

Is there an association between self-reported vaccination knowledge and the immunization behaviour of Health Sciences students?

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Key words: University students, survey, cross-sectional study, immunization, vaccines, self-perceived knowledge

Parole chiave: Studenti universitari, questionario, studio trasversale, immunizzazione, vaccini, conoscenze auto-percepite

Abstract

Introduction. The role of vaccinations is widely acknowledged. However, over the last decades, an alarming reduction in immunization coverage and a rising number of reported cases of vaccine-preventable diseases have been recorded. This multicentre cross-sectional study aimed at examining whether there is an association between self-reported vaccination knowledge and the immunization behaviour of Health Sciences students.

Methods. A cross-sectional study was performed, using a validated questionnaire. A multivariate logistic regression with stepwise backward selection process with a univariate p -value <0.25 as the main criterion was used. The level of significance chosen for statistical analysis was 0.05.

Results. The sample consisted of 3,131 students (68.1% females). 38.9% of them are medicine and surgery students and 33.1% are nursing students. The multivariate logistic regression analysis shows that, regarding the “suboptimal level of knowledge about vaccine-preventable diseases”, the main and statistically significant independent variables associated are: older age (OR 1.56), having developed a vaccine-preventable disease in the last 5 years (OR 1.38), having been vaccinated against seasonal influenza last year (OR 0.70), having recommended the vaccination to patients or family members during the last influenza season based on clinical evaluation (OR 0.53) and according to the ministerial indications (OR 0.48), planning of recommending the influenza vaccination during the next season based on clinical evaluation (OR 0.67) and according to the ministerial indications (OR 0.69).

Discussion. The study highlighted the importance of academic education on vaccinations in order to build a future generation of health care workers that are aware not only of the usefulness of immunization, but particularly of the major role played by health professionals in promoting a vaccination culture among the general population.

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Introduction

It is widely acknowledged that vaccines are a safe and effective tool to prevent infectious diseases, both for vaccinated subjects and for the whole community, through the so called herd immunity (1, 2). In order to guarantee herd immunity, the Italian National Immunization Plan (NIP) 2017-2019 aims at the achievement of a national vaccination coverage rate of 95% for three doses of hexavalent vaccine [diphtheria, tetanus, whooping cough (DTaP), inactivated polio (IPV), haemophilus influenzae type b (Hib), hepatitis B (HepB) vaccine], and for a dose of measles, mumps, rubella and chickenpox vaccine (MMRVar or MMR-Var) at 15 months (3, 4). However, over the last decade, an alarming reduction in vaccination coverage has been recorded not only in Italy but also across Europe and even worldwide, leading to the re-emergence of infectious diseases (5). Such a reduction in vaccination coverage is due not only to the anti-vaccination movements, but also to the so called “vaccine hesitancy” phenomenon: this refers to people that delay the acceptance or refusal of vaccinations despite their availability, due to doubts, fears or simply because they’re undecided. This phenomenon mainly involves countries, like Italy, that had reached high levels of immunization over the previous decades and still benefit from good health: in these countries it seems that, nowadays, people are more afraid of the vaccine than of the disease it protects from. The roots and the causes of vaccine hesitancy are many, including a decreased trust in Healthcare Workers (HCWs), partly due to the wide availability of information on the internet, which is often misleading and incorrect. This phenomenon has been rising over the past few years, contributing to the decrease in vaccination coverage and the spread of infectious diseases (6). In particular, since 2017, Italy has been facing an important outbreak of measles with a total

of 7,517 cases, 437 of which were recorded among HCWs (7, 8). The implementation of immunization strategies has increased the measles vaccination coverage, although it resulted uneven among the 21 Italian Regions (9).

These alarming phenomena highlight the importance of reinforcing surveillance systems and immunization campaigns among HCWs. Indeed, it is especially significant because HCWs play a key role in the transmission of microorganisms, due to their direct and indirect contact with patients (10). Vaccination among HCWs, as well as other collective and individual measures to prevent the spread of diseases in healthcare facilities, has been adopted with several purposes.

