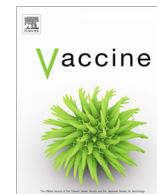


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National immunization strategies targeting migrants in six European countries

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ABSTRACT

Over the last three years an unprecedented flow of migrants arrived in Europe. There is evidence that vaccine preventable diseases have caused outbreaks in migrant holding centres. These outbreaks can be favored by a combination of factors including low immunization coverage, bad conditions that migrants face during their exhausting journey and overcrowding within holding facilities. In 2017, we conducted an online survey in Croatia, Greece, Italy, Malta, Portugal and Slovenia to explore the national immunization strategies targeting irregular migrants, refugees and asylum seekers. All countries stated that a national regulation supporting vaccination offer to migrants is available. Croatia, Italy, Portugal and Slovenia offer to migrant children and adolescents all vaccinations included in the National Immunization Plan; Greece and Malta offer only certain vaccinations, including those against diphtheria-tetanus-pertussis, poliomyelitis and measles-mumps-rubella. Croatia, Italy, Malta and Portugal also extend the vaccination offer to adults. All countries deliver vaccinations in holding centres and/or community health services, no one delivers vaccinations at entry site. Operating procedures that guarantee the migrants' access to vaccination at the community level are available only in Portugal. Data on administered vaccines is available at the national level in four countries: individual data in Malta and Croatia, aggregated data in Greece and Portugal. Data on vaccination uptake among migrants is available at national level only in Malta. Concluding, although diversified, strategies for migrant vaccination are in place in all the surveyed countries and generally in line with WHO and ECDC indications. Development of procedures to keep track of migrants' immunization data across countries, development of strategies to facilitate and monitor migrants' access to vaccinations at the community level and collection of data on vaccination uptake among migrants should be promoted to meet existing gaps.

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1. Introduction

The effective implementation of immunization strategies targeting migrants can protect migrant children and adults from infectious diseases, prevent spread of infection and guarantee the continuity of paediatric immunization schedules that may have been interrupted in countries of origin because of wars and civil unrest.

During 2016, 511,371 people have travelled to Europe from Africa, Asia and the Middle East [1]. Migrant populations entering the European Union/European Economic Area (EU/EEA) tend to be in relatively good health, thus being at risk of developing infectious diseases in the same way as other EU populations [2]. However, the conditions that migrants face during the migratory journey, such as lack of sufficient water and food and inadequate shelter and sanitation, increase the risk of acquiring infectious diseases. In addition, overcrowding in holding/detention centres or refugee camps may favour spread of communicable diseases such as measles, influenza, varicella, tuberculosis and meningococcal disease. Sharing dormitories, poor hygiene, malnutrition and limited access to medical care have been reported as contributing factors for increasing their vulnerability, especially among children and elderly [2–4]. Outbreaks of measles and other vaccine preventable diseases (VPDs) in migrant settings [5–11] and lower immunization coverage rates in migrant populations, compared to native populations [7,12,13], have been documented.

Moreover, sub-optimal vaccination coverage rates have been registered in some host countries, not only among underserved groups, but also in the general population where vaccine hesitant parents are globally increasing [14–16]. For example, in Italy vaccination coverage among children has been decreasing since 2013. In 2016, vaccination coverage rate for poliomyelitis in children at 24 months of age in this country was below 95% [17]. This comes at a time when the WHO European Region is at risk for a poliomyelitis outbreak. The Regional Certification Commission for Poliomyelitis Eradication has repeatedly identified Bosnia and Herzegovina, Romania and Ukraine as at high risk for transmission in the event of wild poliovirus importation [18]. An outbreak of circulating vaccine-derived poliovirus occurred in Ukraine in September 2015 [19]. Also, although targeted for elimination, in 2017 WHO counted 16,000 measles cases in the European Region [20] and measles outbreaks continue to occur in some countries of the Region independently of refugee and migrant population movement [18,21]. It confirms that pockets of susceptible individuals are still present in recipient countries.

The 2015 WHO-UNHCR-UNICEF Joint Statement [18] recommends immunizing migrants without delay according to the immunization schedule of the country in which they intend to stay for more than a week; measles and polio vaccines should be priorities. Also in 2015, the European Centre for Disease Prevention and Control (ECDC) recommended that the assessment of vaccination status should be considered as an integral part of the general health assessment offered to migrants upon arrival and to provide vaccinations to susceptible migrants according to the guidelines of the host country [2,22,23]. Priority vaccinations include those against measles, rubella and polio (that are targeted for elimination), as well as diphtheria, tetanus, pertussis and *Haemophilus influenzae* type b (Hib). The ECDC indicates that for best protection of the individual, first doses of the vaccine series provided should be administered and documented as early as possible following entry to or registration in a host country, preferably within 14 days, especially for the priority vaccines [2].

