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Original article

Do Degree Programs Affect Health Profession Students' Attitudes and Opinions Toward Vaccinations? An Italian Multicenter Study



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ABSTRACT

Background: Healthcare workers' attitudes toward vaccination have been widely described in the literature, but a restricted amount of studies assessed healthcare students' knowledge, attitudes, and opinions on this issue. This study aimed to estimate the influence of a degree course on knowledge and immunization behavior among healthcare students and to compare medical students with students from other health profession degree programs to identify possible differences.

Methods: A multicenter, cross-sectional study was performed in 14 Italian Universities (3,131 students were interviewed). A validated questionnaire was used to assess knowledge, attitudes, and opinions toward vaccinations, with a specific focus on influenza vaccine and attitudes toward mandatory vaccination policies. Statistical software STATA® 14 was used.

Results: Significant differences were recorded between medical students and other healthcare students. The intention to get vaccinated against influenza during the next season and having been vaccinated in the previous season was higher in the medical group ($p < 0.001$). In the group of students of other health professions, we registered a lower probability of identifying themselves as a high-risk group for contracting infectious diseases as a consequence of their profession and health status (aOR 0.49; CI95%: 0.40–0.60) and an increased likelihood of defining their level of knowledge on vaccine-preventable diseases and related vaccinations as “insufficient/sufficient/fair” (aOR 1.31; CI95%: 1.11–1.56).

Conclusions: Results show several differences between medical students and students of other health professions when it comes to vaccination knowledge, attitudes, and perceptions, as well as a general low tendency to be vaccinated against influenza.

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1. Introduction

Students of health profession degree programs (i.e., medicine and nursing), as well as other healthcare workers (HCWs), attend the hospital workplace daily from the beginning of their studies. For this reason, in Italy, they are considered like HCWs for what concerns workplace safety and health [1]. The increasing vaccine hesitancy phenomenon is influencing HCWs' attitudes toward

vaccinations [2,3]. In a national cross-sectional survey in France, for example, Verger et al showed that only 54.5% of general practitioners were “very confident” about vaccines' utility, and only 26.2% of them were “very confident” about vaccines safety [4]. In particular, this negative attitude is even more widespread for what concerns influenza, a highly contagious but preventable acute respiratory illness that affects approximately 5–10% of the general population every year, increasing both morbidity and mortality [5].

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One of the most effective ways to prevent the infection is through seasonal vaccination, which is recommended globally to HCWs (as well as other high-risk groups) by national and international organizations [5,6]. Despite the effectiveness of flu vaccination and the provided recommendations, the seasonal flu vaccination rate among HCWs is unfortunately very low, far from reaching the 75% or 95% (respectively the minimum and optimal) coverage targets set by the WHO. In Europe, flu vaccination coverage among HCWs rarely exceeds 30–40% [7]. During the influenza season 2014–2015, the vaccination coverage was less than 40% in the majority of European countries, with a median of 29.5% (range: 2.6–99.5%) [8]. Even in Italy, the influenza vaccination coverage among HCWs is far from reaching its ideal national goal: according to two systematic reviews, it is possible to estimate that the influenza vaccination coverage rate among HCWs in Italy is between 23% (for physicians) and 13% (for nurses) [9,10]. Moreover, differences can be observed not only in different flu seasons but also between hospitals and categories of HCWs. For example, a recent study conducted in ten different Italian hospitals recorded a 14% vaccination rate among HCWs, with a lower vaccination coverage in the youngest professionals [11]. A study carried out in a regional tertiary adult acute-care reference center in Genoa, during the influenza season 2013–2014, reported a flu vaccination coverage rate of 30% among physicians, 11% among nurses, and 9% among other HCWs [12]. During the influenza season 2017–2018, the vaccination coverage rate in four teaching hospitals located in Rome ranged between 4.23% and 12.97% [13].

Although HCWs' attitudes toward seasonal influenza vaccination have been widely described in the scientific literature, a restricted amount of studies assessed health profession students' knowledge, attitudes, and opinions on this issue [14–25]. The flu vaccination coverage among this specific group varies a lot in different countries, ranging from 4% in the Czech Republic to over 85% in the USA and Canada [17,21,26], sometimes being even lower compared to other HCWs [14]. Furthermore, most of these studies only involved medical students [14–25,27], while to our knowledge, only a limited number of studies investigated students attending nursing schools or other health profession degree programs [26,28]. In studies comparing medical students to other healthcare students, the results showed that medical students were significantly more likely to get vaccinated compared to nursing or midwifery students [26,28]. According to our knowledge, no multicenter studies on this topic have been carried out in Italy so far.