Firstly, to prevent the transmission of infections to patients at risk of secondary complications and death, in order to guarantee the quality of health care provision. Indeed, there is a significant inverse association between the vaccination coverage among HCWs and the rate of nosocomial diseases among patients admitted to acute care hospitals (11); secondly, to reduce the occupational risk of infection (D.Lgs. 81/2008) (12). Moreover, several studies show that in all the European Union (EU) countries, HCWs are identified as the most important and trustable source of information on how to be protected against vaccine-preventable diseases (13).

Community empowerment is not only based on the ability of prevention programs to reach the target subjects, but - above all - on the education received by the HCWs. As a matter of fact, they are health promoters not only for the individuals but also for collective interests in terms of vaccinations. They must establish a professional relationship with people, addressing any questions and worries that a person may have, through a clear and understandable communication. (14). Moreover, vaccinated HCWs set a good example for their patients and promote

a safe culture of vaccination among the population (15); nevertheless there are some cases -particularly in Italy- of HCWs whose behaviour is completely different and deeply negative.

The “Vaccines and Vaccine Hesitancy Working Group” of the Board of Medical Residents in Public Health, a member of the Italian Society of Hygiene, carried out a cross-sectional study aimed at examining whether there is an association between Health Sciences students’ self-perceived level of knowledge on the topics of vaccine-preventable diseases and related vaccinations, and their behaviour in terms of immunization.

Methods

Study design and questionnaire

This multicentre cross-sectional study was developed by the Board of Medical Residents in Public Health of the Italian Society of Hygiene and Preventive Medicine. The survey was carried out from October 10th, 2017 until September 30th, 2018, corresponding to the duration of the academic year. Students eligible for the study included all students enrolled in Health Sciences programmes, regardless of the age or year of study, from 14 Italian Universities. The recruitment was on a voluntary basis, and it required receiving informed consent from all participants. Students were introduced to the study, during a lecture on Hygiene and Preventive Medicine, by a member of the research team. Each member of the Committee proposed the questionnaire to the students of his own university.

An already existing, 21-items validated questionnaire (16) was used, with minor modifications, to evaluate the attitude of Health Sciences students towards vaccinations. The questionnaire included 5 sections: socio-demographic characteristics, personal experiences of influenza vaccination, main

sources of information, willingness to recommend influenza vaccination and level of self-perceived knowledge on the topic of vaccinations (16). The survey, which took no longer than 15 minutes, included an introductory letter for the students, with information about the aims of the study and the research team.

The on-line, self-reported and anonymous questionnaire was developed using Google forms ®. The data collected were saved, in a password-protected file of a computerized and anonymous database. During the presentation, students received information regarding the study’s aims and participation modalities and were provided with a Quick Response (QR) code redirecting to the questionnaire link. The local Ethical Committee of the University of Perugia (Comitato Universitario di Bioetica) initially approved the study, Reference Number 2017-20R, followed by the Ethical Committees of all the other universities.

Study size

To determine the sample size, the total number of students enrolled in the different Health Sciences programs has been considered. To calculate the reference population, we considered the number of students admitted to each degree course in the last academic year and multiplied it by the duration in years of that course; for practical reasons, and to be more conservative, we assumed the number of enrolled students for each program to be constant every year. We obtained a total amount of 49,643 students. Our sample size was calculated using the EpiInfo software, with a 95% confidence level and a 5% margin of error; being the object of this study, the proportion of students not having a sufficient level of self-judged knowledge on vaccinations was unknown, so the expected rate was set at 50% in order to be conservative and maximize the required sample size. The resulting sample size consisted of 382 students, but to be more

conservative it was doubled to 764 students, which was set as the minimum number of surveys to be completed to make the study results accepted. The enrolment was carried out continuously during the whole academic year.

Statistical Analysis

The variable “age” was dichotomized in ≤ 23 years and > 23 years, considering that the mean age was 23.41 years old; the “degree course” variable was aggregated into three categories: Medicine, Nursing and Others (which included all the other students of health professions who completed the questionnaire); 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”; according to the geographical area of origin, the answers were categorized into: “Southern Italy and Islands” (including Bari, L’Aquila, Messina, Naples, Palermo and Salerno), “Central Italy” (including Ancona, Perugia, Rome and Siena) and “Northern Italy” (including Parma, Pavia, Turin and Udine).