Information about immunization strategies targeting migrants in European countries is limited. In 2017, in the framework of the EU-funded “Common Approach for REFugees and other

migrants’ health (CARE)” project addressing migrants’ health care [24], we conducted a survey to explore the national immunization strategies targeting irregular migrants, refugees or asylum seekers in six European countries.

2. Methods

The survey, coordinated by the Italian National Institute of Public Health (Istituto Superiore di Sanità), was conducted among the five European countries involved in the CARE project [24], i.e. Croatia (HR), Greece (GR), Italy (IT), Malta (MT) and Slovenia (SI), plus Portugal (PT) that voluntarily joined the project.

The reference person for the CARE project of these countries was an expert in communicable diseases in charge of national surveillance and control policies in Public Health Institutions or Ministries of Health. They were asked to identify, within their public health institutions, national experts directly involved in the monitoring and evaluation of national immunization programs, who could fill the questionnaire for their country.

Data were collected through an online questionnaire, developed using Survey Monkey (<https://www.surveymonkey.com>). The questionnaire covered the following aspects: (i) existence of regulations supporting immunization of migrants; (ii) assessment of migrants’ immunisation status before offering vaccinations; (iii) vaccinations offered and target groups; (iv) sites for vaccination delivery; (v) availability of standard procedures for migrant immunization; (vi) recording and transmission of data on administered vaccines; (vii) availability of immunization uptake data among migrant populations. For key migration-related definitions, we suggested experts to refer to the IOM glossary of terms [25].

We defined the site of vaccination delivery as at: (i) entry level, vaccination at the point of entry (e.g., harbours or airports), (ii) holding level (i.e. vaccination in migrant centres/camps), (iii) community level (i.e. vaccination after arrival and partial integration into the community in the receiving country e.g. in the primary health care centres or vaccination services).

In October 2016, the questionnaire was piloted in three countries and modified accordingly. The survey was launched in the same month; data collection was completed in February 2017.

We carried out a descriptive analysis of collected information. We performed a frequency analysis for all the categorical variables collected and summarized the proportions of responses.

3. Results

All the countries responded to the survey. The entity of 2016 migration flow largely varied among countries (Table 1). In all countries, the questionnaire was filled by a public health expert, working at the Ministry of Health, the National Public Health Institute or the National School of Public Health. The respondents were national public health experts working in the field of communicable diseases and vaccination programs in all countries but Portugal, where the questionnaire was filled by a senior officer of international relations.

3.1. Regulations supporting vaccination offer to migrants

A national regulation is available in all countries (Table 1). Five responders stated that immunization strategies targeting migrants are homogeneous in the whole country. The Italian reference person specified that the situation may differ across the country’s 21 regions, due to the decentralized health system and the fact that some regions are more affected by migration than others, to the point of establishing specific regional regulations promoting migrants’ immunization in some regions.

Table 1

General characteristics of migration pattern and national regulation supporting immunization of migrants in six EU countries.

	Number of irregular migrants, refugees and asylum seekers arrived in the country in 2016	Number of migrant reception centres at the time of the survey	Type of document supporting immunization of migrants	Year of document
Croatia	2200 ^a	2 holding centres and 1 detection centre	Law, specifically established for migrant immunization	2008
Greece	173,000	3 hotspots and around 45 hosting centres/camps	Recommendations by NIAC, specifically for refugees/migrants	2016
Italy	181,436	4 hotspots, 13 governmental holding centres and around 3100 extraordinary holding centres	Law, specifically established for migrant immunization	1998 ^c
Malta	1700 ^a	6 holding centres	Recommendation, specifically established for migrant immunization	2012
Portugal	1600 ^b	None	Part of the NIP ^d	2017
Slovenia	1308 ^a	3 holding centres	Specifically established guidelines for migrant immunization on the basis of NIP and the law on migrants and asylum seekers	2016

NIP: National Immunization Plan; NIAC: National Immunization Advisory Committee.

^a This number included only asylum seekers.^b From January to September 2016.^c In Italy, a national law was specifically established for migrants' health in 1998. In 1993 a technical document had already been published by the Ministry of health on vaccinations for migrant 0–14 years of age, and has been further developed and integrated in 2011 and 2014, following subsequent migrant flows.^d In Portugal, in the two autonomous regions (Azores and Madeira), there are Regional Immunization Programmes that are currently identical to the NIP.

3.2. Immunization strategies targeting migrants: children/adolescents

3.2.1. Immunization target groups

All countries offer vaccinations to children and adolescent migrants, with some difference in the target groups (Table 2). Greece stated that, at the time of survey, vaccinations were not routinely offered to migrants, but only during vaccination campaigns. All responding countries provide vaccinations for asylum seekers, four of them (GR, IT, MT, PT) also for refugees, unaccompanied minors and irregular migrants. In all countries vaccinations (those included in the National Immunization Plans) are offered free-of-charge to the identified target groups. In Greece, vaccinations were offered free-of-charge to migrants in the framework of the immunization campaigns.

