaccine more frequently than others (AOR = 3.14, 95%CI = 2.1–4.7, $p < 0.001$). The probability of offering influenza vaccine was higher among participants with doctoral degrees (AOR = 3.15, 95%CI = 1.47–6.71, $p = 0.003$), senior residents (AOR = 2.005, 95%CI = 1.147–3.5, $p = 0.015$), working two to five shifts per week (AOR = 1.55, 95%CI = 1.02–2.35, $p = 0.04$), working more than five shifts per week (AOR = 1.75, 95%CI = 1.06- 2.88, $p = 0.027$), and higher attitude score (AOR = 1.33, 95%CI = 1.243- 1.44, $p < 0.001$). In addition, participants who follow the following practice regarding influenza vaccine for office staff tended to offer the vaccine more: encourage and offer the influenza vaccine (AOR = 5.73, 95%CI = 4.11- 8.007, $p < 0.001$), require, but do not offer the influenza vaccine (AOR = 3.73, 95%CI = 2.59- 5.38, $p < 0.001$), require and offer the influenza vaccine (AOR = 6.79, 95%CI = 4.88- 9.45, $p < 0.001$).

Barriers that hinder physicians from offering the influenza vaccine

Regarding the barriers that hindered the participants from providing the influenza vaccine, ($n = 653$, 32%) of the physicians reported unawareness of the availability of the vaccine in their settings, ($n = 505$, 25%) reported the cost of the vaccine, ($n = 472$, 23.4%) reported that they forgot to offer it, ($n = 235$, 11.7%) reported that patients scared of needles, ($n = 196$, 9.7%) reported that they thought it's not beneficial, and ($n = 188$, 9.3%) for the history of side effects. Furthermore, approximately

($n = 524$, 26%) reported not applicable reason, and ($n = 505$, 25%) mentioned other reasons.

The association between the World Bank classification of participants' countries and their reported barriers to offering the vaccine to their patients was significant ($p < 0.001$) for all factors except for 'think it is not beneficial' ($p = 0.22$) as shown in Fig. 3.

Discussion

This study reveals that while participants are generally aware of high-risk groups for influenza complications, their overall knowledge about influenza and vaccination is moderate, with only a minority having high knowledge levels. Citing barriers such as unawareness of availability, cost, forgetfulness, and patient concerns about needles, the findings provide a comprehensive overview of physicians' knowledge, attitudes, practices, and barriers regarding influenza vaccination across several MENA countries.

Awareness of the high-risk groups of patients

Physicians' awareness of patients at high risk for influenza complications is crucial, especially in countries with limited resources. In this cross-sectional study, we found that physicians had an acceptable awareness of high-risk groups (the median number of known items was 13 items, with a minimum number of 0 and a maximum known number of 19 items). However, some groups were less known to participants, such as children and adolescents (< 19 years old) on long-term aspirin or salicylate therapy, patients with a history of stroke, and patients with metabolic disorders, whereas the elderly population constituted the primary focal point for a significant majority of physicians in our study. This can be attributed to the fact that, in many studies examining risk groups, the focus has predominantly been on individuals aged 65 years and older, as they are considered the most vulnerable population [16]. Children pose a significant risk