Absolute and relative frequencies were calculated for all qualitative variables. A multivariate logistic regression with stepwise backward selection process with a univariate p -value < 0.25 as the main criterion was used to include variables in the model, considering all the variables reported in Table 1, excluding the dependent variable.

The dependent variable chosen was the answer “Insufficient/sufficient/fair” to the question “Do you think your level of knowledge on vaccine-preventable diseases and related vaccinations is”; the adjusted odds ratios (OR) are shown below (Table 2). Each independent variable in the final model was adjusted for all the other independent variables. Results are expressed as adjusted OR with 95% Confidence Intervals (95% CI). The level of significance chosen for

statistical analysis was 0.05. The data were analysed using the statistical software STATA® version 14 (17).

Results

A total of 3,137 questionnaires were administered; however, 6 were excluded by the authors because they were incorrectly filled in. The final sample consisted of 3,131 students (68.1% females and 31.9% males). 40.0% of the sample were older than 23 years (mean age 23.4 ± 3.7). 38.9% were medicine and surgery students and 33.1% nursing students (28.0% attended other degree courses). As regards the geographical origins, we can say that 40.1% were students from the North of Italy (33.3% from the South and 26.5% from the Centre). Table 1 shows the sample description in detail, in particular the percentages relative to the answers given to the queries administered are reported.

Table 2 shows the adjusted OR of the multivariate logistic regression with stepwise backward selection process with a univariate p -value < 0.25 as the main criterion. Regarding the dependent variable “You think your level of knowledge on vaccine-preventable diseases and related vaccinations is insufficient/sufficient/fair”, the statistically significant independent variables associated are: “ > 23 years old” (OR 1.6, C.I. 95% 1.3-1.8), “Have you ever had a vaccine-preventable disease in the last 5 years? At least once” (OR 1.4, C.I. 95% 1.2-1.6), “Did you get vaccinated against seasonal influenza last year? Yes” (OR 0.7, C.I. 95% 0.5-0.9), “During the last influenza season did you recommend the vaccination to patients, family members or general population? Yes, based on my clinical evaluation” (OR 0.5, C.I. 95% 0.4-0.7) and “Yes, according to the ministerial indications” (OR 0.5, C.I. 95% 0.4-0.6), “During the next season,

Table 1 - Description of the sample.

Variables		N	%
Gender	Female	2,132	68.1
	Male	999	31.9
Age	>23 years old	1,251	40.0
	≤23 years old	1,880	60.0
Degree Course	Medicine and Surgery	1,219	38.9
	Nursing	1,035	33.1
	Other	877	28.0
Geographical area	South	1,044	33.3
	Center	831	26.6
	North	1,256	40.1
You think your level of knowledge about vaccine-preventable diseases and related vaccinations is	Good / excellent	1,349	43.1
	Insufficient/sufficient/fair	1,782	56.9
Have you ever had a vaccine-preventable disease in the last 5 years?	Never	1,660	55.4
	At least once	1,336	44.6
Given your future profession and your state of health, do you consider yourself a subject with greater risk of contracting infectious diseases?	No	839	26.8
	I don't know	344	11.0
	Yes	1,948	62.2
Did you get vaccinated against seasonal flu last year?	No	2,782	88.9
	Yes	349	11.1
For the next season, do you think you are vaccinating against the flu?	No	2,038	65.1
	Yes	1,093	34.9
During the last flu season did you recommend vaccination to patients or to family members/general population?	No	1,392	44.5
	Yes, based on my clinical evaluation	483	15.4
	Yes, according to the ministerial indications	1,256	40.1
During the next season, do you plan to recommend flu vaccination to patients or family members/general population?	No	953	30.5
	Yes, based on my clinical evaluation	574	18.3
	Yes, according to the ministerial indications	1,604	51.2
During the last flu vaccination campaign did you have to recommend flu vaccination to health workers?	No	2,746	87.7
	Yes	385	12.3
Have you ever participated directly or collaborated in organizing the vaccination campaign for health professionals during your internship?	Yes	78	2.5
	No	3,053	97.5
Have you ever received requests for clarification on vaccinations (composition, contraindication, precautions, ...)?	Yes	1,686	53.9
	No	1,445	46.1
What is your opinion about the introduction of the vaccination obligation for school access?	Contrary	125	4.0
	Indifferent	185	5.9
	Favorable	2,821	90.1
How would you evaluate the possible introduction of the vaccination obligation for health workers?	Contrary	157	5.0
	Indifferent	240	7.7
	Favorable	2,734	87.3
Mean Age and Standard Deviation		23.4 ± 3.7	

