



Vaccination of healthcare personnel in Europe: Update to current policies



Helena C. Maltezos^{a,*}, Elisabeth Botelho-Nevers^b, Arne B. Brantsæter^c, Rose-Marie Carlsson^d, Ulrich Heininger^e, Judith M. Hübschen^f, Kamilla S. Josefsdottir^g, George Kassianos^h, Jan Kyncl^{i,j}, Caterina Ledda^k, Snežana Medić^{l,m}, Aneta Nitsch-Osuchⁿ, Raul Ortiz de Lejarazu^o, Maria Theodoridou^p, Pierre Van Damme^q, Gerrit A. van Essen^r, Sabine Wicker^s, Ursula Wiedermann^t, Gregory A. Poland^u, Vaccination Policies for HCP in Europe Study Group¹

^a Department for Interventions in Health Care Facilities, Hellenic Centre for Disease Control and Prevention, Athens, Greece

^b Clinical Trial Center, INSERM CICEC 1408, and Infectious Diseases Department, University Hospital of Saint-Etienne, 42055 Saint-Etienne, France

^c Department of Infectious Diseases and Department of Acute Medicine, Oslo University Hospital, Oslo, Norway

^d Public Health Agency of Sweden, Solna, Sweden

^e University of Basel Children's Hospital, Basel, Switzerland

^f Luxembourg Institute of Health, Luxembourg, Luxembourg

^g Centre for Health Security and Communicable Disease Control, Directorate of Health, Reykjavik, Iceland

^h Royal College of General Practitioners, Wokingham, United Kingdom

ⁱ Department of Infectious Diseases Epidemiology, National Institute of Public Health, Prague, Czech Republic

^j Department of Epidemiology and Biostatistics, Third Faculty of Medicine, Charles University, Prague, Czech Republic

^k Occupational Medicine, Occupational Medicine, Department of Clinical and Experimental Medicine, University of Catania, Catania, Italy

^l Department of Epidemiology, Faculty of Medicine, University of Novi Sad, Novi Sad, Serbia

^m Centre for Disease Control and Prevention, Institute of Public Health of Vojvodina, Novi Sad, Serbia

ⁿ Department of Social Medicine and Public Health, Medical University of Warsaw, Warsaw, Poland

^o National Influenza Centre, School of Medicine, Microbiology and Immunology Department, Hospital Clinico Universitario, Valladolid, Spain

^p Aghia Sophia Children's Hospital, First Department of Pediatrics, University of Athens, Athens, Greece

^q Centre for the Evaluation of Vaccination, Vaccine & Infectious Disease Institute, University of Antwerp, Antwerp, Belgium

^r General Practitioner, Amersfoort, the Netherlands

^s Occupational Health Service, University Hospital Frankfurt, Frankfurt am Main, Germany

^t Institute of Specific Prophylaxis and Tropical Medicine, Medical University Vienna, Vienna, Austria

^u Director, Mayo Vaccine Research Group, Mayo Clinic, Rochester, MN, United States

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ABSTRACT

We investigated and compared current national vaccination policies for health-care personnel (HCP) in Europe with results from our previous survey. Data from 36 European countries were collected using the same methodology as in 2011. National policies for HCP immunization were in place in all countries. There were significant differences in terms of number of vaccinations, target HCP and healthcare settings, and implementation regulations (recommended or mandatory vaccinations). Vaccination policies against hepatitis B and seasonal influenza were present in 35 countries each. Policies for vaccination of HCP against measles, mumps, rubella and varicella existed in 28, 24, 25 and 19 countries, respectively; and against tetanus, diphtheria, pertussis and poliomyelitis in 21, 20, 19, and 18 countries, respectively. Recommendations for hepatitis A immunization existed in 17 countries, and against meningococcus B, meningococcus C, meningococcus A, C, W, Y, and tuberculosis in 10, 8, 17, and 7 countries, respectively. Mandatory vaccination policies were found in 13 countries and were a pre-requisite for employment in ten. Comparing the vaccination programs of the 30 European countries that participated in the 2011 survey, we found that more countries had national vaccination policies against measles, mumps, rubella, hepatitis A, diphtheria, tetanus, poliomyelitis, pertussis, meningococcus C and/or meningococcus A, C, W, Y; and more of these implemented mandatory vaccination policies for HCP. In conclusion, European countries now have more comprehensive national vaccination programs for HCP, however

* Corresponding author at: Department for Interventions in Healthcare Facilities, Hellenic Centre for Disease Control and Prevention, 3-5 Agrafon Street, Athens 15123 Greece.

E-mail address: helen-maltezos@ath.forthnet.gr (H.C. Maltezos).

¹ Collaborating authors listed at the end of this Section (Vaccination Policies for HCP in Europe Study Group).

there are still gaps. Given the recent large outbreaks of vaccine-preventable diseases in Europe and the occupational risk for HCP, vaccination policies need to be expanded and strengthened in several European countries. Overall, vaccination policies for HCP in Europe should be periodically re-evaluated in order to provide optimal protection against vaccine-preventable diseases and infection control within healthcare facilities for HCP and patients.

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1. Introduction

The widespread implementation of routine vaccination programs during the second half of the 20th century led to the elimination or control of several vaccine-preventable diseases (VPDs) [1]. However, epidemics of VPDs continue to occur even in countries with long-standing vaccination programs. Over the past decade large measles epidemics have occurred in the European Union (33 fatalities were reported in 2018), rubella outbreaks are ongoing (620 cases during the same 12-month period) and a large multi-country hepatitis A outbreak was recorded (3,813 cases from June 2016 through December 2017) [2–4]. Serious and costly outbreaks of VPDs occur in healthcare facilities, with significant morbidity and fatalities [5–7]. Health-care personnel (HCP) are at risk for occupational exposure to VPDs and can also become the sources of transmission of VPDs to susceptible patients at high risk for serious morbidity, complications or even death because of their underlying conditions or age [8,9]. Vaccination of HCP is justified in order to directly protect themselves and indirectly their patients [8]. In 2011 we performed a survey among 30 European countries which demonstrated that national vaccination policies for HCP were in place in principal in all of them. However, considerable country-to-country variations were noted in terms of number of vaccinations, target subgroups of HCP, healthcare settings and frame of implementation [10].