3.2.2. Verification of immunization status

Immunization status is verified through anamnesis or verification of immunization cards in all countries. Italy is the only country that reported using laboratory testing of immunity against hepatitis B and tetanus if migrants had no immunization cards. In most countries immunization status is checked at holding and/or community level.

3.2.3. Vaccinations offered to susceptible migrants and site of delivery

In four countries (HR, IT, PT, SI) migrant children and adolescents are offered all the vaccinations included in the NIP appropriate for age, while Greece and Malta offer only certain vaccinations to this population (Table 2). In all countries the same vaccination scheme [26] is offered to native and migrant children.

In four countries (HR, GR, IT, MT) vaccinations are delivered both at holding level and community level. In Croatia, school-age children are vaccinated at the school medicine service within the Public Health Institute or inside the schools, while the others are immunized at holding centers. In Greece and Malta, the first doses are administered at holding level, but the completion of the routine schedule is planned at community level. In Italy, vaccinations are delivered at migrant holding centres or at the community level depending on the intensity of flow and length of stay of migrants, on human resources available and logistic aspects. In Portugal and Slovenia vaccines are delivered at community level.

3.3. Immunization strategies targeting adult migrants

3.3.1. Immunization target groups

Four countries (HR, IT, MT, PT) extend their vaccination offer to adult migrants, with target groups varying among countries

(Table 3). In these countries, vaccinations (those included in the National Immunization Plans) are offered free-of-charge to the identified target groups. In Greece, at the time of survey, vaccinations were not routinely offered to the recent wave of adult migrants; a program to immunize high risk migrants/refugees in camps and urban settings against influenza was however being implemented. In Slovenia, vaccination to adults is offered (free-of-charge) only if there is an epidemiological indication.

3.3.2. Verification of immunization status

All the four countries offering vaccinations to adults verify the immunization status through anamnesis or by checking immunization cards for certain vaccine preventable diseases/vaccinations. In Italy, the immunization status is verified for poliomyelitis, focusing the attention on migrants coming from endemic countries or from countries at risk of disease reintroduction. In Malta it is checked for poliomyelitis and tuberculosis, particularly among migrants from Sub-Saharan Africa and war-torn countries.

3.3.3. Vaccinations offered to susceptible migrants and site of delivery

All the vaccinations included in the NIP appropriate for age are offered to migrant adults in Portugal, while in other countries certain vaccinations represent a priority. Vaccination against poliomyelitis is offered in the other three countries (HR, IT, MT) as well as tetanus (Table 3). As for children, the vaccination scheme [26] is identical for migrant adults and the local population.

In Croatia, migrants are usually immunized in migrant holding centres, however there is the possibility to be immunized at the vaccination centre of the Public Health Institute. In Malta, the first dose of IPV and DT is given within holding centres, before migrants enter the community where the cycle should be completed. In Italy, vaccines can be delivered both at holding and community level, depending on intensity of flow of migrants, length of stay, human resources and logistic aspects. In Portugal vaccines are delivered at community level.

3.4. Operating procedures for migrants immunization

Three countries (HR, GR, SI) reported the existence of standard operating procedures for immunization practices targeting migrants, children and adolescents, and recording of information on administered vaccines. Operating procedures for immunization

Table 2
Immunization offer to migrants: children and adolescents.

	Croatia	Greece ^a	Italy	Malta	Portugal	Slovenia
<i>Target group for vaccination</i>						
<i>Immigration status</i>						
Asylum seekers	X	X	X	X	X	X
Refugees		X	X	X	X	
Irregular migrants		X	X	X	X	
Unaccompanied minors		X	X	X	X	
Age group (years)	0–18	0–15	0–15	0–16	0–18	0–18
Risk conditions				Coming from Sub-Saharan Africa and War-torn countries		
<i>Verification of the immunization status</i>						
<i>Site for verification</i>						
Entry level			X			
Holding level	X	X	X	X		X
Community level	X	X	X		X	X
Vaccinations/VPDs checked	All vaccinations included in the NIP	All vaccinations included in the NIP	All vaccinations included in the NIP	Polio, DTP, MMR, BCG	All vaccinations included in the NIP	All vaccinations included in the NIP
Use of laboratory test if migrant has no immunization card	No	No	Yes ^b	No	No	No
<i>Vaccination offer to susceptible migrants or with undocumented immunization status</i>						
Vaccinations offered	All vaccinations included in the NIP	DTP, IPV, Hib, HepB, MMR, PCV	All vaccinations included in the NIP	DTP, IPV, Hib, MMR	All vaccinations included in the NIP	All vaccinations included in the NIP
<i>Sites for vaccination delivery</i>						
Entry level						
Holding level	X	X	X	X		
Community level	X	X	X	X	X	X
Informed consent before vaccinating	Verbal	Verbal	n.a. ^c	Verbal	Verbal	Verbal