Table 2 - Multivariate logistic regression, stepwise backward selection process with a univariate p-value <0.25 as the main criterion. Adjusted Odds Ratio are presented. Based on 2,996 observations.

Independent variable	Dependent variable: You think your level of knowledge about vaccine-preventable diseases and related vaccinations is “Insufficient/sufficient/fair”			
		Odds Ratio	[95% C.I.]	p-value
Gender	Female	1		
	Male	0.9	0.7-1.0	0.100
Age	≤23 years old	1		
	>23 years old	1.6	1.3-1.8	<0.001
Have you ever had a vaccine-preventable disease in the last 5 years?	Never	1		
	At least once	1.4	1.2-1.6	<0.001
Did you get vaccinated against seasonal flu last year?	No	1		
	Yes	0.7	0.6-0.9	0.005
During the last flu season did you recommend vaccination to patients or to family members/general population?	No	1		
	Yes, based on my clinical evaluation	0.5	0.4-0.7	<0.001
	Yes, according to the ministerial indications	0.5	0.4-0.6	<0.001
During the next season, do you plan to recommend flu vaccination to patients or family members/general population?	No	1		
	Yes, based on my clinical evaluation	0.7	0.5-0.9	0.007
	Yes, according to the ministerial indications	0.7	0.5-0.9	0.003
Have you ever received requests for clarification on vaccinations (composition, contraindication, precautions, ...)?	Yes	1		
	No	1.6	1.4-1.9	<0.001

do you plan to recommend the influenza vaccination to patients, family members or general population? Yes, based on my clinical evaluation” (OR 0.7, C.I. 95% 0.5-0.9) and “Yes, according to the ministerial indications” (OR 0.7, C.I. 95% 0.5-0.9), “Have you ever received any requests for clarification on vaccinations? No” (OR 1.6, C.I. 95% 1.4-1.9).

Discussion and conclusions

In our study, less than half of the Health Sciences students enrolled declared to have a good/excellent knowledge on vaccine-preventable diseases and their related

vaccines. However, it has been shown through different studies carried out in Italy among HCWs and Health Sciences students from the Latium Region and a University Hospital in Sicily, that their knowledge on recommended occupational vaccinations is insufficient, with a few exceptions represented by HBV and Tuberculosis. This lack of knowledge can lead to false perceptions and beliefs on this issue, thus representing a major barrier for vaccine uptake among HCWs (18, 19). In fact, for Health Sciences students and HCWs, the main reason to refuse influenza vaccination is to not consider themselves as a high risk group (20-22). In our sample, the insufficient/sufficient/fair level of self-reported knowledge had a

statistically significant association with the fact that students didn't know whether they should consider themselves at higher risk or not. Another significant association was found between a low level of self-judged knowledge and having recommended the influenza vaccination to relatives/general population and health care workers. Even though HCWs are notoriously the most important source of information related to vaccinations, an Italian study found a very low level of general knowledge on influenza vaccination recommendations among these professionals (23).

Importantly, students that were less likely to declare an insufficient/sufficient/fair level of knowledge resulted to be those that either recommended the vaccination to patients, family members or general population during the last influenza season, or were planning to do it during the next influenza season. We also obtained the same results among those who received requests for clarification on the topic of vaccinations (composition, contraindications, precautions).