We report the results of a survey conducted in 2018 to investigate changes in national vaccination policies for HCP in Europe since 2011. The same methodology was used as previously [10]. We added the new meningococcus group B, the pneumococcus and the human papilloma-virus vaccines to our list of vaccines, since these vaccinations are recommended to HCP in some countries [11].

2. Methods

The survey was conducted from July to September 2018. Our study concerned countries of the European continent. One expert on vaccination programs from each of the following 37 European countries was invited to participate: Albania, Austria, Belarus, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Moldova, the Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine and the United Kingdom. A form was used for data collection about national vaccination policies for HCP implemented through laws and regulations in each country. HCP were defined as persons employed in healthcare facilities with or without direct patient contact and regardless of their employment status (permanent or temporary). Healthcare facilities were defined as places where healthcare services are provided. Data about HCP vaccination against influenza, measles, mumps, rubella, varicella, diphtheria, tetanus, poliomyelitis, pertussis, hepatitis A, hepatitis B, meningococcus group B, meningococcus group C, meningococci groups A, C, W, Y (tetravalent vaccine), tuberculosis [bacillus Calmette–Guérin (BCG) vaccine], pneumococcus and human papilloma-virus were collected. Vaccina-

tion policies were grouped as follows: “recommended”, “specifically recommended” (recommended for specific subgroups of HCP or healthcare settings), “mandatory”, “specifically mandatory” (mandatory for specific subgroups of HCP or healthcare settings), “mandatory to be hired”, “mandatory to be hired for specific groups of HCP or healthcare settings” and “not mandatory, not recommended”. The terms “recommended” and “mandatory” were used as mentioned in the laws or regulations of each country. If a vaccination was mandatory, participants were asked to clarify the penalty for HCP who refuse vaccination. The routine vaccination programs for the general population were not considered. Data on vaccination costs (e.g. vaccines paid by HCP, vaccines bought by central government) were also collected, as reported in the form. In November 2018 the participants were asked to re-verify the submitted data.

3. Results

Thirty-six surveys were returned (97% response rate). Table 1 shows data per country and vaccine. All countries had national vaccination policies for HCP. Vaccination programs included a median of eight vaccinations (range: 1–15).

3.1. Influenza

Annual influenza vaccination is recommended for all HCP in 30 countries (Table 1). In Finland vaccination is recommended for HCP working near patients and HCP at occupational risk for exposure to influenza virus. In Norway and Slovakia vaccination is recommended only for HCP with direct patient contact. In Sweden influenza vaccination is recommended for HCP caring for severely immunocompromised patients. In Serbia influenza vaccination is mandatory for specific subgroups defined at each healthcare facility, for HCP employed in institutions caring for patients at high-risk for influenza-associated complications, for patients older than 65 years or for pregnant women, and also for HCP with chronic diseases or pregnant HCP. In several hospitals in Austria vaccination has to be documented before employment. No national policy for vaccination against influenza exists in Denmark.

3.2. Measles

Vaccination against measles is recommended for all HCPs in 17 countries (Table 1). In five countries vaccination is recommended only in specific healthcare settings. In Estonia vaccination is recommended only for HCP working in pediatric and hematology departments; in Norway for HCP and cleaning staff in medical laboratories, intensive care units (ICUs), surgical, maternity, anesthesia and dialysis departments, and for personnel performing autopsy or other invasive procedures; in Poland for young female HCP, especially those working in close contact with children; in Slovakia for HCP in pediatric, infectious diseases, anesthesia, emergency, and admission departments and for general practitioners; and in the United Kingdom for clinical staff involved in direct patient care, laboratory and pathology staff, and for non-clinical ancillary staff. In Albania, Croatia, Portugal and Slovenia vaccina-

tion is mandatory and in Serbia it is mandatory for HCP who care for patients at high risk for complications. In Albania and Russia vaccination against measles is mandatory for all HCP to be hired, while in the Czech Republic vaccination is required only to be hired in infectious diseases and dermatology departments. In several hospitals in Austria vaccination is mandatory for HCP before being employed. No vaccination policies against measles exist in 8 countries.

3.3. Mumps

Fourteen countries recommend vaccination against mumps for all HCP (Table 1). Estonia recommends vaccination for HCP in pediatric and hematology departments, Germany for HCP involved in direct patient care, Norway for HCP and cleaning staff in medical laboratories, ICUs, surgical, maternity, anesthesia and dialysis departments, and for personnel performing autopsy or other invasive procedures, Poland for young female HCP, especially those working in close contact with children, and the United Kingdom for clinical staff involved in direct patient care, laboratory and pathology staff, and for non-clinical ancillary staff. Vaccination of HCP is mandatory in Albania, Croatia, Portugal and Slovenia and specifically for HCP who care for patients at high risk for complications in Serbia. In Albania vaccination against mumps is mandatory to be hired. In several hospitals in Austria vaccination is also mandatory for HCP before being employed. No vaccination policies against mumps exist in 12 countries.

3.4. Rubella

In fourteen countries vaccination against rubella is recommended for all HCP (Table 1). In six countries vaccination is recommended only for specific groups of HCP; in Estonia for HCPs in pediatric and hematology departments, in Germany for HCP in pediatric and maternity departments, in Norway for HCP and cleaning staff in medical laboratories, ICUs, surgical, maternity, anesthesia and dialysis departments, and for personnel performing autopsy or other invasive procedures, in Poland for young female HCP, especially those working in close contact with children, in Russia for female HCP aged 18–25 years, and in the United Kingdom for clinical staff involved in direct patient care, laboratory and pathology staff, and for non-clinical ancillary staff. Vaccination is mandatory for all HCP in Albania, Croatia, Portugal and Slovenia; in Serbia for HCP caring for patients at high-risk for rubella-associated complications. In Albania and Russia vaccination against rubella is mandatory to be hired. In several hospitals in Austria vaccination has to be documented before HCP being employed. No vaccination policies against rubella exist in 11 countries.

