# IMMUNIZATION RELATED BEHAVIOUR AMONG HEALTHCARE WORKERS IN EUROPE: RESULTS OF THE HPROIMMUNE SURVEY

**Pania Karnaki[1], Agoritsa Baka[1, 2], Athanassios Petralias[1, 3, 4], Afroditi Veloudaki[1, 3], Dina Zota[1, 3], Athena Linos[1, 3]; HProImmune Partnership**

[1]Institute of Preventive Medicine, Environmental and Occupational Health, Prolepsis, Greece
[2]Hellenic Centre for Disease Control and Prevention, Attika, Greece
[3]Department of Hygiene, Epidemiology and Medical Statistics, Medical School, National and Kapodistrian University of Athens, Athens, Greece
[4]Department of Statistics, Athens University of Economics and Business, Athens, Greece

**SUMMARY**

*Objectives:* Vaccine preventable diseases (VPDs) continue to pose a significant threat to healthcare workers (HCWs) while immunization among this group remains low. HCWs' behaviours as well as facilitators and barriers towards their vaccination for a number of VPDs were explored through an EU-wide survey.

*Methods:* HCWs across the EU answered online survey that explored attitudes and behaviours towards vaccination for a number of VPDs. Response data were adjusted based on weights estimated by HCWs' country and working profession according to WHO statistics. The survey was delivered between October 2012 and April 2014.

*Results:* Analysis was based on responses from 5,424 HCWs from 14 European countries. The majority (86.7%) had a positive attitude regarding immunizations. HCWs considered influenza (86.4%), viral hepatitis type B (71.9%) and tuberculosis (59.1%) as higher risk diseases for occupational exposure in the workplace. However, 43.8% reported not receiving a seasonal influenza vaccine in the last 10 years and 65.6% reported not receiving the pandemic influenza vaccine in 2009. Main enablers towards immunizations included believing in vaccine protection and easy, free of charge access to vaccines in the workplace. Barriers to up-to-date immunizations differed according to disease but included concerns about short- and long-term effects.

*Conclusion:* Although the concept of mandatory vaccination seems to be favoured by many health professionals in Europe, it remains a controversial subject both among HCWs' profession categories and also among different countries. Interventions to increase vaccination among HCWs would benefit by tailoring their approach according to disease and target group.

*Key words:* healthcare workers, immunization, vaccines, Europe

**Address for correspondence:** A. Linos, Department of Hygiene, Epidemiology and Medical Statistics, Medical School, University of Athens, 7 Fragoklisias str., Maroussi, 15125, Greece. E-mail: a.linos@prolepsis.gr

*https://doi.org/10.21101/cejph.a5514*

## INTRODUCTION

Medical doctors, nurses, and allied health professionals with clinical work (i.e. assistants/home health aides, administrative healthcare service personnel, physical/occupational/respiratory therapists, psychologists, hospital epidemiologists, social workers, etc.) are exposed to infectious pathogens as a result of their occupation rendering both themselves and their patients vulnerable to associated infections.

Immunization of healthcare workers (HCWs) remains one of the most important infection control measures protecting staff and patients and ensuring high quality of care. Immunization is the most effective and affordable means for disrupting disease transmission for vaccine preventable diseases (VPDs) and minimizing the risk of nosocomial outbreaks (1, 2). Hospital outbreaks of influenza, pertussis, measles, rubella, varicella, viral hepatitis type A, and viral hepatitis type B have often been reported (1, 3, 4). These outbreaks have led to absenteeism and understaffing, increasing staff costs and affecting patients' care quality (5).

However, despite reported benefits, vaccination coverage of HCWs remains inadequate (2, 4, 6, 7). The EU issued in 2009 a European Council decision (8) aimed at increasing vaccination coverage for the seasonal influenza vaccine to 75% by 2015 in high risk populations in the EU. This decision was not followed by common immunization recommendations for HCWs as there is only a small increase in seasonal influenza vaccinations among HCWs (9–11).

There are no uniform immunization recommendations among European member states (12); some countries require proof of vaccinations and others simply recommend them. A review of 30 European countries showed that HCWs are advised to receive vaccinations for seasonal influenza and viral hepatitis type B (8).