This study aimed to estimate the potential effects of being enrolled in different health science degree programs on the knowledge and immunization behavior among healthcare students, to identify any critical issues responsible for low vaccination coverage rates and to increase awareness on this issue. In particular, this paper aims at comparing medical students with students attending other health science profession programs, to identify possible differences and to suggest specific interventions tailored to the students' needs. Most studies currently available in the literature are specifically focused on medical students or in general healthcare students without making comparisons among different degree programs. The hypothesis behind our work is that the degree program might affect vaccinations' knowledge and it might represent one of the reasons behind vaccination acceptance and refusal. Therefore, this study aims at assessing possible differences, in terms of knowledge, behavior, and attitudes, between students enrolled in different health sciences programs. In this perspective, our approach is innovative compared to what is currently available in the literature. Indeed, exploring differences in terms of knowledge, behavior, and attitude among different types of students could help in developing specific strategies targeted at each specific health sciences program.

2. Materials and methods

2.1. Setting, study design, and time period

This was an Italian multicenter, cross-sectional study designed by the “Vaccine and vaccine hesitancy” working group of the Committee of Medical Residents of the Italian Society of Hygiene, Preventive Medicine and Public Health to estimate students' knowledge on vaccine-preventable diseases (VPDs) and in particular, on flu vaccination, following what was already done in a previous project work focused on medical resident doctors [29]. A questionnaire was administered between October 2017 and September 2018. The 21 items questionnaire was validated in previous studies [30] and it was administered online, using Google forms® [31]. The questionnaire evaluated gender and age of the subjects, degree and year of course, perceived level of knowledge on VPDs and incidence of VPDs, vaccination habit in the last five years and in the last year (assessing the reason why a subject decided to undergo vaccination or not). Additionally, the questionnaire investigated the source of information and intention to get vaccinated for the next season (assessing the reason why a subject wishes to undergo vaccination or not), whether the student recommended the influenza vaccination to family members or to other HCWs during and last season and the intention to recommend it the next season, if the subjects were directly involved in the vaccination campaign during the clinical clerkship. Finally, the questionnaire assessed different strategies to increase vaccination coverage and the acceptability of mandatory vaccination policies for school admission or HCWs. The full Italian version of the questionnaire is available in the [appendix](#) session. VPDs are infectious diseases for which an effective vaccination is available [32]. Some examples, reported in the questionnaire, were influenza, chickenpox, pneumococcus, measles, mumps, rubella, HPV, and meningitidis. Finally, the term clerkship was used to define any form of clinical training performed within the education program.

The study aims and modalities to participate were presented to the students by the members of the study team in their own university. In the break between classes, following a brief but complete explanation of the study, students were given a quick response code, redirecting to an online and anonymous survey. All students enrolled in any health profession degree programs were eligible for this study and no further exclusion/inclusion criteria were applied. Data were collected and stored in an electronic database, only accessible by password to the data manager. The study received ethical approval from the local Ethical Committee of the University of Perugia (Comitato Universitario di Bioetica), Reference Number 2017-20R. A companion article covering other aspects of this research has been published [33].

2.2. Sample size

To estimate the minimum number of students required for the study, we considered all the students enrolled in health profession degree programs of Italian Universities as the reference population. Assuming that the total number of students admitted every year to each degree program would remain constant over time, we multiplied the number of students admitted during the last academic year (2016–2017) by the duration in years of each program, obtaining a total estimate of 49,643 students. Through the EpiInfo software, we calculated the sample size, with a 95% confidence level (CI) and a 5% margin of error. Because the level of knowledge among health care students was unknown, and to be more conservative, we fixed the expected proportion at 50%. The maximized sample size thus resulted to be of 382 students;

however, we further doubled it to 764 subjects to be more confident about the validity and acceptance of our results.