3.5. Varicella

Vaccination of all HCP against varicella is recommended in 12 countries (Table 1). In Belgium it is recommended for HCP working in pediatric hospital units, in Estonia it is recommended for HCP in pediatric and hematology departments, in Greece for HCP in contact with high-risk patients, in Hungary for HCP caring for immunocompromised patients, pregnant women and newborns, in Malta for HCP in pediatric, obstetric, infectious diseases departments and ICUs, in Norway for HCP in pediatric departments, and in the United Kingdom for clinical staff involved in direct patient care and for laboratory staff handling material potentially containing varicella-zoster virus. In several hospitals in Austria vaccination is also mandatory for HCP before being employed. No vaccination policies against varicella exist in 17 countries.

3.6. Tetanus and diphtheria

In 12 countries vaccination against tetanus and diphtheria is recommended for all HCP, in Norway it is recommended for HCP who may be exposed to patients with diphtheria and in the United Kingdom it is recommended for clinical personnel involved in direct patient care, for laboratory and pathology personnel and for non-clinical ancillary personnel (Table 1). In France vaccination against tetanus and diphtheria is mandatory for all HCP, except for those in the ambulatory private sector, for whom it is only recommended. In Portugal, Slovenia and Ukraine vaccination against tetanus and diphtheria is mandatory for all HCP and in Russia it is a prerequisite to be hired. In several hospitals in Austria vaccination against tetanus and diphtheria is also mandatory for HCP before being employed. In Albania tetanus vaccination is recommended for all HCP and diphtheria vaccination is mandatory and mandatory to be hired. In Croatia tetanus vaccination is mandatory for all HCP and in Ireland there are recommendations for HCP who sustain a tetanus-prone wound, however in both countries there are no recommendations regarding diphtheria. In Sweden vaccination against diphtheria is recommended for HCP in emergency, pediatric, infectious disease and otorhinolaryngology departments, primary HCP and staff at microbiology laboratories. In 15 and 16 countries there are no specific vaccination policies against tetanus and diphtheria, respectively.

3.7. Pertussis

Vaccination against pertussis is recommended for all HCP in ten countries (Table 1). The vaccine is recommended for HCP working with infants and pregnant women in Finland, for HCP working with infants, pregnant women and immunocompromised patients in Ireland, for HCP in neonatal units in the Netherlands, for HCP working with patients that should not be exposed to pertussis in Norway, and for HCP in pediatric, obstetric and emergency departments, and also to pregnant HCP in Spain. Mandatory vaccination policies exist in Albania (also mandatory to be hired in healthcare facilities), Croatia, Portugal (for pregnant HCP only), and Slovenia (for HCP at greater risk for exposure to pertussis). Vaccination is also mandatory for HCP to be hired in several hospitals in Austria. Since there is no stand-alone pertussis vaccine available, immunization against pertussis has to be administered in combination with diphtheria and tetanus toxoid vaccine components. In Switzerland, HCP should therefore receive one extra dose of Tetanus-diphtheria-acellular pertussis vaccine (Tdap) for protection against pertussis even if Tetanus-diphtheria (Td) alone had been administered in the recent past. No vaccination policies exist in 17 countries.

3.8. Poliomyelitis

In eight countries vaccination against poliomyelitis is recommended for all HCP (Table 1). In Lithuania vaccination is recommended for laboratory personnel, in Norway for HCP that may potentially be exposed at work, in Spain for laboratory personnel that handle potentially contaminated samples, in Germany a booster dose is recommended for HCP who could have direct patient contact with poliomyelitis cases or work in a laboratory with such a risk, in Switzerland booster doses every 10 years are recommended for laboratory personnel that handle potentially contaminated samples, and in the United Kingdom for clinical staff involved in direct patient care, laboratory, pathology and non-clinical ancillary staff. In Albania, Croatia and Slovenia it is mandatory for all HCP and in France for all HCP except those in the ambulatory private sector, for whom it is only recommended. In Albania it is mandatory to be hired for all HCP and in Russia only

for HCP at risk of exposure. Several hospitals in Austria require vaccination against poliomyelitis for HCP before being employed. No vaccination policies exist in 18 countries.

3.9. Hepatitis A

Vaccination against hepatitis A is recommended for all HCP in Germany and Lithuania. In Austria vaccination is recommended for HCP in direct patient contact and for laboratory and cleaning personnel, in Belgium and Bulgaria for HCP in hospitals and specific healthcare settings who care for people with mental disorders and laboratory staff working with hepatitis A virus, in Finland for HCP at risk for exposure to hepatitis A virus, in France for HCP working in facilities for disabled children and adults, in Ireland for HCP who handle fecal samples, in Italy for HCP at high risk for complications or at increased occupational risk (e.g. laboratory workers, emergency services and infectious diseases staff), in Malta for laundry, sewage and microbiology personnel, in Moldova for HCP at high risk for exposure to hepatitis A virus, in Spain for HCP in high risk environments or with risk factors (laboratory personnel in potential contact with hepatitis A virus, immunocompromised or transplant candidates), in Switzerland for HCPs who handle fecal samples and for HCP in pediatric and infectious disease departments, and in the United Kingdom for laboratory personnel handling specimens potentially containing hepatitis A virus. In Slovakia vaccination is mandatory for laboratory personnel at increased risk of infection and it is recommended for general practitioners, gastroenterologists, and infectious diseases specialists. In the Czech Republic the vaccine is mandatory to be hired in emergency departments and in Russia for HCP at risk for exposure. Several hospitals in Austria require vaccination against hepatitis A for HCP before being employed and for medical students before starting practice. No vaccination policies exist in 19 countries.