HCWs abstain from vaccination for many reasons including conscientious opposition, concerns about the safety and efficacy of

vaccines, possible medical contraindications, improper perception of their own vulnerability to infection and their ability to spread it, disbelief in the seriousness of the disease, or the inconvenience of getting vaccinated (1, 8, 13). A meta-analysis, including HCWs from North and South America, Europe, and Asia, of vaccine coverage rates for seasonal and pandemic influenza and viral hepatitis type B, pertussis, and smallpox reported that interest in self-protection was the most significant facilitator of vaccine acceptance, with patient protection given less weight (10).

This article presents a study in 14 EU member states for HCWs' immunization for a number of different VPDs. It investigates barriers, enablers, perceptions and needs of HCWs concerning booster (MMR, varicella vaccine, viral hepatitis type B vaccine, Td, Tdap), seasonal and pandemic influenza immunization. To our knowledge, no studies have been conducted simultaneously in more than one EU member state to examine HCWs perspectives, triggers, barriers and needs concerning immunization (10).

The study is part of the HProImmune project – Promoting Immunizations for Health Care Professionals – co-funded by the European Commission in the framework of the 2nd Health Programme. The HProImmune project aimed at promoting immunizations for HCWs through tailored made promotional material which was developed after an in-depth exploration of HCWs immunization barriers and facilitators for specific vaccines. The material produced was piloted among HCWs in Greece, Poland, Lithuania, Italy, Romania, Cyprus, and Germany.

## MATERIALS AND METHODS

### Survey Questionnaire

In the framework of assessing the general attitude of European HCWs towards immunizations, a purpose-made, anonymous questionnaire was developed comprising 14 questions on attitudes, facilitators and barriers towards vaccination of HCWs for the following VPDs: influenza (flu), tuberculosis, measles, mumps, rubella (German measles), meningococcal disease, varicella/zoster (chickenpox), viral hepatitis type A, viral hepatitis type B, pneumococcal disease, tetanus, diphtheria, and pertussis (whooping cough). The questionnaire asked respondents about specific vaccinations received over the last 10 years, reasons for not being immunized, as well as attitudes and opinions towards obligatory vaccination. Demographic characteristics collected included education, specialty, work setting, years of experience, gender, age, and country of employment.

The questionnaire (translated into 10 languages: English, Greek, German, Italian, Spanish, Portuguese, Romanian, Swedish, Lithuanian, and French) was accessible from the HproImmune project website.

### Participants

The online survey was completed by 5,553 HCWs. Questionnaires with incomplete data (n = 79) and from countries with < 20 respondents (n = 50) were omitted from the current analysis.

Due to resulting general asymmetry that was observed among countries and profession categories, we adjusted the sample using weights. We obtained the statistics on HCWs workforce by country and profession category (2013 data) from the World Health Organization (WHO) and estimated weights by country and health professional category weighing accordingly our observations to be representative with respect to the number of HCWs working in participant countries (WHO, Global Health Observatory, Health Workforce data, 2013).

### Statistical Analysis

Results are presented as absolute (n) and relative (%) frequencies by country, by disease, and by professional category. Relationships between categorical variables were assessed using Pearson's chi-square test. To explore the characteristics of HCWs who do not hold a positive view towards vaccination, we performed multivariate logistic regression. All data were analyzed using IBM SPSS version 21.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.). A two-sided $p < 0.05$ was considered as statistically significant.

## RESULTS

A total of 5,424 questionnaires from 14 European countries – Sweden, Greece, Finland, Italy, Germany, Malta, Lithuania, Romania, Slovenia, Spain, Poland, UK, Cyprus, and Ireland − were included in the analysis. From the sample, 24.6% were medical doctors, 42.7% nurses and 32.8% allied health professionals. The majority (42%) of medical doctors were specialized in general practice/family medicine; 28% of the nurses were hospital nurses and 19.5% were primary healthcare nurses; 33.5% of allied health professionals were assistants/aides and 20.9% were administrative healthcare service personnel. Table 1 presents the percentages of respondents who participated in the final analysis by professional category.

Most participants (59.1%) held a post-graduate degree and 66.5% had more than 10 years of experience in the field; most (80.9%) were females, 39.5% worked in a public hospital, 23.8% in a primary healthcare centre, 8.9% in a public health institute or other governmental organization, 6.1% in specialty clinics, 6.0% in long-term care facilities, and the rest (11.8%) in various settings such as private hospitals, academia, industry, etc. The distribution of respondents by country (actual and weighted rates, according to WHO data as described above) is shown in Table 2.