2.3. Statistical analysis

To make the results more readable, some variables were dichotomized or aggregated. In particular, the questionnaire requested variable “age” was dichotomized in ≤ 23 years and > 23 years because the average age of the sample was equal to 23.4 years. Normal distribution was verified using the Shapiro–Wilk test. The answers related to the degree course variable were aggregated into two categories, depending on whether the students were attending medicine (including both “medicine and surgery” and “dental medicine”) or other health profession degree programs (including all the other students of health professions who completed the questionnaire). According to the geographical area of the Universities, the answers were categorized into “South and Islands” (Bari, Messina, Naples, Palermo, and Salerno), “Center” (Ancona, L’Aquila, Perugia, Rome, and Siena), and “North” (Parma, Pavia, Turin, and Udine). The answers to the question “Do you think your level of knowledge on vaccine-preventable diseases and related vaccinations is” were aggregated into two groups, “Good/excellent” and “Insufficient/sufficient/fair”. Absolute and relative frequencies were calculated for all qualitative variables; Pearson’s Chi-square test (χ^2) was used to analyze categorical variables. A multivariable logistic regression model was used. Cases with missing values were excluded from the logistic regression (listwise deletion) and retained in the descriptive analysis (pairwise deletion). The dependent variable selected was “Degree course: Other versus Medicine (Medicine is the reference)”. Each independent variable in the model was adjusted for all the other variables. To increase the capacity to describe the complexity of factors influencing the dependent variable, in light of the sample size, a fixed model was used and selection of the variables was performed. Results are expressed as adjusted odds ratios (aOR) with CI95%. The level of significance chosen for statistical analysis was 0.05. The collected data were analyzed using the statistical software STATA® version 14.

3. Results

The final sample, as shown in Table 1, consisted of 3,131 students, mostly female (68.1%) who did not participate in a previous vaccination campaign during their clinical clerkships (97.5%). Furthermore, as reported in Table 1, proposed strategies to increase seasonal flu vaccination among HCWs were assessed. Each subject could respond by selecting as many options as desired. Multidisciplinary education courses were the most frequently selected option (56.5%), followed by introducing a mandatory vaccination policy for HCWs (34.1%) and improving university courses on vaccination (31.7%).

Additionally, bivariate analysis was performed to assess possible differences among the medical students’ groups and the group of students of other health profession degree programs (complete data are presented in Table 2). All the variables assessed resulted to be significantly different, except for two. In particular, the two groups resulted to be different in terms of gender, age, and geographical area. Furthermore, the intention to get vaccinated during the next flu season (39.54% vs. 31.96%; p -value <0.001) and having been vaccinated during the past season (15.01% vs. 8.68%; p -value <0.001) was higher in the medical students’ group, where the level of knowledge on vaccinations was perceived as higher (53.16% vs. 36.66%; p -value <0.001) and a more favorable attitude toward mandatory vaccinations (91.14% vs. 84.88%; p -value <0.001) was observed. Moreover, medical students identified themselves as

Table 1
Descriptive characteristics of the sample ($n = 3131$)

	<i>n</i> (%)
Gender	
Female	2,132 (68.1)
Male	999 (31.9)
Geographical distribution	
North	1,256 (40.1%)
Center	889 (28.4%)
South and Islands	986 (31.5%)
Degree program	
Medicine	1,219 (38.9)
Nursing	916 (29.3)
Pharmacy	159 (5.1)
Midwifery	125 (4.0)
Physical Therapy	120 (3.8)
Other	592 (18.9)
Personal participation in previous vaccination campaigns during clinical clerkships	
Yes	78 (2.5)
No	3,053 (97.5)
Having clarified misconceptions on vaccination	
Yes, to colleagues	99 (3.2)
Yes, to patients/relatives	1,477 (47.2)
Yes, to other HCWs	110 (3.5)
No	1,445 (46.1)
Proposed strategies to increase seasonal flu coverage among HCWs*	
Multidisciplinary educational courses	1,769 (56.5)
Introducing mandatory vaccinations for HCWs	1,068 (34.1)
Incentives (i.e., paid leave, meal vouchers, ...)	481 (15.4)
Improving university course on vaccination	994 (31.7)
Other	39 (1.2)

* More than one answer was allowed.

subjects with an increased risk of being affected by influenza as a consequence of their profession (73.67% vs. 54.92%; p -value <0.001), and they also resulted to be more likely to recommend the flu vaccination to parents (Yes, based on my clinical evaluation: 20.59% vs. 12.13%; Yes, according to the ministerial indications: 51.35% vs. 32.95%; p -value <0.001) and colleagues (15.09% vs. 10.51%; p -value <0.001).