n.a.: Information not available; VPD: vaccine preventable diseases; NIP: National Immunization Plan; BCG: Bacille Calmette-Guérin vaccine; DTP: diphtheria-tetanus-pertussis; IPV: inactivated poliovirus vaccination; Hib: Haemophilus influenzae type b; HBV: hepatitis B virus; MMR: measles-mumps-rubella; PCV: pneumococcal vaccination.

^a In Greece, at the time of survey, vaccinations were not routinely offered to migrants. Vaccinations against DTP, IPV, Hib, HepB, MMR and PCV (appropriate for age) were only offered during vaccination campaigns.

^b Laboratory test for hepatitis B and tetanus.

^c As the variability of procedures at the regional and local level, the Italian responder could not provide this information.

practices targeting adult migrants are not available in the participating countries.

Only Portugal indicated that there are standard procedures that guarantee the migrants' access to vaccination at the community level: migrants are informed on their vaccination needs and, if necessary, they are accompanied to health facilities by dedicated social workers.

3.5. Recording and transmission of information on migrants' immunization

In five countries (GR, HR, MT, PT, SI) migrants are given an individual vaccination card reporting the information on received vaccines. Malta and Portugal also record information on administered vaccines in the electronic immunization registries for the general population (Malta only for children). In Slovenia, individual data on administered vaccines is recorded in a paper registry specific for immunized asylum seekers. In Croatia, data on all vaccinated migrants is sent to the National Public Health Institute where an electronic database for immunized migrants was developed. All countries made information on administered vaccines available to varying centres/institutions. Data on administered vaccines is available at the national level in four countries: electronic individual data in Malta and Croatia, aggregated data in Greece and Portugal (Table 4). In Italy, procedures differ at the local level; for this reason this information is not available at the national level.

3.6. Vaccination uptake among migrant populations

Only in Malta data on vaccination uptake among migrant populations is available. In 2016 they reported a rate of 100% for the first dose of pentavalent vaccine (against DTP, poliomyelitis and Hib) in children. The Italian responder indicated that there is no collection at national level, but that there may be at the local level.

4. Discussion

As the current influx of migrants is unprecedented in scale and speed, the implementation of strategies to immunize migrants is an issue of debate [13,27]. Data on immunization strategies targeting migrants in Europe is currently poor. To our knowledge, the only information available comes from the results of a request made by ECDC to its National Focal Points for VPDs in September 2015: they were asked if their government/NIP offered vaccinations for irregular migrants and asylum seekers and which vaccinations were offered [28]. Our study is the first one that collected detailed information from six European countries, including sites and modalities of vaccination delivery and recording of immunization data. All the reference persons, appointed to fill the questionnaire for their countries, were national experts working in the Ministries of Health or Public Health Institutions, thus assuring that respondents were qualified to provide accurate and

Table 3
Immunization offer to migrants: adults.

	Croatia	Italy	Malta	Portugal
<i>Target group of vaccination</i>				
<i>Immigration status</i>				
Asylum seekers	X	X	X	X
Refugees		X	X	X
Irregular migrants		X		X
Age group (years)	18–35	All ages	All ages ^a	All ages
Risk conditions		Adults with wounds at risk of tetanus and adults coming from countries endemic for polio or at risk of reintroduction	Adults coming from Sub-Saharan Africa and War-torn countries	
<i>Verification of the immunization status</i>				
<i>Site for verification</i>				
Entry level		X		
Holding level	X	X	X	
Community level	X	X		X
Vaccinations/VPDs checked	Polio, DT, measles	Polio	Polio, BCG	All vaccinations included in the NIP
Use of laboratory test if migrant has no immunization card	No	Yes ^b	No	No
<i>Vaccination offer to susceptible migrants or with undocumented immunization status</i>				
Vaccinations offered	DT, IPV, MMR	T, IPV, MMR	DTP, IPV	All vaccinations included in the NIP
<i>Sites for vaccination delivery</i>				
<i>Entry level</i>				
Holding level	X	X	X	
Community level	X	X	X	X
Informed consent before vaccinating	Verbal	n.a. ^d	Verbal	Verbal

n.a.: information not available; VPD: vaccine preventable diseases; NIP: National Immunization Plan; BCG: Bacille Calmette-Guérin vaccine; DTP: diphtheria-tetanus-pertussis; IPV: inactivated poliovirus vaccination; Hib: Haemophilus influenzae type b; HBV: hepatitis B virus; MMR: measles-mumps-rubella; PCV: pneumococcal vaccination.