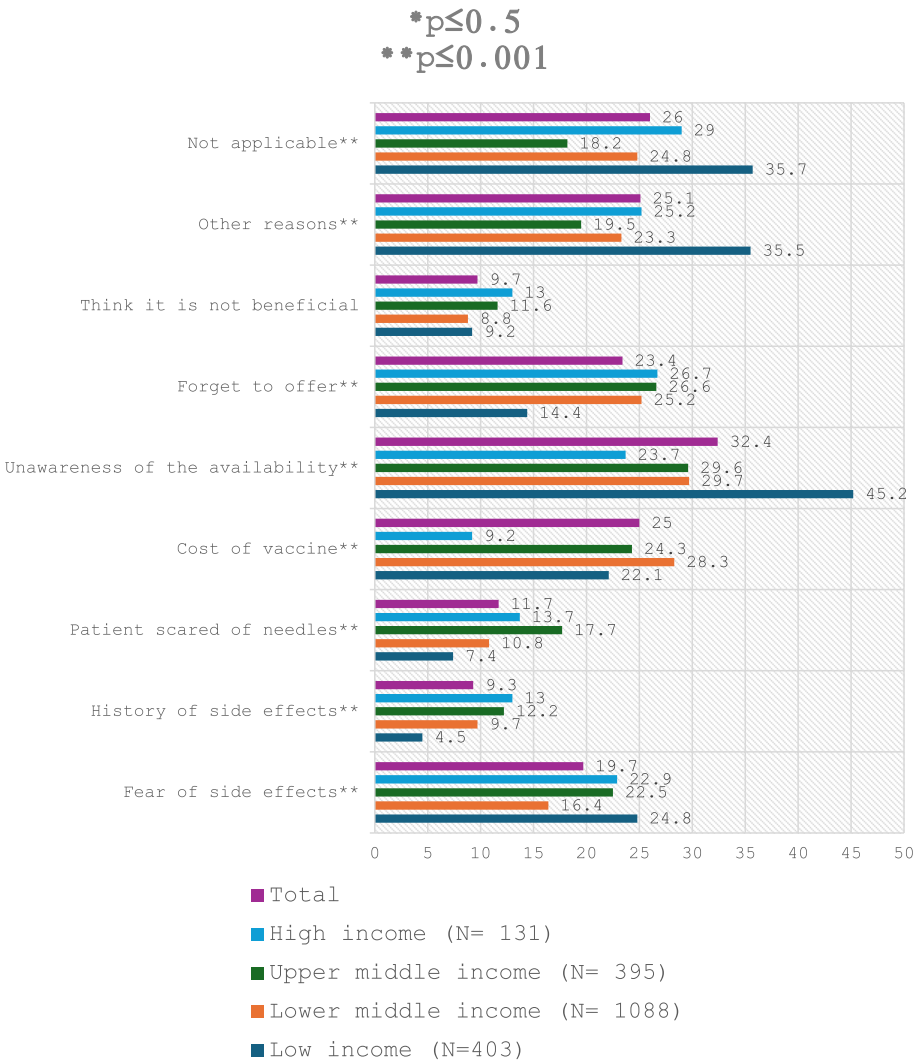

Fig. 3 Distribution of reported barriers that hinder physicians from offering the influenza vaccine

of spreading infections to their parents and caregivers. A report on the mortality of children due to influenza revealed that half of the deceased children had an underlying medical condition that made them more susceptible to severe influenza-related complications [17]. Because healthcare professionals often avoid giving aspirin to individuals under age 16 due to concerns about Reye's syndrome, this particular group constitutes a minority from the perspective of the majority of physicians in the context of the influenza vaccine, leading to their hesitation in addressing its needs [18]. Diabetes has the highest prevalence in the MENA region, emphasizing the importance of prioritizing comprehensive vaccination efforts within this high-risk group [19]. Additionally, chronic kidney disease has also been reported to have elevated rates in the MENA region [20]. However, physicians have not given sufficient attention to this issue. In contrast, while asthma is less prevalent in this region, healthcare providers still consider it as a contributing factor that can increase the risk of other health problems [21].

Physicians' knowledge and attitude toward influenza vaccine

In our research, we discovered that physicians were distributed fairly evenly between those with limited knowledge and those with moderate knowledge, with only a small percentage (less than 4%) demonstrating a high level of expertise concerning the vaccine. Additionally, the majority (74.9%) had a quite concerned attitude toward the vaccination of high-risk groups. These findings are consistent with those of Vora et al. [15], who reported that of 780 physicians from India, about 53% had a medium level of knowledge and almost 4% had a high level of knowledge, but according to attitude, about 92% were quite concerned about the vaccine. These differences may be attributed to the differences in the samples between the two studies, as the sample in the Vora et al. [15] study consisted of physicians with more than 5 years of clinical experience and had previous experience in treating high-risk patients with increased risk of influenza-associated complications. Notably, males had a higher level of knowledge than females, and this result was observed previously in the general population [22]. However, sex difference in the level of knowledge was not observed in other studies on physicians [23].

A country's income plays an important role in physicians' knowledge. Participants from high-income economies have better knowledge than those from low-income. This situation may arise due to financial ability in healthcare facilities and the inclusion of influenza vaccines as a requirement under health insurance policies, such as in the case of Gulf Cooperation Council (GCC) countries [10].