A multivariable logistic regression model was used, and the adjusted odds ratios (aOR) are presented in Table 3. In particular, students from other healthcare degree programs were less likely to be male (aOR 0.53; CI95% 0.44–0.63) and older (aOR 0.94; CI95% 0.92–0.96) and more likely to study in Central (aOR 2.76; CI95% 2.22–3.42) or Northern Italy (aOR 2.26; CI95% 0.44–0.63) compared to medical students. No significant differences were recorded in the reported prevalence of VPDs in the last 5 years, including influenza, between the two groups. In the group of other health profession students, we registered a reduced likelihood of identifying themselves as subjects with a higher risk of contracting infectious diseases due to their profession and health status (aOR 0.49; CI95%: 0.40–0.60) and an increased likelihood of defining their own level of knowledge on VPDs and related vaccinations as “insufficient/sufficient/fair” (aOR 1.31; CI95%: 1.11–1.56). Moreover, they reported a lower likelihood of receiving requests for clarification on vaccinations (aOR 1.85; CI95%: 1.56–2.22). Finally, students from other health degree courses resulted to be less likely to have participated directly or collaborated in the organization of the vaccination campaign for HCWs (aOR: 0.47; CI95%: 0.28–0.79).

On evaluation of the attitudes toward compulsory vaccinations among the two groups, no significant differences were recorded concerning mandatory vaccinations for school enrolment. On the

Table 2
Bivariate associations. Used Pearson's Chi-square test

Variables		Degree course: Other versus medicine		
		Medicine (%)	Other (%)	p-value
Gender	Female	730 (59.89)	1,402 (73.33)	<0.001
	Male	489 (40.11)	510 (26.67)	
Age	>23 years old	742 (60.87)	509 (26.62)	<0.001
	≤23 years old	477 (39.13)	1,403 (73.38)	
Geographical area	South and Islands	527 (43.23)	459 (24.01)	<0.001
	Center	306 (25.10)	583 (30.49)	
	North	386 (31.67)	870 (45.50)	
Have you ever had a vaccine-preventable disease in the last 5 years?	Never	657 (55.54)	1,003 (55.32)	0.908
	At least once	526 (44.46)	810 (44.68)	
Given your future profession and your health status, do you consider yourself a subject with a higher risk of contracting infectious diseases?	No	228 (18.70)	611 (31.96)	<0.001
	I do not know	93 (7.63)	251 (13.13)	
	Yes	898 (73.67)	1,050 (54.92)	
You think your level of knowledge on vaccine-preventable diseases and related vaccinations is	Good/excellent	648 (53.16)	701 (36.66)	<0.001
	Insufficient/sufficient/fair	571 (46.84)	1,211 (63.34)	
Have you ever received any requests for clarification on vaccinations (composition, contraindications, precautions, ...)?	No	377 (30.93)	1,068 (55.86)	<0.001
	Yes	842 (69.07)	844 (44.14)	
Have you ever participated directly or collaborated in the organization of the vaccination campaign for health professionals during your clinical clerkships?	No	1,191 (97.70)	1,862 (97.38)	0.578
	Yes	28 (2.30)	50 (2.62)	
How would you evaluate the possible introduction of mandatory vaccinations for healthcare workers?	Against it	38 (3.12)	119 (6.22)	<0.001
	Indifferent	70 (5.74)	170 (8.89)	
	Favorable	1,111 (91.14)	1,623 (84.88)	
What is your opinion about the introduction of mandatory vaccinations for school access?	Against it	35 (2.87)	90 (4.71)	<0.001
	Indifferent	37 (3.04)	148 (7.74)	
	Favorable	1,147 (94.09)	1,674 (87.55)	
Were you vaccinated against seasonal flu last year?	No	1,036 (84.99)	1,746 (91.32)	<0.001
	Yes	183 (15.01)	166 (8.68)	
During the last flu season, did you recommend the vaccination to patients, family members, or the general population?	No	342 (28.06)	1,050 (54.92)	<0.001
	Yes, based on my clinical evaluation	251 (20.59)	232 (12.13)	
	Yes, according to the ministerial indications	626 (51.35)	630 (32.95)	
During the last flu vaccination campaign, did you recommend the flu vaccination to any healthcare worker?	No	1,035 (84.91)	1,711 (89.49)	<0.001
	Yes	184 (15.09)	201 (10.51)	
For the next season, do you think you are vaccinating against the flu?	No	737 (60.46)	1301 (68.04)	<0.001
	Yes	482 (39.54)	611 (31.96)	
During the next season, do you plan on recommending the flu vaccination to patients, family members, or the general population?	No	229 (18.79)	724 (37.87)	<0.001
	Yes, based on my clinical evaluation	256 (21.00)	318 (16.63)	
	Yes, according to the ministerial indications	734 (60.21)	870 (45.50)	

