

## Vaccinations in migrants and refugees: a challenge for European health systems. A systematic review of current scientific evidence

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### ABSTRACT

The decline of immunization rates in countries of origin of migrants and refugees, along with risky conditions during the journey to Europe, may threaten migrants' health. We performed a systematic review of the scientific literature in order to assess the frequency of vaccine preventable diseases, and vaccination coverage among migrants and refugees in Europe. To this end, Medline and Cochrane databases were considered. After the screening and the selection process, 58 papers were included in the review. We focused on the following vaccine-preventable diseases: hepatitis B, measles, rubella, mumps, tetanus, poliomyelitis, pertussis, diphtheria, meningitis, and varicella. The results were presented as a qualitative synthesis. In summary, several studies highlighted that migrants and refugees have lower immunization rates compared to European-born individuals. Firstly, this is due to low vaccination coverage in the country of origin. Then, several problems may limit migrants' access to vaccination in Europe: (i) migrants are used to move around the continent, and many vaccines require multiple doses at regular times; (ii) information on the immunization status of migrants is often lacking; (iii) hosting countries face severe economic crises; (iv) migrants often refuse registration with medical authorities for fear of legal consequences and (v) the lack of coordination among public health authorities of neighboring countries may determine either duplications or lack of vaccine administration. Possible strategies to overcome these problems include tailoring immunization services on the specific needs of the target population, developing strong communication campaigns, developing vaccination registers, and promoting collaboration among public health authorities of European Countries.

### KEYWORDS

Migration; refugees; vaccination; Europe; hepatitis; measles; mumps; rubella; poliomyelitis; tetanus; diphtheria; pertussis; meningitis; varicella

### Background and aims

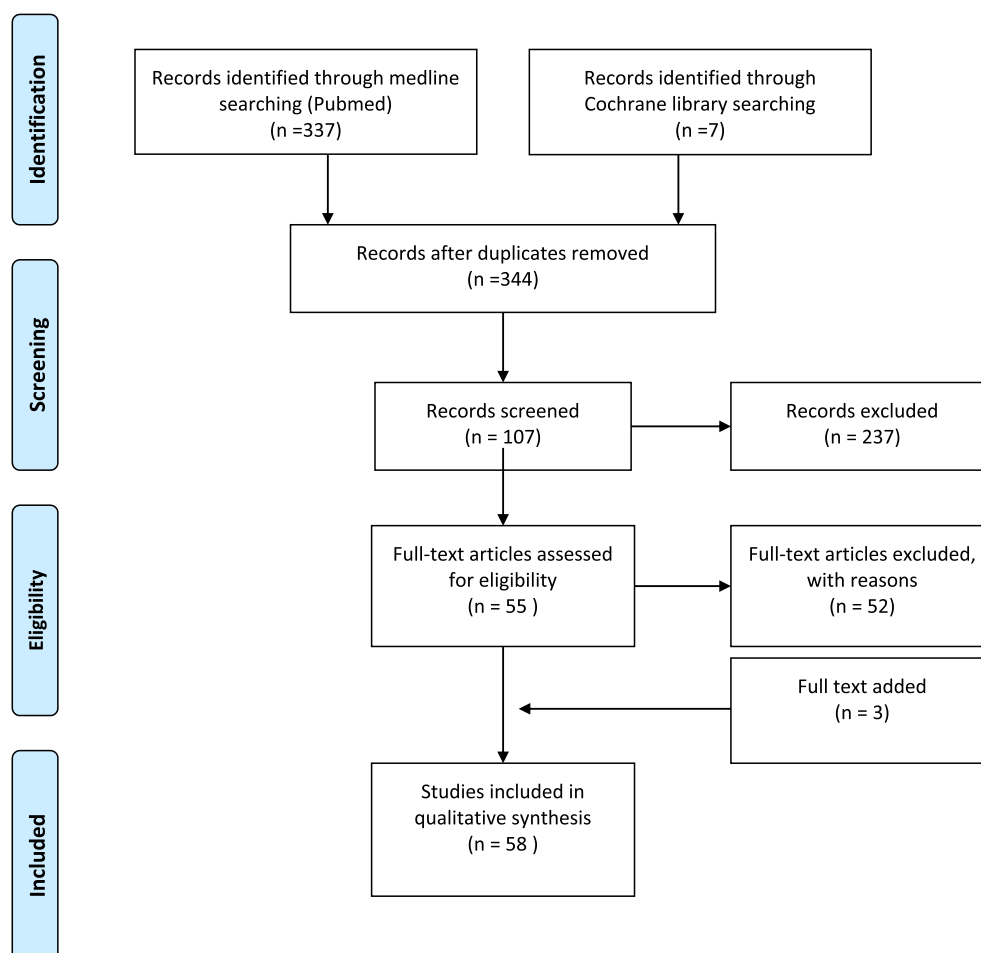
Since 2011, Europe is facing one of the greatest migration inflows in its history. According to Eurostat, after the Northern African turmoil, in 2012, EU countries received 300,000 asylum applications, which peaked to 1,300,000 in 2015, after the Syrian conflict; almost the double of the previous great migration inflow recorded in 1992, after the former Yugoslavia crisis [1]. The UNHCR estimated that, in 2015, more than 1 million migrants arrived in Europe after crossing the Mediterranean Sea, and almost 5000 disappeared during the journey [2].