In our study, more than half of the sample (54.9%) recommended the vaccination to the general population, whilst only 12.3% recommended it to HCWs. The percentage of HCWs recommending vaccinations is variable depending on the type of vaccine, the target of the campaign and the HCWs' role. Indeed, influenza vaccination was previously recommended in approximately 90% of the cases when the target was the general population and only the physicians were considered as HCWs, while it was recommended in 50% of the cases when other HCWs were considered in the analysis (20).

It should be noted that the most important reason to delay/refuse vaccinations among the general population is having received contrasting opinions on vaccinations from different HCWs (24). In other words, HCWs' divergent opinions, not updated knowledge and scarce communication skills have an

unfavourable impact on immunisation rates (25), proving that they are likely to strongly influence the efficacy of public health strategies for influenza control (26, 27).

In our sample the proportion of students who received the influenza vaccination during the previous campaign was very low (11.1%; n=349 subjects); however, our results are in line with previous publications (20). A recent Italian study showed that having received a specific training on the topic of influenza vaccination during the degree course, and thus having a good knowledge on this topic, plays a major role in improving students' acceptance of influenza vaccination (28).

Furthermore, despite the international recommendations, vaccination coverage among European HCWs, including physicians, has continued to be less than 25% (29). Considering the low vaccination coverage among HCWs recorded in Italy as well, two Italian Regions, Marche and Emilia-Romagna, decided to declare some vaccinations to be a strict requirement for HCWs, thus making such vaccinations compulsory for HCWs admitted to operate in high-risk settings (30, 31). In Italy, vaccination of HCWs against hepatitis B, measles, mumps, rubella, chickenpox, whooping cough and influenza is emphasized by the National Immunization Plan 2017-19 (NIP) (4), because these professionals have an increased risk of being exposed to pathogens, compared with the general population, with potential threats both for their own health and patients' safety. The same vaccinations are highly recommended also among Health Sciences students, due to their training time in healthcare facilities.

However, the main goal is to reach high vaccination coverage rates (75% as feasible target and 95% as optimum target) associated to a significant increase in public health and economic benefits (32).

In order to raise awareness among HCWs, in March 2017, several Italian scientific

societies, including SItI (Italian Society of Hygiene and Preventive Medicine), SIMPIOS (Italian Multidisciplinary Society for Infection Prevention) and SIP (Italian Paediatrics Society), elaborated a document named “The Pisa’s Charter of Vaccinations” (33). The importance of HCWs’ training on the topic of vaccination and the development and promotion of vaccination culture at all levels are also highlighted in the 119/2017 law. In fact, this law provides immunization promotion not only in schools, targeting both students and teachers, but also among the general population and healthcare professionals (34). Increasing the vaccine literacy of citizens, improving HCWs’ communication skills and applying with care a strategic nation-wide vaccination plan will help increase vaccination acceptance (35). Indeed, poor population knowledge, having received information from false or inaccurate sources and incomplete or scarce attention from HCWs are responsible for delaying or refusing vaccinations (36). Reducing the missed opportunities to discuss with parents on the topic of immunization, and improving the ability to perform a valid counselling are essential skills that a new generation of physicians, and health professionals in general, should have (37). As a matter of fact, our results suggest that an insufficient/sufficient/fair self-reported knowledge is inversely associated with having recommended the influenza vaccination to patients/family/general population during the last campaign, planning to recommend the influenza vaccination during the next campaign, and having been vaccinated against the influenza during the last season. In this perspective, the information provided should be continuously updated, since an appropriate level of knowledge is associated to positive attitudes towards vaccinations (38). Lastly, considering that multidisciplinary activities and lectures for students on vaccinations improve their level of awareness on this

issue (23) – also confirmed by our results – HCWs training should be not only through graduate studies, but also through continuous medical education in order to always be up to date on the epidemiological situation and vaccination policies.