The online survey demonstrated that the overwhelming majority (86.7%) of HCWs in the 14 EU countries had a positive attitude towards immunization acknowledging their importance. This was observed for each health profession category (medical doctors, nurses and allied health professionals) separately (rates above 90% in all 3 categories). However, respondents' views about vaccines differed among the participating countries (p-value < 0.001). While almost all participating countries had a response rate above 90% to the question "Do you have a positive view about vaccines?", responses from Slovenia reached 32.1%. The majority (57.1%) of the Slovenian respondents believed that vaccinations do more harm than good.

HCWs recognized the risk of exposure to VPDs in their workplace, and the subsequent threat to their families and vulnerable patients. Seasonal influenza (86.1%), viral hepatitis type B (71.9%), and tuberculosis (59.1%) were the diseases that HCWs

***Table 1.*** *Percentages by professional category of respondents (N = 5,424)*

| **Medical doctors** | **n (%) 1,334 (24.6)** | **Nurses** | **n (%) 2,313 (42.7)** | **Allied health professionals** | **n (%) 1,777 (32.8)** |
|---|---|---|---|---|---|
| General practice, family medicine | 560 (42.0) | Hospital nurse | 649 (28.0) | Assistants/aides (home health aides, orderlies) | 596 (33.5) |
| Internal medicine specialty | 259 (19.4) | Primary healthcare nurse | 452 (19.5) | Administrative healthcare service personnel | 372 (20.9) |
| Paediatric specialty | 215 (16.1) | Nurse in other settings (home, outpatient clinic) | 342 (14.8) | Physical, occupational, respiratory therapists | 247 (13.9) |
| Surgical specialty | 212 (15.9) | Public health nurse | 308 (13.3) | Psychologists | 99 (5.6) |
| Laboratory | 88 (6.6) | Maternal health or school health nurse | 194 (8.4) | Hospital epidemiologists | 87 (4.9) |
| | | Infection control nurse | 141 (6.1) | Social workers | 82 (4.6) |
| | | Midwife or maternal health nurse | 116 (5.0) | Laboratory technicians | 78 (4.4) |
| | | Emergency department nurse | 111 (4.8) | Support personnel (food services, maintenance) | 71 (4.0) |
| | | | | Pharmacist | 52 (2.9) |
| | | | | Ambulance personnel | 52 (2.9) |
| | | | | Dental hygienists | 41 (2.3) |

***Table 2.*** *Distribution by country of respondents (N = 5,424)*

| **Country of employment** | **n** | **%** | **Weighted %** |
|---|---|---|---|
| Sweden | 2,945 | 54.3 | 3.6 |
| Greece | 563 | 10.4 | 3.1 |
| Lithuania | 436 | 8.0 | 0.9 |
| Finland | 307 | 5.7 | 3.4 |
| Italy | 251 | 4.6 | 15.0 |
| Germany | 233 | 4.3 | 30.0 |
| Malta | 217 | 4.0 | 0.1 |
| Romania | 110 | 2.0 | 4.4 |
| Slovenia | 100 | 1.8 | 0.5 |
| Spain | 93 | 1.7 | 10.1 |
| Poland | 63 | 1.2 | 7.6 |
| UK | 59 | 1.1 | 19.1 |
| Cyprus | 25 | 0.5 | 0.2 |
| Ireland | 22 | 0.4 | 2.0 |
| Total | 5,424 | 100.0 | 100.0 |

The weights applied in the last column were estimated based on the WHO data on healthcare workers by country and working profession.