other hand, students of other health profession degree programs than medicine showed a less favorable attitude toward the introduction of mandatory vaccinations for HCWs (aOR 0.26; CI 95%: 0.15–0.44). Regarding flu vaccination, no significant differences were recorded among medical students and students from other health profession degree programs in terms of vaccinations received during the past flu season and of the intention to get vaccinated against influenza during the next season. For what concerns the students' attitudes in recommending the vaccination, our study showed that other health profession students had an increased likelihood of recommending the flu vaccination according to the ministerial indications both to patients (aOR 1.78; CI95% 1.38–2.28) and to other HCWs (aOR 1.64; CI95% 1.26–2.13) compared to medical students.

4. Discussion

Our results confirm the presence of differences among medical students and students from other health profession degree programs on the topics of vaccination knowledge, attitudes, and perceptions. It is important to highlight these differences, to find the

best possible strategies to reduce them and to improve training and education in this area.

According to our results, medical students, who had a higher vaccination coverage rate, perceived themselves as a group with a higher risk of contracting infectious diseases given their future profession and their health status, compared to students of other health professions that resulted to be less likely to identify themselves as a high-risk group (aOR 0.49; CI95%: 0.40–0.60). These results are consistent both with a previous study and with the international literature that reported how the fear of the disease and its consequences resulted to be the main reasons for being vaccinated [20,22,23,25,34]. Moreover, in our study, as reported in Table 3, medical students were significantly more likely to recommend flu vaccination both to the general population and to other HCWs, having received requests for clarification on vaccinations and having either participated directly or collaborated in the organization of the vaccination campaign for HCWs during their clinical clerkships. This could help them realize how their profession plays a key role in vaccination promotion, thus improving their sense of responsibility on this issue. This engagement could be beneficial even for the students of other healthcare professions

Table 3

Multivariable logistic regression. Adjusted odds ratios are presented. Each independent variable is adjusted for all the other independent variables. Based on 2996 observations

Independent variable		Dependent variable: Degree program, other versus medicine (medicine is the reference)		
		Odds ratio	[CI95%]	p-value
Gender	Female	1		
	Male	0.53	0.44-0.63	<0.001
Age	As the unit increases	0.94	0.92-0.96	<0.001
For the next season, do you think you are vaccinating against the flu?	No	1		
	Yes	1.11	0.92-1.36	0.312
Geographical area	South and Sicily	1		
	Center	2.76	2.22-3.42	<0.001
	North	2.26	1.85-2.77	<0.001
You think your level of knowledge on vaccine-preventable diseases and related vaccinations is	Good/excellent	1		
	Insufficient/sufficient/fair	1.31	1.11-1.56	0.002
Have you ever had a vaccine-preventable disease in the last 5 years?	Never	1		
	At least once	0.99	0.83-1.16	0.865
Given your future profession and your state of health, do you consider yourself a subject with a higher risk of contracting infectious diseases?	No	1		
	I do not know	0.82	0.59-1.13	0.224
	Yes	0.49	0.40-0.60	<0.001
Were you vaccinated against seasonal flu last year?	No	1		
	Yes	0.78	0.58-1.04	0.092
During the last flu season, did you recommend vaccination to patients or family members/general population?	No	1		
	Yes, based on my clinical evaluation	0.89	0.66-1.20	0.444
	Yes, according to the ministerial indications	1.78	1.38-2.28	<0.001
During the next season, do you plan on recommending the flu vaccination to patients, family members, or the general population?	No	1		
	Yes, based on my clinical evaluation	0.85	0.62-1.17	0.318
	Yes, according to the ministerial indications	0.81	0.62-1.07	0.137
During the last flu vaccination campaign, did you recommend the flu vaccination to any health worker?	No	1		
	Yes	1.64	1.26-2.13	<0.001
Have you ever participated directly or collaborated in the organization of the vaccination campaign for health professionals during your clinical clerkships?	Yes	1		
	No	0.47	0.28-0.79	0.005
Have you ever received any requests for clarification on vaccinations (composition, contraindications, precautions, ...)?	Yes	1		
	No	1.85	1.56-2.22	<0.001
What is your opinion about the introduction of mandatory vaccinations for school access?	Against it	1		
	Indifferent	2.8	1.39-5.62	0.004
	Favorable	1.68	0.95-2.99	0.076
How would you evaluate the possible introduction of mandatory vaccinations for health workers?	Against it	1		
	Indifferent	0.47	0.26-0.86	0.014
	Favorable	0.26	0.15-0.44	<0.001