^a From 16 years.

^b Laboratory test for hepatitis B and tetanus.

^c In case of exposed wounds.

^d As the variability of procedures at the regional and local level, the Italian responder could not provide this information.

Table 4
Recording of information on administered vaccines and transmission to other centres/institutions.

	Croatia	Greece	Malta	Portugal	Slovenia
Is information on administered vaccines recorded?	Yes	Yes	Yes	Yes	Yes
<i>Where are information archived?</i>					
Individual vaccination card to migrants	X	X	X	X	X
General population immunization registries			X (electronic)	X (electronic)	
Other	X ^a				X (paper) ^b
Is information on administered vaccines made available to other centres/institutions?	Yes, individual	Yes, aggregated	Yes, individual ^c	Yes, aggregated	Yes, individual
To whom is this information made available?	RHAs, National Institute of Public Health	MoH ^d	MoH	RHAs, LHAs, MoH, WHO ^e	LHAs
How often is this information made available?	Not defined periodicity ^f	After campaign	On demand	Timely	On demand

RHA: Regional Health Authorities; LHA: Local Health Authorities; MoH: Ministry of Health.

^a Electronic database for immunized migrants at the National Public Health Institute.

^b Paper registry for asylum seekers.

^c A database to archive data on administered vaccines is kept only for children.

^d Aggregated data are sent to the Ministry of Health after the immunization campaign.

^e Aggregated data reflecting coverage are those available at these levels. Individual data are available only at local level, although the implementation of an electronic platform to make this information available was ongoing at the time of the survey in Portugal.

^f There is not a defined period within which the report on vaccinated migrants has to be sent; data are being sent after immunization.

up-to-date information to the questions on which this manuscript's findings are based.

We found that strategies for immunizing children and adolescent migrants are in place in all of them, generally in line with

WHO and ECDC indications [18,22], although approaches vary across countries. Adult migrants are targeted for immunization offer in four countries. It is not surprisingly that priority is given to childhood vaccinations. WHO and ECDC state that in case of

vaccine shortage children immunization should be priority [2,18,22,23]. Moreover, it is documented that immunization programmes targeting adults are generally less consolidated also among local populations, if compared with childhood immunization programmes in EU countries [29].

Four of the surveyed countries offer childhood vaccinations to asylum seekers, refugees, irregular migrants and unaccompanied minors, while two countries (Croatia and Slovenia) reported to offer vaccination only to asylum seekers, thus potentially leaving part of migrant population unimmunized. This proportion might not be marginal, for example irregular migrants were estimated to be 435,000 at 1st January 2016 in Italy, representing the 7.4% of the entire foreign population [30].

No country uses serology for ascertaining immune status before vaccinating, except for Italy that reported to test for immunity against hepatitis B and tetanus when individuals were lacking proof of immunization. ECDC recommends assessing immunization status for all migrants using available documentation and states that, if no or uncertain documentation exists, the individual should be tested or considered susceptible. For hepatitis B, ECDC defers to the national guidelines of hosting countries [2]. Serological testing of infection/immunity for hepatitis B and vaccination of susceptible individuals, mainly if coming from highly endemic countries, is recommended in guidelines from Australia, Ireland and United States of America [31].

We found that none of the six countries administer vaccinations at entry site; some countries start vaccinations at the holding level and complete the cycle at the community level, other countries offer vaccinations directly at community level. It is in line with WHO-UNHCR-UNICEF indications that do not recommend vaccinating refugees, asylum seekers and migrants at border crossings unless there is an outbreak of a VPD in the host or transit country [18]. In fact, for vaccines that require multiple doses, follow up of the full immunization series might be difficult if vaccination has started at the point of entry. Our finding is similar to the result of a survey conducted in 2009 among EU and non EU countries of the Mediterranean basin [32] that identified the same community-based services used by local population as the predominant vaccination delivery pattern for migrants.

Discussing on vaccinations delivery patterns is relevant to understand the more appropriate modalities to ensure high immunization coverage of migrant population. Starting/updating vaccinations after the integration of migrants in the community might facilitate the administration of full vaccination cycles. However, barriers in accessing community health services might unnecessarily delay the administration of first doses, especially while people are on the move. Many migrants have limited access to healthcare services, due to a combination of legal, administrative, linguistic and cultural factors [32,33]. A 2017 study compared access to preventive health services between migrants and native populations in five EU countries and found that migrants have poorer access to cervical cancer screening, colorectal cancer screening and flu vaccination than natives [34]. In our study, standard procedures to guarantee the migrants' access to vaccination at the community level are in place only in Portugal, where dedicated social workers, if necessary, accompany migrants to health facilities for vaccination.