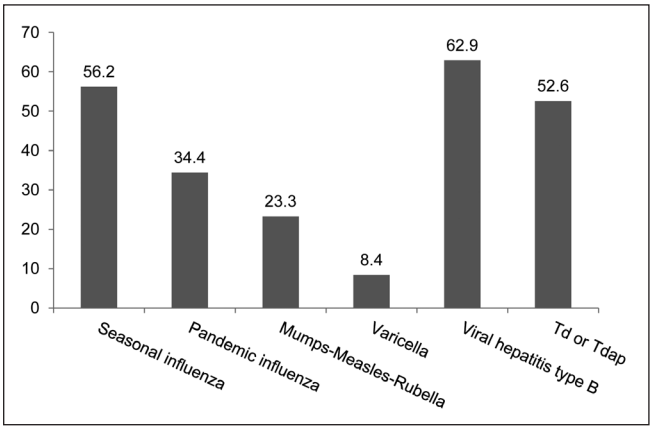


***Fig. 1.*** *Percentage of HCWs who have received vaccination against vaccine preventable diseases in the last 10 years by vaccine (weighted results).*

considered most risky of contracting at their work. Similarly, influenza was the disease that HCWs considered most risky of being transmitted to patients and family (91.9%), followed by tuberculosis (42.0%), and viral hepatitis type B (37.9%).

Despite recognizing the risk of exposure to VPDs, HCWs reported not being vaccinated against a number of diseases. The majority of HCWs reported not receiving vaccinations against measles/mumps/rubella and varicella/zoster (rates ranged from 65% to 92%) in the last 10 years (Fig. 1). Only 56.2% of HCWs reported receiving the seasonal influenza vaccine during the last 10 years. Regarding the pandemic influenza vaccine in 2009, most of the medical doctors (56.8%), nurses (69.3%), and allied health professionals (67.6%) reported not receiving it, and the rates by professional category differed significantly ($p < 0.001$). In many countries such as Sweden, Greece, Italy, Malta, Lithuania, Romania, Slovenia, Spain, and Cyprus, approximately half or even less reported not being vaccinated against the hepatitis type B virus in the last 10 years (Table 3).

Viral hepatitis type B 93.6%, rubella 40.8%, measles 39.7%, mumps 36.9%, varicella 27.9%, and pertussis 17.4% (weighted results) were the VPDs organizations/hospitals required proven immunity by their future employees according to our sample's answers.

The main reasons (barriers) for not receiving the vaccinations under study included concerns about side-effects (short- and long-term), underestimation of personal risk, and the vaccination costs not being covered by employers or insurance. Specifically for the

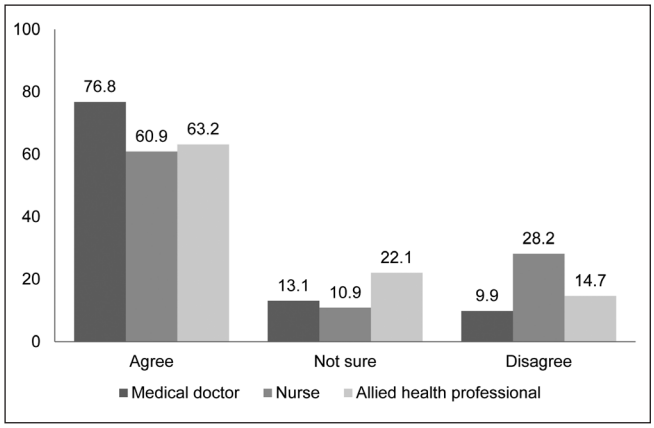


***Fig. 2.*** *Percentage of HCWs that think it should be mandatory for HCWs who come in regular contact with patients to be vaccinated against vaccine preventable diseases (weighted results).*

seasonal influenza vaccine the main barrier against vaccination was the belief of challenging natural immunity by contracting the disease (19.5%), followed by side-effect concerns (14.5%). In all cases the two main vaccination enablers were believing in the protection power of the vaccine and believing there is risk of acquiring the disease. Other significant enablers included availability of the vaccine in the workplace, offer of the vaccine free of charge, and risk of transmitting the disease to patients.

Respondents in our survey favoured significantly the concept of mandatory vaccination, with an overall of 65.7% of HCWs responding that "immunization against VPDs should be mandatory for HCWs who come in regular contact with patients." Stratification of rates by professional category found that medical doctors (76.8%) supported mandatory vaccination significantly more than nurses and other allied categories (60.9% and 63.2%, respectively) ($p < 0.001$) (Fig. 2). In terms of HCWs not supporting mandatory vaccination, rates differed significantly among countries; they were higher in Slovenia (58.6%), followed by Germany (27.5%), Spain (22.1%), and Sweden (21.7%) ($p < 0.001$) (Table 4).