Asylum seekers and migrants may be exposed to recognized risk factors for communicable diseases: they often come from countries endemic for poverty-related diseases, affected by war and social conflicts, and undertake long journeys [3]. Moreover, crises in their country

of origin often lead to the disruption of National Health-care Services (NHS), with fall of vaccination coverage [4].

However, according to WHO, there is little evidence for an association between migration flows and the importation of infectious diseases [3].

Hereby, we provide an overview of vaccine preventable diseases (VPD) among migrants and refugees arriving in Europe, vaccination coverage in their countries of origin, and European strategies in the field of migrants' vaccination. The scarcity of official or confirmed data represents the main limit of our review. In order to overcome this problem, we used multiple sources, performing a systematic review of scientific papers, complementing the information through the WHO database and the revision of official reports from other international organizations.



**Figure 1.** Flow-chart of included studies.

## Methods

### Sources and search strategies

Papers were searched in two databases: Medline and Cochrane. The search was performed on 21 October 2016. The following search strategy was adopted:

Medline: (*vaccin\*[Title/Abstract] OR varicella\*[Title/Abstract] OR measles\*[Title/Abstract] OR rubella\*[Title/Abstract] OR hepatitis\*[Title/Abstract] OR mening\*[Title/Abstract] OR polio\*[Title/Abstract] OR tetanus\*[Title/Abstract] OR pertussis\*[Title/Abstract] OR whooping cough\*[Title/Abstract]*) AND (*migrant\*[Title/Abstract] OR refugee\*[Title/Abstract] OR asylum seeker\*[Title/Abstract]*) AND PUBYEAR >2005;

Cochrane library: (*migrant OR refugee OR Asylum*) AND PUBYEAR >2005.

### Eligibility criteria and selection of the studies

The papers identified through the search were screened by two independent researchers on the basis of title and abstract. The papers fitting the following eligibility criteria were included in the systematic review:

- (1) Language and year: (i) year of publication > 2005, and (ii) English or Italian language.

- (2) Outcomes: all papers providing information on prevalence of infection/antibodies, immunization coverage, and outbreaks of vaccine preventable diseases among migrants and refugees in Europe;
- (3) No selection was made on the basis of the study design.

In case the two researchers disagreed on a specific paper, a third researcher was requested to decide about the inclusion or the exclusion of the manuscript.

### Data collection, risk of bias, synthesis of the results

#### vResults

The PRISMA flow chart is reported in Figure 1. Overall, 344 papers were identified (337 through PubMed and 7 through the Cochrane library search). At the end of the screening process and eligibility evaluation, 58 papers were included in the review.

The main attributes of the selected papers are reported in Table 1. In summary, 41 prevalence studies, 30 immunological/serological studies, and 11 outbreak investigations were considered. The following VPDs were considered: HBV (29 papers), polio (9), measles (7), tetanus (6), meningitis (4), diphtheria, rubella, and varicella (3 each), mumps and pertussis (one each).