Our findings show some similarities with a survey conducted in 2016 among 15 non-EU countries of the Mediterranean Area and the Black Sea basin [35]. In all these countries children are generally offered all the vaccinations included in the NIP of the hosting country, while immunization strategies target adults only in 8 countries. Only 3 countries provide vaccinations at the entry level, confirming a mainly community-based service delivery model.

The main challenge detected from our study is the difficulty to keep track of data on immunized migrants within the country and

among countries. Archiving of data on administered vaccines and its sharing within and among countries becomes a crucial challenge to facilitate the completion of a vaccination series and avoid lack or re-vaccination.

Firstly, we found that centres/institutions to which data on administered vaccines is made available, type of information and the reporting frequency vastly vary among countries. Moreover another survey, conducted in the framework of the CARE project to explore how these national strategies for migrants immunization are locally implemented in the migrants reception centres or in the local health services, showed that in Greece and Italy the procedures to archive data on immunized migrants highly vary also within the country itself [36].

These structural differences would likely challenge attempts to exchange information across registries as a way to track and complete immunization cycles. A strict coordination and collaboration among public health authorities of different countries would be necessary to define a common format for data sharing and appropriate infrastructures to exchange electronic data while ensuring confidentiality. At the time of our survey, electronic individual data of immunized migrants were available at the national level only in two of the six surveyed countries.

Secondly, we asked for national data on migrant immunization uptake and only one country was able to provide this data. This country, Malta, has uptake data of the first dose of pentavalent vaccine administered to children at the reception centre or at the first visit at health centre, but no data on follow up doses. It confirms the difficulty to monitor immunization of migrants after they enter in the community.

Under the current year 2017–2018, the International Organization for Migration is consolidating the electronic Personal Health Record (e-PHR), an online health platform to archive migrants' health information. It could ensure that migrant health assessment records are available, under strict data protection rules, within transit and destination countries [37].

Universal European guidelines are challenging to be developed given that migration patterns, financial resources and health system organization vary among countries and could be responsible of different national needs. Instead, the development of national guidelines should be promoted to make strategies and practices homogeneous across local centres/services within a country. In Italy, where a high variability was described [36], the recently published guidelines for migrant health care might help to reduce this heterogeneity [31].

The main limitation of this survey is that it involved only the six countries participating in the CARE project. Collecting this information from all European countries should be precious to have a clear and comprehensive picture of immunization strategies targeting migrants in Europe. VENICE (Vaccine European New Integrated Collaboration Effort), a network under the coordination of ECDC dedicated to VPDs [38], is going to extend the survey on strategies for migrants' immunization to all EU/EEA countries, in 2018.

5. Conclusions

Although diversified, strategies for migrant vaccination are in place in all the six EU surveyed countries and generally in line with WHO and ECDC indications. The detailed description of these strategies has allowed to identify some critical points and some areas where further efforts should be focused: (1) development of procedures to keep track of migrants' immunization data within and across countries to avoid lack or duplication of vaccinations; (2) promotion of cooperation among public health authorities of different countries to define common procedures for data sharing;

(3) development of migrant-friendly strategies to increase and monitor access to vaccinations at the community level; (4) collection of data on vaccination uptake among migrants.

Competing interests

The authors declare that they have no competing interest.

Authors' contributions

CG conceived and designed the study, developed the questionnaires, coordinated and monitored the study activities, collected and analyzed the data and interpreted the results, drafted and edited the manuscript. MD conceived and designed the study, developed the questionnaires, coordinated and monitored the study activities, collected and analyzed the data and interpreted the results and critically revised the manuscript. TD collected and analyzed the data, interpreted the results and critically revised the manuscript. SD conceived and designed the study, coordinated and monitored the study activities, interpreted the results and critically revised the manuscript. FR, ABe, MGC conceived and designed the study, interpreted the results and critically revised the manuscript. ABa, NC, TM, RM, GP contribute to develop the questionnaire, identified contact point for the survey and coordinated the survey in their country, interpreted the results and critically revised the manuscript. The CARE working group for the National Immunization Survey collaborate to develop and test the questionnaire, filled out the questionnaires for their own country and critically revised the preliminary paper. All authors read and approved the final manuscript.