Table 5 presents the results from the multivariate logistic regression analysis for the probability of HCWs not believing in vaccination. Probability for each country was determined in relation to Sweden that had the largest sample size of respondents. As shown, there were significant differences between countries, professional categories, work setting, and level of education. In particular, nurses had more than 7 times higher odds of not believing in vaccination, and allied health professionals had almost 3 times higher odds of not believing in vaccination, compared to medical doctors ($p < 0.001$). HCWs from Italy and Slovenia had the highest probabilities of not believing in vaccinations (OR = 4.82, p-value = 0.001 for Italy and OR = 194.8, p-value < 0.001 for Slovenia in relation to those from Sweden). On the other hand, HCWs from Finland showed a lower probability of not believing in vaccination (OR = 0.14. p-value = 0.017 in relation to those from Sweden). No HCWs from UK, Cyprus or Ireland reported not believing in vaccination. Gender and age did not seem to affect the probability of believing in vaccination.

***Table 3.*** *Percentage of HCWs who have not received vaccination against vaccine preventable diseases in the last 10 years, by country and disease (weighted results)*

| Country | Seasonal influenza (flu) vaccine % | Pandemic influenza (swine flu) vaccine % | MMR (mumps-measles-rubella vaccine) % | Varicella (chicken-pox) vaccine % | Viral hepatitis type B vaccine % | Td or Tdap (adult tetanus, diphtheria and pertussis vaccine) % |
|---|---|---|---|---|---|---|
| Sweden | *63.9* | 34.9 | **84.4** | **96.4** | 48.4 | *61.5* |
| Greece | *57.5* | *73.7* | **82.6** | **87.4** | 48.5 | *59.9* |
| Finland | 34.1 | 31.9 | *69.2* | **92.9** | 37.4 | 20.9 |
| Italy | *53.3* | **76.6** | **90.6** | **92.5** | *50.8* | *55.9* |
| Germany | 45.2 | *70.1* | *60.9* | **82.8** | 24.2 | 21.0 |
| Malta | 40.0 | 50.0 | **80.0** | **100.0** | 50.0 | *66.7* |
| Lithuania | *52.0* | **89.8** | **94.0** | **98.0** | *70.0* | *71.4* |
| Romania | 43.0 | *54.5* | **95.3** | **98.3** | 48.5 | **89.4** |
| Slovenia | **79.3** | **85.7** | **96.6** | **100.0** | *64.3* | **82.8** |
| Spain | 49.5 | **79.1** | **76.6** | **91.0** | 47.3 | 46.5 |
| Poland | 35.0 | **82.4** | **93.9** | **98.8** | 25.4 | *74.6* |
| UK | 29.5 | *51.6* | **77.1** | **99.0** | 35.8 | *56.8* |
| Cyprus | *75.0* | **87.5** | **77.8** | **88.9** | *62.5* | 50.0 |
| Ireland | 40.6 | 24.5 | **77.4** | **100.0** | 43.4 | **78.3** |
| Total | 43.8 | *65.6* | **76.7** | **91.6** | 37.1 | 47.4 |

Italics – greater than 50%, bold – greater than 75%

***Table 4**. Percentages for responses to question: "Do you think that it should be mandatory for HCWs who come in regular contact with patients to be vaccinated against vaccine preventable diseases?" by country (weighted results)*

| Country | Agree % | Not sure % | Disagree % |
|---|---|---|---|
| Sweden | 47.1 | 31.2 | 21.7 |
| Greece | 77.8 | 15.6 | 6.6 |
| Finland | 54.0 | 36.2 | 9.8 |
| Italy | 66.9 | 18.9 | 14.2 |
| Germany | 62.1 | 10.5 | 27.5 |
| Malta | 80.0 | 20.0 | 0.0 |
| Lithuania | 77.6 | 10.2 | 12.2 |
| Romania | 79.1 | 5.1 | 15.7 |
| Slovenia | 27.6 | 13.8 | 58.6 |
| Spain | 64.2 | 13.7 | 22.1 |
| Poland | 89.2 | 3.2 | 7.6 |
| UK | 59.1 | 21.5 | 19.4 |
| Cyprus | 77.8 | 11.1 | 11.1 |
| Ireland | 95.3 | 2.8 | 1.9 |
| Total | 65.6 | 15.0 | 19.4 |

## DISCUSSION

This study is the first to our knowledge to explore HCWs perspectives about a number of VPDs in different European countries as well as examining the barriers, enablers and facilitators of immunization. Our findings are important for professionals aiming at increasing immunization coverage among HCWs. Health professionals are increasingly recognized as a key population, both as a target group for protection against VPDs, as well as a promoter of immunization. HCWs can promote immunizations actively to their patients, as well as passively through their status as role models.