3.10. Hepatitis B

Vaccination against hepatitis B is recommended for all HCP in 15 countries (Table 1). In Denmark vaccination is recommended for HCP in contact on a regular basis with high-risk patients; in Estonia for HCP in contact with high-risk patients, for HCP in laboratories and for medical students; in Finland for HCP at risk for exposure to blood; in Latvia for HCP in direct contact with patients, biological materials which may contain hepatitis B virus or potentially contaminated objects and specifically for HCP who perform surgical interventions, injections, wound treatment, deliveries, dental care, emergency assistance, pathological, anatomical or laboratory examinations, blood transfusion, acupuncture, cardiopulmonary resuscitation and anesthesia, ancillary staff of rehabilitation institutions, persons who sterilize medical equipments, cleaners and employers of laundries and medical students; in Norway for HCP and cleaning staff in medical laboratories, ICUs, surgical, maternity, anesthesia, and dialysis departments, and also for personnel performing autopsy or other invasive procedures; and in the United Kingdom for clinical staff involved in direct patient care, laboratory, pathology and non-clinical ancillary staff if at risk.

Mandatory policies for hepatitis B vaccination for all HCP exist in eight countries (Table 1). In France vaccination is mandatory for all HCP except those in ambulatory private practice (for those it is only recommended). In Serbia each healthcare facility determines the subgroups of HCP that should get vaccinated. Vaccination is a prerequisite to be hired for all HCP in Albania, Croatia, Hungary, Poland, Romania, and Russia, for HCP undertaking exposure-prone clinical procedures in Malta, for HCP in contact with blood or blood products (surgeons, dentists, laboratory personnel) in Netherlands, and for HCP at risk for infection in Slovakia. Lastly, vaccination is

also required for HCP before being employed in several Austrian hospitals.

3.11. Meningococcal group B disease

Slovenia recommends vaccination against meningococcus group B for all HCP. Germany, Greece, Norway and Romania recommend vaccination for microbiology personnel, Austria for HCP in laboratories, ICUs, infectious diseases and pediatric departments, Czech Republic for microbiology personnel and HCP providing care to patients with invasive meningococcal disease, Hungary for microbiology personnel and for HCP in infectious diseases units and ICUs, Italy for microbiology, infectious diseases and emergency department personnel, and for those at high risk for complications, and Spain for microbiology personnel and HCP at high risk for complications. No recommendations exist in 26 countries.

3.12. Meningococcal group C disease

Slovenia has recommendations for vaccination against meningococcus group C for all HCP, Germany for microbiology personnel, Norway and Romania for laboratory personnel, Hungary for laboratory personnel and for HCP in infectious disease units and ICUs, Austria for HCP in laboratories, ICUs, infectious diseases and pediatric departments, Italy for laboratory, infectious diseases and emergency department personnel, and for those at high-risk for complications, and Spain for laboratory personnel and HCP at high-risk for complications. The remaining countries have no specific recommendations against meningococcus C in place (some because these are covered by recommendations for use of a tetravalent meningococcus vaccine).

3.13. Meningococci groups A, C, W, Y diseases

Albania and Slovenia recommend vaccination with the tetravalent meningococcus vaccine for all HCP. Twelve countries (Austria, Czech Republic, Germany, Greece, Hungary, Italy, Norway, Portugal, Romania, Spain, Switzerland, United Kingdom) recommend vaccination for microbiology personnel. In Austria the vaccine is also recommended for HCP in ICUs, infectious diseases and pediatric departments, in the Czech Republic for HCP providing care to patients with invasive meningococcal disease, in Hungary for HCP in infectious disease units and ICUs, and in Italy for HCP in infectious disease units and emergency departments. Italy and Spain also recommend the vaccine for HCP at high risk for complications. Lithuania has recommendations for HCP working in endemic areas. In Malta the vaccine is recommended for HCP working in emergency departments, paediatrics and ICUs. In Serbia, vaccine is mandatory for laboratory staff that can potentially be exposed to aerosolized *Neisseria meningitidis*. No national policies for vaccinations exist in 19 countries.

3.14. Tuberculosis

In Albania and Italy BCG vaccination is recommended for all HCP, in Norway it is recommended for HCP in hospitals who will be working for three months or longer with adult patients with infectious pulmonary tuberculosis or *Mycobacteria* cultures in microbiology laboratories, and in the United Kingdom it is recommended for clinical staff involved in direct patient care following risk assessment. In Croatia it is mandatory for all HCP. In France BCG vaccination is mandatory for all HCP except those in the ambulatory private sector, however it is possible that it will become only recommended in the future since Haut Conseil de Sante Publique recommended this change (this change was not yet translated in law). In Slovakia it is mandatory for HCP to be

Table 1
National vaccination policies for healthcare personnel (HCP) in Europe by vaccine and by country, 2018.