Limits and strengths

Before generalizing our results, some limitations need to be taken into consideration. First, this was survey based on self-reported information: data on immunization were not double-checked through an immunization certificate, therefore recall bias and social desirability bias cannot be excluded. Moreover, it should be noted that the goal of this study was not to measure the students’ knowledge on the topic of vaccinations, but rather they were asked to provide a self-assessed judgement: as a matter of fact, the available literature shows that students do have some ability to self-assess. Of course their ability increases with time and in particular after they have had some practical experiences, such as a clinical clerkship in this field (39). Nevertheless, this increases the risk of either under- or over-estimating the reality, therefore limiting the interpretation of our results. However, considering the nature of the questionnaire (on-line and anonymous), these biases might be limited, according to previous publications (40). Nevertheless, this study has also important strengths, such as the inexpensive way of administration and the easy modality to participate, that allowed us to reach a large population size. Furthermore, because the questionnaire was on-line and all questions were mandatory in order to submit it, there were no missing data. Lastly, we used a previous Italian validated questionnaire that allowed us to minimize the culture bias.

In conclusion, this study highlights the importance of academic education on the topic of immunization, in order to build a future generation of HCWs that are

aware of the benefits of immunization and particularly of the key role that they play in the promotion of a vaccination culture among the general population. Even though a new mandatory vaccination law has been approved in Italy, an active public health planning and implementation of structural and organizational measures would be very effective to improve the vaccination culture.

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Riassunto

Esiste un'associazione tra le conoscenze auto-percepite degli studenti di area sanitaria circa le malattie prevenibili da vaccino e le relative vaccinazioni ed il loro comportamento vaccinale?

Introduzione. Il ruolo delle vaccinazioni è ampiamente riconosciuto, tuttavia nell'ultimi anni si è verificata una riduzione della copertura vaccinale con il conseguente aumento di casi di malattie prevenibili da vaccino. Obiettivo del lavoro è stato quello di valutare se esista un'associazione tra il livello di conoscenze auto-valutate in ambito vaccinale ed i comportamenti degli studenti di area sanitaria per quanto riguarda le vaccinazioni.

Metodi. È stato condotto uno studio trasversale, utilizzando un questionario precedentemente validato. È stata effettuata una regressione logistica multivariata con processo di retroselezione graduale con un valore p univariato di 0,25 come criterio principale utilizzato. Il livello di significativa statistica è fissato a 0,05.

Risultati. Il campione è composto da 3.131 studenti (68,1% femmine). Il 38,9% sono studenti di medicina e chirurgia e il 33,1% sono studenti di infermieristica. L'analisi di regressione logistica multivariata mostra che in relazione al "livello non ottimale di conoscenze sulle malattie prevenibili con vaccinazione" le principali variabili indipendenti statisticamente significative associate sono: aumento dell'età (OR 1,56), aver contratto una malattia prevenibile da vaccino negli ultimi 5 anni (OR 1,38), essere stato vaccinato contro l'influenza stagionale l'anno scorso (OR 0,70), aver raccomandato la vaccinazione a pazienti o familiari durante l'ultima stagione influenzale sulla base della valutazione clinica (OR 0,53) e secondo le indicazioni Ministeriali (OR 0,48), aver in programma di raccomandare la vaccinazione antinfluenzale durante la prossima stagione sulla base della valutazione clinica (OR 0,67) e secondo le indicazioni Ministeriali (OR 0,69).

Discussione. Lo studio ha evidenziato l'importanza dell'educazione accademica sull'immunizzazione al fine di formare un futuro operatore sanitario consapevole dell'importanza dell'immunizzazione e del ruolo rilevante svolto dagli operatori sanitari nel promuovere una cultura della vaccinazione tra la popolazione generale.

References

1. European Commission. Council conclusions on vaccinations as an effective tool in public health. Official Journal of the European Union 2014; **57**(C 438).
2. World Health Organization (WHO). Global Vaccine Action Plan 2011-2020. Geneva: WHO, 2013.
3. World Health Organization (WHO). Immunization coverage 2017. Available on: <https://www.who.int/news-room/fact-sheets/detail/immunization-coverage> [Last Accessed: 2019, June 23].
4. Ministry of Health. Piano Nazionale Prevenzione Vaccinale-PNPV 2017-2019. 2017. Available on: http://www.salute.gov.it/imgs/C_17_pubblicazioni_2571_allegato.pdf [Last Accessed: 2019, June 23].
5. European Center for Disease Prevention and Control (ECDC). Surveillance report.