[35]. On the other hand, factors like laziness, lack of time, and lack of knowledge resulted to be the main reasons for not being vaccinated [20,23]. In particular, the importance of the level of knowledge for vaccination uptake was confirmed in our study as well, where students from other health profession degree courses defined their level of knowledge on VPDs and related vaccinations as “insufficient/sufficient/fair” more frequently than medical students (aOR 1.31; CI95%: 1.11–1.56).

The results of the bivariate analysis showed that medical students were more motivated to undergo flu vaccination than students of other health professions, even though in the multivariable logistic regression model, this difference did not result to be statistically significant.

Regarding the possible strategies to adopt to improve vaccination coverage among HCWs, according to our study, more than 85% of health profession students resulted in favor of the introduction of mandatory vaccination for HCWs (91.14% and 84.88% in medical students and students from other health profession degree programs, respectively), showing significant differences between medical and non-medical degree courses, with medical students being more favorable to it. Previous studies had already assessed medical students' attitudes toward

compulsory vaccinations: in particular, in some studies, the majority of the interviewed subjects declared to be supportive of mandatory influenza vaccination policies for medical students and would be compliant if such policies were in place [17,23,26,36,37]. Furthermore, lower injunctive norms and higher feelings of autonomy were shown to contribute to reducing the intention to get vaccinated against influenza in a sample of German students [18].

Other strategies that emerged from our study to increase seasonal flu coverage among HCWs included the introduction of multidisciplinary educational courses on vaccines, which were considered even more useful than mandatory vaccinations from our sample of healthcare students. Receiving an invitation directly from the university and proper training on this issue seem to be factors that may increase the vaccination coverage among students and other HCWs, even according to other studies [22,25,27,35,38,39]. Moreover, a study from Northwest China underlined the importance of “free of charge vaccination” policies for healthcare students, which have been shown to improve vaccination coverage especially among people from low-income families [24,40]. Taking for granted that in Italy most vaccinations, including flu, are free of charge for HCWs [6], also the

institution of incentives (i.e., paid leave and meal vouchers) was considered beneficial.

Furthermore, even though no significant differences were recorded in the prevalence of VPDs in these two groups of students, the fact that almost 45% of the sample reported at least one VPD during the last 5 years surely raises a concern. This could be explained by the fact that seasonal influenza was included among the VPDs: its seasonal impact, the difficulty in recognizing and correctly diagnosing the pathology, and the low annual flu vaccination coverage (as we reported in our sample where only 11.15% were vaccinated) are all factors that may lead to an overestimation of the percentage of students that reported at least one VPD during the past 5 years [34]. Additionally, HCWs and healthcare students attending clinical clerkship present an increased risk because they have more contacts with people than the general population [41].

Finally, it has to be stated that in the present study, the socio-economic status (SES) of the sample was considered homogeneous because all the respondents were enrolled in an academic setting. Therefore, no further questions were asked to investigate differences in SES and this could be considered a limitation, in light of the role played by this variable in influencing the willingness to adhere to vaccination campaigns.

In conclusion, our results show several differences between medical students and students from other health profession degree courses on the issue of vaccination knowledge, attitudes, and perceptions as well as a general poor tendency to get vaccinated against influenza. Healthcare students could play an important role in health promotion, to reduce the burden of VPDs, to encourage vaccinations among patients and other HCWs, and to decrease the risk of patients' infection.

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Conflicts of interest

None to declare.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.shaw.2021.10.005>.

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