Country	Influenza	Measles	Mumps	Rubella	Varicella	Hep A	Hep B	Diphtheria	Tetanus	Pertussis	Polio	Men B	Men C	Men A, C, W, Y	BCG	Pneumo	HPV
Albania	R	M hM	M hM	M hM	nMnR	nMnR	M hM	M hM	R	M hM	M hM	nMnR	nMnR	R	R	nMnR	nMnR
Austria	R	R	R	R	R	spR	R	R	R	R	R	spR	spR	spR	nMnR	spR	nMnR
Belgium	R	R	R	R	spR	spR	M	R	R	R	R	nMnR	nMnR	nMnR	nMnR	nMnR	spR
Bulgaria	R	nMnR	nMnR	nMnR	nMnR	spR	R	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Croatia	R	M	M	M	nMnR	nMnR	hM	nMnR	M	M	M	nMnR	nMnR	nMnR	M	nMnR	nMnR
Cyprus	R	R	R	R	nMnR	nMnR	R	R	R	nMnR	R	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Czech Republic	R	sphM	nMnR	nMnR	nMnR	sphM	M	nMnR	nMnR	nMnR	nMnR	spR	nMnR	spR	nMnR	nMnR	nMnR
Denmark	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	spR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Estonia	R	spR	spR	spR	spR	nMnR	spR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Finland	spR	R	R	R	R	spR	spR	nMnR	nMnR	spR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
France	R	R	R	R	R	spR	M	M	M	R	M	nMnR	nMnR	nMnR	M	nMnR	nMnR
Germany	R	R	spR	spR	R	R	R	nMnR	nMnR	R	spR	spR	spR	spR	nMnR	nMnR	nMnR
Greece	R	R	R	R	spR	nMnR	R	nMnR	nMnR	nMnR	nMnR	spR	spR	spR	nMnR	nMnR	nMnR
Hungary	R	nMnR	nMnR	nMnR	spR	nMnR	hM	nMnR	nMnR	nMnR	nMnR	spR	spR	spR	nMnR	nMnR	nMnR
Iceland	R	R	R	R	nMnR	nMnR	R	R	R	R	R	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Ireland	R	R	R	R	R	spR	R	nMpR	spR	spR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Italy	R	R	R	R	R	spR	R	R	R	R	nMnR	spR	spR	spR	R	nMnR	nMnR
Latvia	R	nMnR	nMnR	nMnR	nMnR	nMnR	spR	R	R	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Lithuania	R	R	R	R	R	R	R	R	R	nMnR	spR	nMnR	nMnR	spR	nMnR	nMnR	nMnR
Luxembourg	R	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Malta	R	R	R	R	spR	spR	R	R	R	R	R	nMnR	nMnR	spR	nMnR	nMnR	nMnR
Moldova	R	nMnR	nMnR	nMnR	nMnR	spR	M	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Netherlands	R	nMnR	nMnR	nMnR	nMnR	nMnR	sphM	nMnR	nMnR	spR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Norway	spR	spR	spR	spR	spR	nMnR	spR	spR	spR	spR	spR	spR	spR	spR	spR	nMnR	nMnR
Poland	R	spR	spR	spR	nMnR	nMnR	M hM	nMnR	nMnR	R	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Portugal	R	M	M	M	nMnR	nMnR	M	M	M	spM	R	nMnR	nMnR	spR	nMnR	nMnR	nMnR
Romania	R	R	R	R	R	nMnR	M hM	R	R	R	R	spR	spR	spR	nMnR	spR	nMnR
Russia	R	R hM	nMnR	spR hM	nMnR	sphM	R hM	R hM	R hM	nMnR	sphM	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Serbia	spM	spM	spM	spM	nMnR	nMnR	spM	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	spM	nMnR	nMnR	nMnR
Slovakia	spR	spR	nMnR	nMnR	nMnR	spR	sphM	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	sphM	nMnR	nMnR
Slovenia	R	M	M	M	R	nMnR	M	M	M	spM	M	R	R	R	nMnR	nMnR	nMnR
Spain	R	R	R	R	R	spR	R	R	R	spR	spR	spR	spR	spR	nMnR	spR	nMnR
Sweden	spR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	spR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
Switzerland	R	R	R	R	R	spR	R	R	R	R	R	nMnR	nMnR	spR	nMnR	nMnR	nMnR
Ukraine	R	R	nMnR	nMnR	R	nMnR	R	M	M	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR	nMnR
United Kingdom	R	spR	spR	spR	spR	spR	spR	spR	spR	nMnR	spR	nMnR	nMnR	spR	spR	nMnR	nMnR

hM: mandatory to get hired; M: mandatory; nMnR: not mandatory-not recommended; R: recommended; sphM: mandatory to get hired for specific HCP groups or settings; spM: mandatory for specific HCP groups or healthcare settings; spR: recommended for specific HCP groups or healthcare settings; Hep A: Hepatitis A; Hep B: Hepatitis B; Polio: Poliomyelitis; Men: Meningococcus; BCG: Bacillus Calmette-Guérin vaccine; Pneumo: Pneumococcus; HPV: human papilloma-virus.

hired in pulmonary and pathology departments, forensic medicine and microbiology laboratories. In 29 countries there are no national policies for BCG vaccination for HCP.

3.15. Pneumococcal disease

In Austria pneumococcal vaccine [13-valent conjugate vaccine (PCV13), followed by 23-valent polysaccharide pneumococcal vaccine (PPV23)] is recommended to HCP > 50 years and for high-risk groups (including laboratory personnel). In Romania PCV13 vaccination is recommended for laboratory personnel. In Spain recommendations vary by Autonomous Communities (e.g. in Castiel and Leon there are recommendations for vaccination with PCV13 of HCP > 60 years previously vaccinated with the PPV23). No recommendations exist in the other countries.

3.16. Human papilloma-virus

In Belgium vaccination against human papilloma-virus is recommended to laboratory personnel working with body fluid samples. No recommendations exist in the other countries.

3.17. Mandatory vaccinations for HCP in Europe

Mandatory vaccination policies for HCP are in place in the following 13 countries (Table 2): Albania, Belgium, Croatia, Czech Republic, France, Moldova, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia and Ukraine. Refusal of mandatory vaccinations by HCP in France may be associated with move to a post with no direct patient contact; employment termination may also be an option if

Table 2
Mandatory vaccinations for HCP in Europe, 2018.

Influenza: Serbia (for specific groups of HCP)
Measles-Mumps-Rubella: Albania, Croatia, Portugal, Serbia (for specific groups of HCP), Slovenia
Tetanus: Croatia, France, Portugal, Slovenia, Ukraine
Diphtheria: Albania, France, Portugal, Slovenia, Ukraine
Pertussis: Albania, Croatia, Portugal, Slovenia
Poliomyelitis: Albania, Croatia, France, Slovenia
Hepatitis A: Slovakia (for specific groups of HCP)
Hepatitis B: Albania, Belgium, Czech Republic, France, Moldova, Poland, Portugal, Romania, Serbia (for specific groups of HCP), Slovenia
Meningococcus A, C, W, Y: Serbia (for specific groups)
Tuberculosis: Croatia, France

HCP: healthcare personnel.