- Monthly measles and rubella monitoring report. Stockholm, 2018.
6. Petrelli F, Contratti CM, Tanzi E, and Grapasonni I. Vaccine hesitancy, a public health problem. *Ann Ig* 2018; **30**(2): 86-103.
 7. National Institut of Health. Portale Epicentro. Morbillo & Rosolia News, Gennaio. 2018. Available on: <http://www.epicentro.iss.it/problemi/morbillo/bollettino.asp> [Last Accessed: 2019, June 23].
 8. National Institut of Health. Portale Epicentro. Morbillo & Rosolia News, Gennaio. 2019. Available on: <http://www.epicentro.iss.it/problemi/morbillo/bollettino.asp> [Last Accessed: 2019, June 23].
 9. Adamo G, Sturabotti G, Baccolini V, et al. Regional reports for the subnational monitoring of measles elimination in Italy and the identification of local barriers to the attainment of the elimination goal. *PLoS One* 2018; **13**(10): e0205147.
 10. Haviari S, Benet T, Saadatian-Elahi M, Andre P, Loulergue P, Vanhems P. Vaccination of healthcare workers: A review. *Hum Vaccin Immunother* 2015; **11**(11): 2522-37.
 11. Amodio E, Restivo V, Firenze A, Mammina C, Tramuto F, Vitale F. Can influenza vaccination coverage among healthcare workers influence the risk of nosocomial influenza-like illness in hospitalized patients? *J Hosp Infect* 2014; **86**(3): 182-7.
 12. Council of Ministers, Legislative Decree n. 81, 9th april 2008 on health and safety in workplaces. 2008: GU Serie Generale n.101 del 30-04-2008 (Suppl Ord n. 108).
 13. European Centre for Disease Prevention and Control (ECDC). Vaccine hesitancy among healthcare workers and their patients in Europe – A qualitative study. Stockholm, 2015.
 14. European Centre for Disease Prevention and Control (ECDC). Let's talk about protection. Stockholm, 2016.
 15. Yassi A, Lockhart K, Buxton JA, McDonald I. Vaccination of health care workers for influenza: promote safety culture, not coercion. *Can J Public Health* 2010; **101**(Suppl 1): S41-5.
 16. Costantino C, Ricciardi A, Pennacchietti L, et al., Percezione della importanza della vaccinazione antinfluenzale tra gli specializzandi in Igiene e Medicina Preventiva Italiani. Studio conoscitivo della Consulta dei Medici in Formazione Specialistica della S.It.I. *Ann Ig* 2013; **25**(Suppl. 1): 421-7.
 17. StataCorp., Stata Statistical Software. Release 14. 2015, StataCorp LP.: College Station, TX.
 18. La Torre G, Scalingi S, Garruto V, Siclari M, Chiarini M, Mannocci A. Knowledge, Attitude and Behaviours towards Recommended Vaccinations among Healthcare Workers. *Healthcare (Basel)* 2017; **5**(1): pii E13.
 19. Squeri R, Genovese C, Trimarchi G, Palamara MAR, La Fauci V. An evaluation of attitude toward vaccines among healthcare workers of a University Hospital in Southern Italy. *Ann Ig* 2017; **29**(6): 595-606.
 20. Rabensteiner A, Buja A, Regele D, Fischer M, Baldo V. Healthcare worker's attitude to seasonal influenza vaccination in the South Tyrolean province of Italy: barriers and facilitators. *Vaccine* 2018; **36**(4): 535-44.
 21. Esposito S, Tremolati E, Bellasio M, et al., Attitudes and knowledge regarding influenza vaccination among hospital health workers caring for women and children. *Vaccine* 2007; **25**(29): 5283-9.
 22. Bonaccorsi G, Lorini C, Porchia BR, et al. [Influenza vaccination: coverage and risk perception among students of the health professions at Florence University, Italy]. *Ann Ig* 2013; **25**(3): 181-9.
 23. Marotta C, Raia DD, Ventura G, et al. Improvement in vaccination knowledge among health students following an integrated extra curricular intervention, an explorative study in the University of Palermo. *J Prev Med Hyg* 2017; **58**(2): E93-E8.
 24. Giambi C, Fabiani M, D'Ancona F, et al. Parental vaccine hesitancy in Italy - Results from a national survey. *Vaccine* 2018; **36**(6): 779-87.
 25. Simone B, Carrillo-Santistevé P, Lopalco PL. Healthcare workers role in keeping MMR vaccination uptake high in Europe: a review of evidence. *Euro Surveill* 2012; **17**(26).
 26. Demicheli V, Jefferson T, Rivetti D, and Deeks J. Prevention and early treatment of influenza in healthy adults. *Vaccine* 2000; **18**(11-12): 957-1030.
 27. Dini G, Toletone A, Sticchi L, Orsi A, Bragazzi NL, Durando P. Influenza vaccination in healthcare workers: A comprehensive critical appraisal of the literature. *Hum Vaccin Immunother* 2018; **14**(3): 772-89.
 28. Gallone MS, Gallone MF, Cappelli MG, et al. Medical students' attitude toward influenza vaccination: Results of a survey in the University