The aim of our study was to investigate the beliefs of European HCWs' on immunizations and the most commonly encountered vaccination obstacles and enablers. In addition, we investigated the concept of mandatory vaccination for HCWs who come into clinical contact with patients. While most of the existing studies in the literature have addressed the matter of influenza and viral hepatitis type B vaccination, our research examined a number of other VPDs for which recommendations exist in the adult immunization programmes in Europe. In addition, our study is one of the few available in the literature where the behaviour of other HCWs besides medical doctors or nurses is recorded.

HCWs vaccination is a key safety initiative for healthcare systems given our multi-cultural societies and the unencumbered population movement across the globe. Vaccinations are efficient and cost-effective in reducing the risk of VPD transmission in hospitals and the community (2). Professional organizations, public health bodies and authorities strongly recommend the vaccination of HCWs not only against influenza, but also against other VPDs (8, 14). Nevertheless, European harmonized guidance on vaccinations of HCWs is lacking.

Our study showed that although the majority of European HCWs (86.7%) have positive attitudes towards vaccines, most report not receiving all recommended vaccines heading possibly to suboptimal vaccination coverage inside various healthcare facilities for a number of communicable diseases currently causing outbreaks such as measles, mumps, rubella and pertussis. Similar findings have been reported elsewhere in the literature (1, 3, 13). Only 39.7% of respondents from our study reported that their healthcare institution required proof of immunization for measles while the majority had not received the MMR vaccine in the last 10 years. While most respondents explained their lack of recent vaccination because of having received past vaccination or having contracted the disease in the past, some reported fear of side effects or belief in challenging natural immunity. Meanwhile measles outbreaks are occurring in European countries including Italy, Greece and Romania (11). During the ongoing epidemics of measles in Europe, Greece reported 117 cases of HCWs contracting measles in the outbreak of 2017–2018, of which almost 31% (n = 36) reported serious complications (15). Understanding the reasons behind minimal vaccination coverage can help improve vaccination campaigns to prevent outbreaks like these.

Despite the obvious immunization benefits including community protection ("herd immunity"), effectiveness, and cost-effectiveness, non-adherence among HCWs has been attributed in the literature to a variety of barriers, from lack of commitment by senior management of health facilities and unclear policies to lack of knowledge and denial of risk (10, 16). Our research also suggests that the main reasons for not receiving vaccination included concerns about vaccine side-effects (short- and long-term), lack of belief in personal risk, and vaccination costs.

Specifically regarding the seasonal influenza vaccine, it was found that the main barrier against vaccination was the belief in challenging natural immunity by contracting the disease. However, after the 2009 influenza pandemic, it has been well described that about 25–30% of healthy immunocompetent persons may develop serious lower respiratory disease which may lead to hospitalization in intensive care unit (17). Furthermore, up to 30% of individuals may develop subclinical or even asymptomatic influenza infection, but are able to transmit the disease, a fact that is very relevant for the health sector (18). Thus, seeking to challenge natural immunity by refusing vaccination can result in serious life-threatening conditions in oneself and vulnerable patients and others.

Findings from a qualitative study conducted within the HproImmune project showed that physicians and nurses who question the influenza vaccine and relevant campaigns wonder about concealed financial interests (19). Clearly vaccination campaigns for HCWs must target these misconceptions in order to be successful.

It has been argued that the ethical responsibility to ensure universal vaccination of staff lies not only within individual health care providers but also within each healthcare institution (2, 20). Giri et al. (21) underlined the significant cost-effectiveness of offering vaccination without prior serology for HCWs with no evidence of prior immunization to measles/mumps/rubella, implying that institutions would save resources by covering the cost of vaccination for their staff. Similarly, Maltezou and Tsakris (22) stated that nosocomial influenza poses a threat for specific groups of patients and is associated with the disruption of healthcare services as well as with excess costs.