the first option is not feasible. A fine is imposed for HCP who refuse mandatory vaccinations in Albania and Slovakia. In Albania employment termination can be also implemented. A fine or termination of employment may be implemented in Serbia. In Serbia fines have been imposed on healthcare facilities that have not vaccinated their HCP for mandatory vaccinations. In Croatia and Romania there are no official regulations for HCP who refuse mandatory vaccinations; cases of refusal are addressed at the hospital level and usually the HCP is moved to a low-risk post. In Slovenia a medical certificate cannot be issued for HCP who refuse mandatory vaccinations and the person is not employed; this policy is particularly strict for hepatitis B and measles-mumps-rubella vaccinations for HCP involved in direct patient contact. In Belgium healthcare students who refuse hepatitis B vaccination are not allowed access to training hospitals, which means that their education cannot be completed. No regulatory policy or penalty in case of mandatory vaccination refusal is in place in the Czech Republic, Moldova, Poland, Portugal, or Ukraine. Recently two Italian regions have approved the requirement for vaccinations for HCP but the penalties have not yet been clarified. In the United Kingdom, hospitals may formulate their own policies and frame their implementation (mandatory or voluntary vaccinations, use of declination forms). In Iceland a healthcare facility may make a vaccine a prerequisite for hiring or move a HCP who refuses a vaccination to a post with no patient contact or a post caring for less vulnerable patients. In Finland, although all vaccinations are voluntary, healthcare facilities' duty is to protect patients at risk of having severe disease or sequelae due to measles, varicella, influenza or pertussis; therefore, it is possible to place unimmunized HCP to less risk task if needed. Lastly, the following ten countries have mandatory policies in place concerning the hiring of all or of specific groups of HCP: Albania, Croatia, Czech Republic, Hungary, Malta, the Netherlands, Poland, Romania, Russia, and Slovakia. Vaccinations for HCP are a prerequisite to get hired and for medical students to start practice in several hospitals in Austria and Iceland since 2018.

3.18. Comparison of current vaccination policies for HCP in Europe with those in 2011

In order to investigate the trends in national vaccination policies for HCP in Europe over the past seven years, we compared the vaccination programs of the 30 European countries² that participated in the first (2011) survey [10] with current findings. We found that more countries now have a policy for vaccination against measles (23 in 2018 versus 15 in 2011), mumps (20 versus 12), rubella (21 versus 15), hepatitis A (16 versus 11), diphtheria (17 versus 14), tetanus (17 versus 14), poliomyelitis (15 versus 11), pertussis (16 versus 9), meningococcus C (8 versus 4) and meningococcus A, C, W, Y (15 versus 4) (Fig. 1). In addition, more countries have mandatory vaccination policies for HCP now compared to 2011 (8 versus 5 countries). Currently employment of HCP who refuse mandatory vaccinations can be terminated in France only; this option was not available in any of the 30 countries in 2011.

3.19. Vaccination costs

Vaccinations are provided free-of-charge (either by the state or by the employer) to HCP in 26 countries³. In Belgium vaccinations

are provided free-of-charge to permanent and contract HCP and to healthcare students (HCP working in the private sector are excluded). In Cyprus vaccinations are provided free-of-charge only for HCP working in the public sector and to HCP eligible for free medical care. In Iceland influenza vaccine is paid for centrally for all HCP and hepatitis B is typically paid by the employer; for other vaccinations the employers may choose to supply the vaccines to their employees. In Czech Republic, Latvia, Poland and Slovakia only mandatory vaccinations are provided free-of-charge while recommended vaccines are paid by the employee or the employer. In Ukraine only measles vaccination is provided free-of-charge to HCP. In Estonia vaccinations are not provided free-of-charge to HCP, however some employers may pay for the vaccines.

4. Discussion

We studied current vaccination policies for HCP in 36 European countries. All countries have national vaccination policies specifically for HCP. As shown in our 2011 survey [10], there still are significant variations between countries in terms of vaccinations, target HCP subgroups or healthcare settings, and the regulatory frame of implementation. These results may be attributed, in part, at least for European Union Member States, to the paucity of any specific recommendations beyond the 2000 and 2010 Directives of the European Council on the protection of workers from risks related to exposure to biological agents and from sharp injuries in the healthcare sector, respectively, and the 2009 recommendation on improving influenza vaccination [12–14]. However, the World Health Organization has issued recommendations to assist countries to develop national vaccination policies for HCP against tuberculosis (BCG vaccine), hepatitis B, poliomyelitis, diphtheria, measles, rubella, meningococcus, influenza, varicella and pertussis [15]. Specific recommendations on HCP vaccinations have been also issued by European Technical Advisory Group of Experts in 2018 [16]. Issues that may impact vaccination policy making for HCP include the epidemiology of VPDs, the vaccination programs and the coverage rates of the general population, failure to comply with regulations including penalty politics, and costs. Lack of licensed vaccines in a country may also impact vaccination programs.

We noticed vast improvements in many European countries relating to vaccination policies for HCP. In particular, the 2018 vaccination policies were more comprehensive compared to what we found in the 2011 survey, and they have been strengthened. More countries now have laws or regulations for HCP vaccination against measles, mumps, rubella, hepatitis A, diphtheria, tetanus, poliomyelitis, pertussis and various meningococcus serogroups. This may be attributed to the increasing awareness of occupational acquisition of several VPDs in light of the recent large measles, rubella, pertussis and hepatitis A outbreaks and the increasing infection control capacity of healthcare facilities the past decade, especially after the 2009 influenza H1N1 pandemic. The enormous recent influx of several million refugees might also have an impact [17–19].

However, one fourth of European countries have no national policies in place for vaccination of HCP against measles, one third have no vaccination policies against mumps and rubella, tetanus and diphtheria, and approximately half have no vaccination policies against pertussis, poliomyelitis or varicella, despite their potential for severe morbidity or even death in susceptible patients and for serious and difficult to manage nosocomial outbreaks [5–7,9,20,21]. It is possible that many countries rely on their vaccination programs for the general population. However there are VPDs where booster doses are required. Young HCP may also move to another country to work. It is important for the hosting health systems to ensure HCP' immunity against VPDs.

² Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Norway, Netherlands, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom.