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References

- FRONTEX. Migratory routes map. Available from: <<http://frontex.europa.eu/trends-and-routes/migratory-routes-map/>> Last access: 11 September 2017.
- European Centre for Disease Prevention and Control. ECDC technical document: infectious diseases of specific relevance to newly-arrived migrants in the EU/EEA. Stockholm; 2015. Available from: <<https://ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/Infectious-diseases-of-specific-relevance-to-newly-arrived-migrants-in-EU-EEA.pdf>> Last access: 11 September 2017.
- International Organization for Migration. World Health Organization. 2014. Tuberculosis prevention and care for migrants. Available from: <http://www.who.int/tb/publications/WHOIOM_TBmigration.pdf> Last access: 21 January 2018.
- International Organization for Migration. World Health Organization. Health of migrants: resetting the agenda. Report of the 2nd Global Consultation. Colombo, Sri Lanka, 21–23 February 2017 Available from: <https://www.iom.int/sites/default/files/our_work/DMM/Migration-Health/GC2_SriLanka_Report_2017_FINAL_22.09.2017_Internet.pdf> Last access: 21 January 2018
- WHO Regional Office for Europe. Migration and Health: Key Issues. Available from: <<http://www.euro.who.int/en/health-topics/health-determinants/migration-and-health/migrant-health-in-the-european-region/migration-and-health-key-issues>> Last access: 11 September 2017.
- European Centre for Disease Prevention and Control. Epidemiological Update: Measles among Asylum Seekers in Germany, 10 August 2016. Available from: <<https://ecdc.europa.eu/en/news-events/epidemiological-update-measles-among-asylum-seekers-germany-10-august-2016>> Last access: 11 September 2017.
- Williams GA, Bacchi S, Shadwick R, Tillmann T, Rechel B, Noori T, et al. Measles among migrants in the European Union and the European Economic Area. *Scand J Public Health* 2016;44:6–13.
- Jones G, Haeghebaert S, Merlini B, Antona D, Simon N, Elmouden M, et al. Measles outbreak in a refugee settlement in Calais, France: January to February 2016. *Euro Surveill* 2016;21:30167.
- Haas EJ, Dukhan L, Goldstein L, Lyandres M, Gdalevich M. Use of vaccination in a large outbreak of primary varicella in a detention setting for African immigrants. *Int Health* 2014;6:203–7.
- Lesens O, Baud O, Henquell C, Lhermet A, Beytout J. Varicella outbreak in Sudanese refugees from Calais. *J Travel Med* 2016;23. taw042.
- Meinel DM, Kuehl R, Zbinden R, Boskova V, Garzoni C, Fadini D, et al. Outbreak investigation for toxigenic *Corynebacterium diphtheriae* wound infections in refugees from Northeast Africa and Syria in Switzerland and Germany by whole genome sequencing. *Clin Microbiol Infect* 2016;22. 1003.e1–1003.e8.
- Fabiani M, Riccardo F, Di Napoli A, Gargiulo L, Declich S, Petrelli A. Differences in influenza vaccination coverage between adult immigrants and Italian citizens at risk for influenza-related complications: a cross-sectional study. *PLoS ONE* 2016;11:e0166517.
- Mipatrini D, Stefanelli P, Severoni S, Rezza G. Vaccinations in migrants and refugees: a challenge for European health systems. A systematic review of current scientific evidence. *Pathog Glob Health* 2017;111(2):59–68.
- WHO Regional Office for Europe. Addressing Vaccine Hesitancy. 7 June 2016. Available from: <http://www.who.int/immunization/programmes_systems/vaccine_hesitancy/en/> Last access: 11 September 2017.
- European Centre for Disease Prevention and Control. Let's talk about hesitancy. Stockholm: ECDC; 2016. Available from: <<https://ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/lets-talk-about-hesitancy-vaccination-guide.pdf>> Last access: 11 September 2017.
- Larson HJ, Jarrett C, Eckersberger E, Smith DM, Paterson P. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007–2012. *Vaccine* 2014;32(19):2150–9.
- Italian Ministry of Health. Copertura Vaccinali Pediatriche. (Childhood Vaccination Coverage Data.) Available from: <http://www.salute.gov.it/imgs/C_17_tavole_20_allegati_iitemAllegati_0_fileAllegati_itemFile_5_file.pdf> Last access: 11 January 2018.
- WHO Regional Office per Europe. WHO-UNHCR-UNICEF Joint Technical Guidance: General Principles of Vaccination of Refugees, Asylum-Seekers and Migrants in the WHO European Region. 3 November 2015. Available from: <<http://www.euro.who.int/en/health-topics/disease-prevention/vaccines-and-immunization/news/news/2015/11/who-unicef-and-unhcr-call-for-equitable-access-to-vaccines-for-refugees-and-migrants/who-unhcr-unicef-joint-technical-guidance-general-principles-of-vaccination-of-refugees-asylum-seekers-and-migrants-in-the-who-european-region>>. Last access: 11 September 2017.
- WHO Regional Office for Europe. Circulating Vaccine-Derived Poliovirus type 1 confirmed in Ukraine. Available online: <<http://www.euro.who.int/en/health-topics/communicable-diseases/poliomyelitis/news/news/2015/09/circulating-vaccine-derived-poliovirus-type-1-confirmed-in-ukraine>> Last access: 11 September 2017.
- WHO. Measles and Rubella Surveillance Data. Available online: <http://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/active/measles_monthlydata/en/> Last access: 11 January 2018.
- Ministry of Health, National Institute of Public Health (Istituto Superiore di Sanità). Measles in Italy: weekly bulletin. Update as of 12 December 2017 Available from: <http://www.epicentro.iss.it/problemi/morbillo/bollettino/Measles_WeeklyReport_N35eng.pdf> Last access: 11 January 2018.
- European Centre for Disease Prevention and Control. Expert Opinion on the Public Health Needs of Irregular Migrants, Refugees or Asylum Seekers across the EU's Southern and South-Eastern Borders. September 2015. Available from: <<http://ecdc.europa.eu/en/publications/Publications/Expert-opinion-irregular-migrants-public-health-needs-Sept-2015.pdf>> Last access: 11 September 2017.
- Semenza JC, Carrillo-Santistevan P, Zeller H, Sandgren A, van der Werf MJ, Severi E, et al. Public health needs of migrants, refugees and asylum seekers in Europe, 2015: infectious disease aspects. *Eur J Public Health* 2016;26:372–3.
- CARE. “Common Approach for Refugees and Other Migrants’ Health”. Communicable Diseases Monitoring. Available from: <<http://careformigrants.eu/communicable-diseases-monitoring/>> Last access: 11 September 2017.
- International Organization for Migration. Key Migration Terms. Available from: <<http://www.iom.int/key-migration-terms>> Last access: 11 September 2017.
- European Centre for Disease Prevention and Control. Vaccination schedules. Available from: <<http://vaccine-schedule.ecdc.europa.eu/Pages/Scheduler.aspx>> Last access: 11 September 2017.
- Prymula R, Shaw J, Chlibek R, Urbancikova I, Prymulova K. Vaccination in newly arrived immigrants to the European Union. *Vaccine* 2017; in press. doi: 10.1016/j.vaccine.2017.05.079.
- European Centre for Disease Prevention and Control. ECDC Rapid Risk Assessment. Shortage of Acellular Pertussis-Containing Vaccine and Impact on Immunization Programs in the EU/EEA—8 October 2015; ECDC: Stockholm, Sweden, 2015.
- Kanitz EE, Wu LA, Giambi C, Strikas RA, Levy-Bruhl D, Stefanoff P, et al. Variation in adult vaccination policies across Europe: an overview from VENICE network on vaccine recommendations, funding and coverage. *Vaccine* 2012;30:5222–8.
- Fondazione ISMU. Ventiduesimo rapporto sulle migrazioni 2016. Franco Angeli Edizioni; 2017.