***Table 5.*** *Multivariate logistic regression analysis results for probability of HCWs not believing in vaccination (weighted results)*

| | p-value | Odds ratio (OR) | 95% CI for OR | |
|---|---|---|---|---|
| | | | Lower | Upper |
| Country of employment* (reference level: Sweden) | < 0.001 | | | |
| Greece | 0.912 | 0.92 | 0.2 | 4.1 |
| Finland | **0.017** | **0.14** | **0.0** | **0.7** |
| Italy | **0.001** | **4.82** | **1.8** | **12.7** |
| Germany | 0.692 | 1.22 | 0.5 | 3.3 |
| Malta | 0.957 | 0.84 | 0.0 | 457.1 |
| Lithuania | 0.165 | 0.14 | 0.0 | 2.3 |
| Romania | 0.944 | 1.05 | 0.3 | 4.1 |
| Slovenia | **< 0.001** | **194.75** | **45.6** | **832.2** |
| Spain | 0.724 | 0.80 | 0.2 | 2.8 |
| Poland | 0.409 | 0.61 | 0.2 | 2.0 |
| Current profession (reference level: medical doctors) | < 0.001 | | | |
| Nurses | **< 0.001** | **7.47** | **3.8** | **14.8** |
| Allied health professionals | **0.003** | **2.93** | **1.5** | **5.9** |
| Setting of work (reference level: other setting) | < 0.001 | | | |
| Public regional/community hospital | **< 0.001** | **0.32** | **0.2** | **0.6** |
| Private regional/community hospital | 0.446 | 1.34 | 0.6 | 2.9 |
| Public tertiary/university hospital | 0.260 | 0.59 | 0.2 | 1.5 |
| Specialty clinics (i.e. obstetrics/gynaecology, psychiatry etc.) | **0.001** | **2.76** | **1.5** | **5.0** |
| Long term care facilities (i.e. nursing homes, chronic care facilities etc.) | **0.047** | **0.37** | **0.1** | **1.0** |
| Primary health care centre (including outpatient or ambulatory clinic, maternal health care centre, child health care centre, school health care centre) | 0.554 | 1.21 | 0.6 | 2.3 |
| Private practice | 0.084 | 2.14 | 0.9 | 5.1 |
| Public health institute or other governmental organization | **< 0.001** | **0.22** | **0.1** | **0.5** |
| Academia | **< 0.001** | **6.79** | **2.6** | **17.5** |
| Industry | **< 0.001** | **10.65** | **3.8** | **30.2** |
| Level of education (reference level: vocational training) | < 0.001 | | | |
| Primary school | 0.857 | 1.69 | 0.0 | 495.6 |
| Secondary school | 0.500 | 1.35 | 0.6 | 3.2 |
| Academic degree | **< 0.001** | **4.20** | **2.2** | **7.9** |
| Postgraduate degree | 0.997 | 1.001 | 0.6 | 1.8 |
| Age (reference level: 65 years and over) | < 0.001 | | | |
| 18–24 | 0.072 | 0.12 | 0.0 | 1.2 |
| 25–34 | 0.991 | 0.99 | 0.2 | 5.0 |
| 35–44 | 0.984 | 0.98 | 0.2 | 4.9 |
| 45–54 | 0.088 | 0.24 | 0.1 | 1.2 |
| 55–64 | 0.717 | 1.35 | 0.3 | 6.8 |
| Gender (reference level: female) | 0.196 | 0.76 | 0.5 | 1.2 |

No. of observations after excluding missing cases for all variables: 5,020;
Nagelkerke $R^2$: 0.387; correctly classified: 95.7%.
Statistically significant variables included in the model are marked in bold.
*All respondents from UK, Cyprus and Ireland believed in vaccination.

Our results show that one of the barriers to vaccination for HCWs is the absence of coverage of the vaccination costs by the employer. This barrier indicates a gap in the support for universal vaccination that can be filled by healthcare institutions. Our qualitative study echoed these findings, as physicians and nurses noted that attitudinal barriers would decrease

if organizational barriers were overcome, such as working schedules and vaccination costs (19).