In addition, consultants tended to have a higher level of knowledge compared to other seniority ranks; this result has been observed in other studies [9, 23, 24]. Working time was positively associated with knowledge level. Participants who worked longer hours or more frequent shifts had a better awareness of the influenza vaccine and its importance, maybe because of the accumulated experience due to heavy loads of work. Consequently, these healthcare professionals exhibit a strong tendency to enhance their knowledge of preventive measures, such as vaccination [25]. In addition, participants with PhDs were more concerned about influenza vaccination, a finding that can be interpreted as a reflection of their dedicated adherence to guidelines. As a result, they may possess a heightened awareness of the importance of adhering to vaccination guidelines and recommendations.

We found a significant positive correlation between participants' knowledge and attitudes. Participants with higher knowledge exhibited better attitudes, as obvious in many other studies [9, 15, 26].

In addition, our results showed a significant correlation between the level of knowledge and age and the level of attitude and age. Older physicians, who were seniors, possess greater experience and a more profound understanding of guidelines compared to junior physicians, which significantly influences their medical practice, particularly in advocating for vaccination [27].

Practice of the physicians towards offering the influenza vaccine to their patients

In this cross-sectional study, the majority of the participants did not offer the vaccine to any of their patients (74.6%), and those who offered it only offered it to a small proportion of their patients (39% offered it to less than 10% of their patients).

Several factors were associated with the tendency to offer the vaccine. The analysis indicates that age was a significant predictor for offering the vaccine, with older physicians being more likely to offer it. This could be attributed to greater clinical experience and possibly a stronger appreciation for the vaccine protective benefits, which aligns with previous research suggesting that older workers have a better understanding of the benefits of the vaccine [28].

Also, males tended to offer the vaccine more frequently than females, which may reflect broader trends in healthcare practice or possibly differences in workload and responsibilities that have not been fully explored in the literature. In the same context, the interesting finding of the correlation between the number of shifts worked and the likelihood of offering the vaccine suggests that physicians with a higher workload may have more opportunities to offer the vaccine.

Physicians with doctoral degrees and senior staff had a higher likelihood of offering a vaccine, which suggests that advanced education and training positively impact physicians' vaccination practices. This is consistent with another finding in our study, which indicates a strong association between the level of attitude and vaccine-offering practice, emphasizing the role of physicians' beliefs and concern in influencing clinical behavior. Notably, participants from countries with higher incomes prescribed the vaccine to their patients more than those from lower incomes, which may be due to better healthcare infrastructure or greater vaccine availability compared to lower income settings.

Finally, the practices regarding influenza vaccination for office staff revealed that encouragement and requests to vaccinate significantly increased the likelihood of offering the vaccine to patients. This finding suggests that institutional policies and culture play a crucial role in promoting vaccination among healthcare providers [29].

Barriers

Many barriers hinder the offering of the vaccine to patients and emphasize the current inappropriate clinical practice that leads to low vaccination rates among high-risk groups of patients reported by physicians. Unawareness of vaccine availability was the predominant barrier for physicians, except for physicians who lived in high-income countries according to the World Bank classification, as forgetting to offer the vaccine was the most common barrier. The same reason was the most reported barrier in the study by Amin et al. [30]. The majority of hospitals and medical centers in the MENA region, except in GCC do not provide the vaccine to their patients, and most patients have to look for the vaccine in private pharmacies. In addition, the influenza vaccine is only available for a few weeks each year. As a result, most physicians are unaware of vaccine availability, and this result was observed previously in a study on the Lebanese population [31]. The financial aspect was a significant barrier, especially in settings where patients had to pay out of pocket or where the health care system did not cover the vaccination [32]. Forgetting to offer vaccines points to organizational challenges, which can be reduced by integrating reminder systems into electronic health records. The significant association between the World Bank's classification of countries and reported barriers indicates that economic factors likely play a role in these barriers. However, the influenza vaccination landscape in the (MENA) region is diverse. Some countries have robust policies, programs, and vaccine supplies, while others lack these entirely. These disparities are likely influenced by differences in resources, as well as social, political, and economic factors [33].