- [31] Sistema nazionale per le linee guida. I controlli alla frontiera. La frontiera dei controlli. Controlli sanitari all'arrivo e percorsi di tutela per i migranti ospiti nei centri di accoglienza. Giugno 2017. Available from: <http://www.salute.gov.it/imgs/C_17_pubblicazioni_2624_allegato.pdf> Last access: 11 September 2017.
- [32] Riccardo F, Dente MG, Kojouharova M, Fabiani M, Alfonsi V, Kurchatova A, et al. Migrant's access to immunization in Mediterranean Countries. *Health Policy* 2012;105:17–24.
- [33] European Centre for Disease Prevention and Control. Migrant health: Background note to the 'ECDC Report on migration and infectious diseases in the EU'. 2009. Available from: <http://ecdc.europa.eu/en/publications/Publications/0907_TER_Migrant_health_Background_note.pdf> Last access: 11 September 2017.
- [34] Rosano A, Dauvrin M, Buttigieg CS, Ronda E, Tafforeau J, Dias S. Migrant's access to preventive health services in five EU countries. *BMC Health Services Res* 2017;17:588.
- [35] Giambi C, Del Manso M, Dente MG, Napoli C, Montaña-Remacha C, Riccardo F, et al. Immunization strategies targeting newly arrived migrants in Non-EU countries of the mediterranean basin and black sea. *Int J Environ Res Public Health* 2017;14(5).
- [36] CARE. Report on the survey on immunization offer targeting newly arrived migrants. 2017. Available from: <<http://careformigrants.eu/wp-content/uploads/2017/09/D5.2-Comparative-vaccination-report.pdf>> Last access: 11 September 2017.
- [37] International Organization for Migration. Electronic Health Database. Available from: <<http://re-health.eea.iom.int/Electronic-health-database-project2>> Last access: 11 September 2017.
- [38] Vaccine European New Integrated Collaboration Effort (VENICE) III project. Available from: <<http://venice.cineca.org/index.html>> Last access: 11 September 2017.