Our study points out that although the concept of mandatory vaccination seems to be favoured by many health professionals in Europe, it remains a controversial subject for different professionals but also among different countries, a finding also described in other multi-centre studies (23). Nurses and other allied categories, as well as the country of Slovenia, showed significantly less support. Some studies have determined that implementing mandatory vaccination for seasonal influenza is the single most effective way to increase vaccination among HCWs (24, 25). The lack of universal vaccination coverage among HCWs and the majority support for mandatory vaccination found in our results support this claim, implying that mandatory vaccination may be the best way forward.

Variations in professional category and country of practice were also present in the odds of not supporting vaccination. Nurses have more than 7 times higher odds of not believing in vaccination compared to medical doctors, finding which is also supported by other literature (26, 27). Smedley et al. (28) found that nurses in the UK who did not support vaccination would most likely be persuaded if they were given additional information about side effects. More research is needed to examine whether vaccination campaigns that recognize the heterogeneity of HCWs and target the specific concerns of nurses would be successful in the future.

In terms of variation by country, HCWs from Italy and Slovenia had the highest probabilities of not believing in vaccinations in relation to those from Sweden. Similarly, Fortunato et al. (29), in a survey completed by 2,198 HCWs in the Puglia region of Italy found that vaccination rates were as low as 24.8% for influenza, 9.7% for MMR and 3.6% for varicella. Mrvic (30) examined rates of vaccination coverage and attitudes towards influenza vaccination in Ljubljana. Vaccination rates were 36.4% while the main reasons for declining vaccination included fear of side effects and belief of not being at risk. Respondents also believed that the vaccine was ineffective with the pharmaceutical industry being accused for the unnecessary promotion of the vaccine. Low rates of vaccination in these countries will require a more targeted approach that takes into account these beliefs.

A limitation of the study is that more than 50% of the respondents (54.3%) were from one country (Sweden). This reflected the use of the survey by Swedish public health authorities to assess their HCWs' beliefs in order to develop their national recommendations. Moreover, the majority of participants were nurses (42.7%), compared to doctors who made up for only 24.6% of the total sample. In order to address this asymmetry, we adjusted the sample using weights constructed on basis of WHO data on healthcare workers by country and working profession. Nevertheless, one cannot rule out the possibility of bias and presumably more representative results could be obtained if the original sample resembled the distribution of HCWs in EU.

Another limitation concerns the question about HBV vaccination. In order to allow for appropriate answers for vaccination against tetanus we specified in the survey a period of 10 years for the last booster. This may have affected the self-reporting of HBV vaccination status.

## CONCLUSIONS

Although the majority of HCWs (86.7%) in 14 European countries have positive attitudes about vaccines, the majority also self-report very low compliance with most of the immunizations recommended for adults in Europe (e.g., viral hepatitis type B, Tdap and MMR). Two out of three HCWs from our sample in 14 EU countries agree that vaccination should be mandatory for professionals involved in clinical work. In the present study, responses were found to vary considerably with respect to type of vaccine, country, profession, and work setting. HCWs in specific countries seem to have considerably negative views about immunizations.

Health promotion activities targeting HCWs concerning recommended immunizations should focus on delivering up to date and tailored per professional category information on vaccine effectiveness and possible side effects and provide guidance on practical enablers like improving access to vaccinations through the workplace.

**Acknowledgements**

This manuscript is a result of the research undertaken in the framework of the HProImmune – Promotion of Immunization for Health Professionals in Europe Project (http://www.hproimmune.eu/). HProImmune is a 3-year project co-funded by the Health Programme of the European Union aiming to promote immunization among healthcare workers in Europe. HproImmune partnership comprises 10 associated partners from 7 countries and 2 collaborating partners from 2 countries.

HProImmune partnership:

Main partner: Institute of Preventive Medicine, Environmental and Occupational Health, Prolepsis, Greece

Associated partners: National Institute of Infectious Diseases, Romania; Nofer Institute of Occupational Medicine, Poland; Training, Research and Development Centre, Lithuania; National Institute of Health, Italy; Romtens Foundation, Romania; Cyprus University of Technology, Cyprus; Technical University of Dresden, Germany; National Hellenic Nurses Association, Greece; Hellenic Centre for Disease Control and Prevention, Greece.

**Funding**

The HProImmune project has received funding from the European Union/DG Health and Consumer Protection in the framework of the 2nd Health Programme.

**Conflict of Interests**

None declared

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*Received August 28, 2018*
*Accepted in revised form July 26, 2019*