³ Albania, Austria, Bulgaria, Croatia, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Malta, Moldova, Norway, Netherlands, Portugal, Romania, Russia, Serbia, Spain, Sweden, Switzerland, United Kingdom.

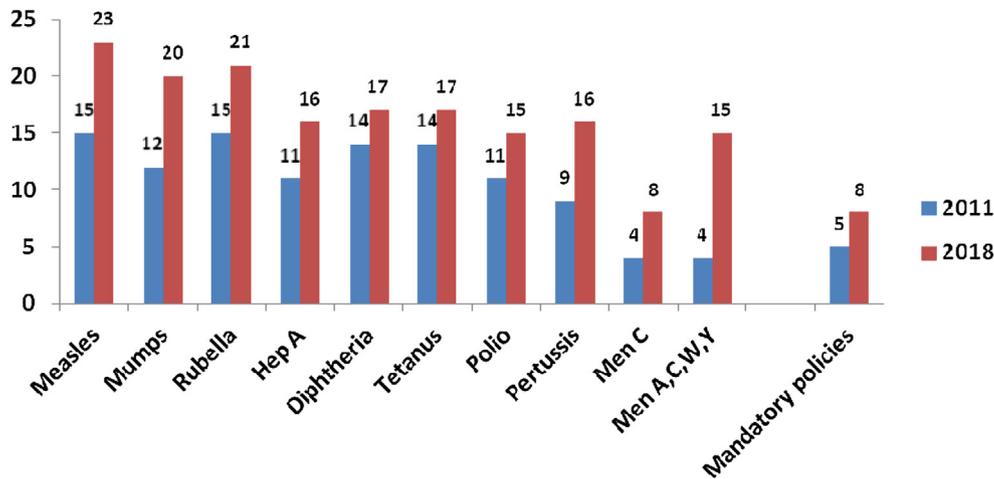


Fig. 1. Vaccination policies for HCP in Europe in 2011 compared to 2018*. HCPs: healthcare personnel; Hep A: hepatitis A; Polio: poliomyelitis; Men C: meningococcus group C; meningococcus groups A, C, W, Y. *Concerns 30 countries that participated in the 2011 survey [10].

Influenza and hepatitis B vaccinations of HCP are almost uniformly implemented across Europe. Both vaccines have been recommended for more than three decades and constitute the core of vaccination programs for HCP globally [8].

Meningococcal disease is an occupational risk for laboratory personnel. In a review of 16 probable laboratory-acquired meningococcal disease cases with an associated 50% case fatality rate, the incidence was 13/100,000 for microbiologists compared to 0.2/100,000 in the general population of adults [22]. However, 19 of the 36 participating countries have no policies for vaccination of laboratory personnel against meningococcus. Although tuberculosis is also an occupational risk for personnel handling potentially infected clinical samples [23], most countries have no policies for BCG vaccination of laboratory personnel. This may be attributed to concerns over the moderate effectiveness of the BCG vaccine beyond infancy and lack of a licensed vaccine in some countries [24].

In several countries there are recommendations issued by professional societies or at the healthcare facility level, which may act complementarily. In Sweden, beyond the national policies for influenza and diphtheria vaccination, protection of HCP and the safety of patients are regulated at subnational levels. In practice each employer/healthcare facility recommends and implements vaccinations for HCP against other VPDs following risk assessment.

Mandatory vaccination policies for specific vaccinations are in place in 13 European countries. In most cases the HCP who refuses a mandatory vaccination will be moved to a low-risk post. Mandatory vaccination policies are rather flexible in Europe given that regulations for HCP who refuse mandatory vaccinations are not specified in five countries with mandatory vaccination policies. Overall, three more European countries have established mandatory vaccination policies for HCP in 2018 compared to 2011 [10]. It is likely that mandatory vaccination policies will be increasingly adopted in Europe, in light of the increasing levels of vaccine hesitancy among the general population and the increased risks of vaccine hesitancy among HCP [25–29]. Notably, only 26 European countries offer vaccinations to HCP free-of-charge, while in four countries a clear association between mandatory and free-of-charge vaccinations exist.

Our study has the strength of participation of almost all European countries in the continent of Europe. We conducted our survey using the same methodology as previously [10], which allowed us to study trends in vaccination programs for HCP in Europe over the past decade. As a potential limitation, the definitions of “recommended” and “mandatory” may vary between countries. We

communicated with participants in order to standardize the use of these definitions and to ensure that the collected data concerned HCP and not the general population. In addition, we did not search for differences (if any) between public and private healthcare facilities.

In conclusion, significant variation exists in vaccination policies for HCP in Europe in 2018. Compared to 2011, vaccination programs are more comprehensive while mandatory vaccination policies for HCP have been adopted by more countries. However, there are still gaps in vaccination policies for HCP in Europe, since several countries do not have national policies in place for vaccination of HCP against measles, rubella, mumps, pertussis or meningococcal disease. There may be policies at subnational or healthcare facility levels, but regardless of level, the national vaccination policies for HCP should be re-examined considering the current epidemiological trends of VPDs and the documented risk and potential of exposure and transmission within healthcare facilities throughout Europe. Vaccines in development, such as those to prevent other healthcare-associated infections or for emerging infections, may be added to vaccination policies for HCP in future [30]. Mandatory vaccination policies against VPDs that are documented to cause significant morbidity and mortality should be prioritized. Steps to increase awareness of vaccine policies for HCP and a consensus-based policy at the European level will facilitate strengthening current vaccination programs for HCP and increase safety within healthcare facilities for both personnel and patients alike.