- of Bari (Italy). *Hum Vaccin Immunother* 2017; **13**(8): 1937-41.
29. Burls A, Jordan R, Barton P, et al. Vaccinating healthcare workers against influenza to protect the vulnerable--is it a good use of healthcare resources? A systematic review of the evidence and an economic evaluation. *Vaccine* 2006; **24**(19): 4212-21.
 30. ASUR Marche. DDG 613 del 26/10/17. Le vaccinazioni negli operatori sanitari e la prevenzione delle infezioni correlate all'assistenza. 2017.
 31. Regione Emilia-Romagna, Delibera N. 351 del 12/03/2018 Rischio biologico in ambiente sanitario. linee di indirizzo per la prevenzione delle principali patologie trasmesse per via ematica e per via aerea, indicazioni per l' idoneità dell' operatore sanitario. 2018.
 32. Preaud E, Durand L, Macabeo B, et al. Annual public health and economic benefits of seasonal influenza vaccination: a European estimate. *BMC Public Health* 2014; **14**: 813.
 33. Italian Multidisciplinary Society for Infection Prevention (SIMPIOS). Pisa's Charter of Vaccinations. 2017. Available on: <http://www.simpios.eu/wp-content/uploads/2017/06/Carta-di-Pisa-Vaccinazione-Operatori-Sanitari.pdf> [Last Accessed: 2019, June 23].
 34. Boccia S, Calamusa V, Grossi A, Villari P, Ricciardi W. Improving vaccination coverage among healthcare workers in Italy. *Epidemiol Biostat Public Health* 2018; **15**(3): e12980-1.
 35. Italian Parliament, Legge 31 luglio 2017, n. 119. Disposizioni urgenti in materia di prevenzione vaccinale, di malattie infettive e di controversie relative alla somministrazione di farmaci. GU Serie Generale n. 182 del 05/08/2017.
 36. Adamo G, Sturabotti G, D'Andrea E, et al. The end of measles and congenital rubella: an achievable dream? *Ann Ig* 2017; **29**(1): 1-26.
 37. Massimi A, Rosso A, Marzuillo C, et al. Childhood vaccinations. Validation of a tool for measuring knowledge, attitudes and vaccine hesitancy in pregnant women. *Epidemiol Biostat Public Health* 2017; **14**(4): e12625.1-e.5.
 38. Gianfredi V, Grisci C, Nucci D, Parisi V, Moretti M. [Communication in health.]. *Recenti Prog Med* 2018; **109**(7): 374-83.
 39. Rosso A, Massimi A, De Vito C, et al. Knowledge and attitudes on pediatric vaccinations and intention to vaccinate in a sample of pregnant women from the City of Rome. *Vaccine* 2019; **37**: 1954-63.
 40. Blanch-Hartigan D. Medical students' self-assessment of performance: results from three meta-analyses. *Patient Educ Couns* 2011; **84**(1): 3-9.
 41. Kataoka Y, Yaju Y, Eto H, Horiuchi S. Self-administered questionnaire versus interview as a screening method for intimate partner violence in the prenatal setting in Japan: a randomised controlled trial. *BMC Pregnancy Childbirth* 2010; **10**: 84.

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