Strength and limitations

The strength of this study relies in its inclusion of multiple countries characterized by significant variations in resources and vaccine policies. Since this study was conducted as a survey, there are several limitations to consider when interpreting the presented results. The primary constraint is that the findings rely on the respondents' perceptions without the ability to verify the sources of data directly. Additionally, the cross-sectional design of the study restricts its ability to establish causal relationships between variables, and due to the questionnaire being published on the platforms, we were unable to calculate the response rate Furthermore, the healthcare systems across the nations included in this study exhibit considerable heterogeneity. While low-income countries often lack comprehensive vaccine policies, the majority of GCC countries have implemented active vaccination policies. Moreover, while efforts were made to recruit healthcare workers from various regions within each country, there is possibility of overrepresentation from major healthcare facilities, particularly in urban centers, as well as language barriers in some North African countries and variability in internet accessibility may have affected the participation and responses. This may not fully capture the regional diversity within countries; therefore, the findings may not be entirely representative of all the regions within these countries. Finally, a limitation of utilizing a self-reported questionnaire is the potential for common method bias, particularly when the survey assesses both the independent and dependent variables concurrently. This methodological approach can introduce systematic error and inflate the observed relationships between the variables of interest.

Recommendations

Our study on influenza vaccine knowledge, attitudes, and practices among healthcare providers in the MENA region highlighted several recommendations to boost vaccine uptake and engage healthcare providers more effectively.

Firstly, we need to bridge the knowledge gap among healthcare providers; it's crucial to provide educational interventions that enhance their understanding of the vaccine's importance and safety. Although mandatory workshops, online training modules, and continuous professional development programs can keep providers up-to-date with the latest guidelines and recommendations, they are still traditional ways. It is recommended to use additional approaches more than traditional ways, such as interactive digital platforms or mobile applications that can educate HCWs about influenza vaccination in a fun and interactive way. Implementing vaccine

policies in developing countries is vital to improving attitudes towards influenza vaccination. Emerging agencies should work to license influenza vaccines in these countries by collaborating with international organizations to secure vaccine supply. Advocating for affordable or government-funded vaccination options can have a positive impact and improve accessibility for the population.

For high-income countries, despite the existence of vaccine policies, one common reason for non-administration of influenza vaccines is forgetting to prescribe the vaccine. To address this issue, implementing reminder systems and integrating vaccination prompts into electronic health records can be a game changer. These simple tools can prompt providers during patient encounters, ensuring vaccines are offered consistently. In summary, our recommendations focus on closing the knowledge gap, improving attitudes, and ensuring vaccine availability and accessibility among healthcare providers in the MENA region. By implementing these strategies, we can actively engage providers in promoting vaccination, ultimately reducing the burden of influenza in the region. Furthermore, great benefits from increasing vaccination rates, such as reducing morbidity, mortality, and utilization of the healthcare system, which leads to a decrease in the load on the healthcare system, can be achieved.

Conclusions

In conclusion, this multinational study on influenza vaccination in the MENA region identifies a significant gap in both knowledge and practice among healthcare providers, especially junior staff and those with fewer working shifts. These findings highlight the need for further research to address these deficiencies. The correlation between knowledge and attitude suggests that increasing awareness could positively influence physicians' willingness to offer vaccination. However, practical barriers such as vaccine availability and cost significantly impede this practice. The findings highlight the urgent need for targeted educational intervention and systemic changes to address these barriers, thereby improving vaccination rates, especially among high-risk patient groups. Such efforts are essential to enhance the role of physicians in advocating for and administering the influenza vaccine, ultimately contributing to better public health outcomes.

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

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Authors' contributions

SMS and DH declare that they had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. SMS and AB contributed to the study's conceptualization. SMS contributed to the methodology and validation. SMS contributed to data curation. SMS and DH conducted the formal analysis. SMS, DH, and WA wrote the original draft. All authors contributed to reviewing and editing the manuscript. AA and IA coordinated the data collection process. MA contributed to data collection. AB supervised the study. DARS Consortium collected the data for this study

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Declarations

Ethics approval and consent to participate

The authors declare that this study was conducted according to the principals of the Declaration of Helsinki and was approved by the Ethics Committee of Alexandria University's Faculty of Medicine in Egypt, with an IRB number of "00012098.". The authors declare that informed consent was obtained from each participant prior to enrollment in the study.

Consent for publication

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Competing interests

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