Declaration of Competing Interest

Dr. Bino coordinates the Albanian vaccination program; Dr. Drazanovic has received travel expenses and a lecture honorarium from Sanofi Pasteur in 2018; Dr. Heinger is a member of the Global Pertussis Initiative and CEEPAG (Collaboration of European Pertussis Awareness Generation), which are both supported by an unrestricted educational grant from Sanofi Pasteur; Prof. Theodoridou is the President of the Hellenic National Vaccinations Committee; Dr. Kassianos is the National Immunisation Lead for the Royal College of General Practitioners and President of the British Global & Travel Health Association and has participated in advisory panels and lectured at meetings organised by pharmaceutical companies as well by the CDC, ESWI, NHS; Dr. Kyncl is Vice Chairman of the Expert Working Group of the Czech National Immunization Committee; Dr. Maltezou is the Coordinator of the Committee for the Promotion of Influenza Vaccination among HCPs and primary investigator in studies for which universities received funds from vaccine

manufacturers; Dr. Ortiz de Lejarazu has received fees for conferences and advising from GSK, Sanofi and Seqirus; Dr. Poland is the chair of a Safety Evaluation Committee for novel investigational vaccine trials being conducted by Merck Research Laboratories. Dr. Poland offers consultative advice on vaccine development to Merck & Co. Inc., Avianax, Adjuvance, Valneva, Medicago, Sanofi Pasteur, GlaxoSmithKline, and Emergent Biosolutions. Dr. Poland holds patents related to vaccinia and measles peptide vaccines. These activities have been reviewed by the Mayo Clinic Conflict of Interest Review Board and are conducted in compliance with Mayo Clinic Conflict of Interest policies; Prof. Van Damme is a member of the Belgian NITAG and primary investigator of a number of vaccine trials for which to university of Antwerp obtains grants from vaccine manufacturers; Dr van Essen received speaking fees and was paid for consultancy on RSV vaccinations two times in the past three years; Dr. Wicker is a Member of the German Standing Committee on Vaccination (STIKO), Robert Koch-Institute; Prof. Wiedermann is a Member of the Austrian Committee of Immunization Practise and primary investigator of clinical vaccination trials sponsored by GSK, Pfizer and Themis; Silvia Bino, Françoise Berthet, Elisabeth Botelho-Nevers, Arne B. Brantsæter, Saulius Caplinskas, Rose-Marie Carlsson, Liudmyla Chernyshova, Olga Cirstea, Vladimir Drazenovic, Ulpu Elonsalo, Oana Falup-Pecurariu, Irina Filipova, Radosveta Filipova, Silva Graça, Lise Heilmann Jensen, Judith M. Hübschen, Kamilla Josefsdottir, Maria Koliou, Dagmar Kollárová, Fedir Lapiy, Caterina Ledda, Helena Malteizou, Snežana Medić, Irina Mikheeva, Zsuzsanna Molnár, Tatjana Mrvic, Aneta Nitsch-Osuch, Jurijs Pervoscikovs, Adam Roth, Larisa Savrasova, Lynda Sisson: no conflict of interest.

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Vaccination Policies for HCP in Europe Study Group

Silvia Bino (Institute of Public Health, Tirana, Albania), Ursula Wiedermann (Medical University Vienna, Vienna, Austria), Pierre Van Damme (University of Antwerp, Antwerp, Belgium), Radosveta Filipova (Ministry of Health, Sofia, Bulgaria), Vladimir Draženović (Croatian National Institute of Public Health, Zagreb, Croatia), Maria Koliou (University of Cyprus Medical School, Nicosia, Cyprus), Katerina Fabianova and Jan Kyncl (National Institute of Public Health, Prague, Czech Republic), Lise Heilmann Jensen (Roskilde University Hospital, Roskilde, Denmark), Irina Filipova (Center for Disease Surveillance and Control, Tallinn, Estonia), Ulpu Elonsalo (National Institute for Health and Welfare, Helsinki, Finland), Elisabeth Botelho-Nevers (University Hospital of Saint-Etienne, Saint-Etienne, France), Sabine Wicker (University Hospital Frankfurt, Frankfurt am Main, Germany), Helena C. Malteizou (Hellenic Centre for Disease Control and Prevention, Athens, Greece), Maria Theodoridou (University of Athens, Athens, Greece), Zsuzsanna Molnár (Ministry of Human Capacities, Budapest, Hungary), Kamilla Sigridur Josefsdottir (Directorate of Health, Reykjavik, Iceland), Lynda Sisson (Workplace Health and Wellbeing Unit, Dublin, Ireland), Caterina Ledda (University of Catania, Catania, Italy), Jurijs Pervoscikovs and Larisa Savrasova (Centre for Disease Prevention and Control, Riga, Latvia), Saulius Caplinskas (Centre for Communicable Diseases and AIDS, Vilnius, Lithuania), Françoise Berthet (Ministry of Health, Luxembourg, Luxembourg), Judith M Hübschen (Luxembourg Institute of Health, Luxembourg, Luxembourg), Michael Borg (University of Malta, Msida, Malta), Olga Cirstea (State University of Medicine and Pharmacy “Nicolae Testemitanu”, Chisinau, Moldova), Gerrit A. van Essen (Amersfoort,

Netherlands), Arne B. Brantsæter (Oslo University Hospital, Oslo, Norway), Aneta Nitsch-Osuch (Medical University of Warsaw, Warsaw, Poland), Silva Graça (National Health Institute, Lisbon, Portugal), Oana Falup-Pecurariu (Transilvania University Faculty of Medicine, Brasov, Romania), Irina Mikheeva (Central Research Institute for Epidemiology, Moscow, Russia), Snežana Medić (University of Novi Sad, Novi Sad, Serbia), Dagmar Kollárová (Slovak Medical University, Bratislava, Slovakia), Tatjana Mrvic (Infection Control UMC, Ljubljana, Slovenia), Raül Ortiz de Lejarazu (National Influenza Centre, Valladolid, Spain), Rose-Marie Carlsson and Adam Roth (Public Health Agency of Sweden, Solna, Sweden), Ulrich Heininger (University of Basel Children's Hospital, Basel, Switzerland), Liudmyla Chernyshova and Fedir Lapiy (National Medical Academy of Postgraduate Education, Kiev, Ukraine), George Kassianos (Royal College of General Practitioners, Wokingham, United Kingdom) and Gregory A. Poland (Mayo Vaccine Research Group, Mayo Clinic, Rochester, United States). We also thank Natasa Tentoma for technical assistance. The opinions in this article are those of the authors, and do not necessarily represent those of their institutions.

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