**Table 1.** Characteristics of the studies included in the review.

VPD	Country	Paper	Prevalence	Immunity	Outbreak
Diphtheria	Austria	Grabmeier–Pfistershammer et al. 2015 [6]	–	X	–
Diphtheria	EU	Mullaert et al. 2015 [7]	X	X	–
Diphtheria	Finland	Sane et al. 2016 [8]	X	–	X
HBV	EU	Hahne et al. 2013 [9]	X	–	–
HBV	EU	Mockenhaupt et al. 2016 [10]	X	–	–
HBV	EU	Sharma et al. 2015 [11]	–	–	–
HBV	France	Mullaert et al. 2015 [7]	X	X	–
HBV	Germany	Cai et al. 2011 [12]	X	X	–
HBV	Germany	Mikolajczyk et al. 2008 [13]	–	X	–
HBV	Germany	Ott et al. 2008 [14]	X	–	–
HBV	Italy	Coppola et al. 2015 [15]	X	X	X
HBV	Italy	El-Hamad et al. 2015 [16]	X	–	–
HBV	Italy	Fasano et al. 2013 [17]	X	–	–
HBV	Italy	Tafari et al. 2010 [18]	X	X	–
HBV	Italy	Villano et al. 2015 [19]	X	X	–
HBV	Malta	Padovese et al. 2014 [20]	X	–	–
HBV	Netherlands	Hahne et al. 2012 [21]	X	–	–
HBV	Netherlands	Marshall et al. 2008 [22]	X	–	–
HBV	Netherlands	Richter et al. 2014 [23]	X	X	–
HBV	Netherlands	Veldhuijzen et al. 2009 [24]	X	–	–
HBV	Netherlands	Veldhuijzen et al. 2012 [25]	X	–	–
HBV	Netherlands	Whelan et al. 2012 [26]	X	–	–
HBV	Netherlands	Zuure et al. 2013 [27]	X	–	–
HBV	North EU	Chu et al. 2013 [28]	X	–	–
HBV	Portugal	Tavora-Tavira et al. 2007 [29]	X	–	–
HBV	Spain	Monge-Maillo et al. 2015 [30]	X	–	–
HBV	UK	Chadwick et al. 2014 [31]	X	–	–
HBV	UK	Clark et al. 2007 [32]	X	–	–
HBV	UK	Cochrane et al. 2015 [33]	X	–	–
HBV	UK	Hargreaves et al. 2014 [34]	X	–	–
HBV	UK	Uddin et al. 2010 [35]	X	–	–
HBV	UK	Vedio et al. 2013 [36]	X	–	–
HBV	World	Rossi et al. 2012 [37]	X	X	–
Measles	EU	Williams et al. 2016 [38]	X	X	X
Measles	France	Jones et al. 2016 [39]	–	–	X
Measles	Germany	Jablonka et al. 2016 [40]	–	X	–
Measles	Germany	Mikolajczyk et al. 2008 [13]	–	X	–
Measles	Germany	Poethko-muller et al. 2009 [41]	–	X	–
Measles	Germany	Takla et al. 2012 [42]	–	–	X
Measles	Switzerland	Getaz et al. 2011 [43]	X	–	–
Meningitis	Italy	Stefanelli et al. 2016 [44]	–	–	X
Meningitis	Italy	Tafari et al. 2012 [45]	–	–	–
Meningitis	Turkey	Tezer et al. 2014 [46]	–	–	X
Meningitis	World	Mateen et al. 2012 [47]	–	–	X
Mumps	Germany	Jablonka et al. 2016 [40]	–	X	–
Pertussis	Austria	Grabmeier–Pfistershammer et al. 2015 [6]	–	X	–
Polio	Europe	Mullaert et al. 2015 [7]	X	X	–
Polio	Europe	Eichner et al. 2013 [4]	–	–	X
Polio	Europe	Hives-Wood et al. 2013 [48]	–	–	X
Polio	Europe	Mohammadi 2013 [49]	–	–	–
Polio	Germany	Bottcher et al. 2015 [50]	X	X	–
Polio	Italy	Tafari et al. 2008 [51]	–	X	–
Polio	Italy	Tafari et al. 2010 [52]	X	–	–
Polio	Italy	Tafari et al. 2010 [53]	–	X	–
Polio	Italy	Tafari et al. 2012 [54]	X	X	X
Rubella	Germany	Jablonka et al. 2016 [40]	–	–	–
Rubella	Sweden	Kakoulidou et al. 2010 [55]	–	X	–
Rubella	UK	Hardelid et al. 2009 [56]	–	–	–
Tetanus	Austria	Grabmeier–Pfistershammer et al. 2015 [6]	–	X	–
Tetanus	EU	Mullaert et al. 2015 [7]	X	X	–
Tetanus	Italy	Rapisarda et al. 2014 [57]	X	X	–
Tetanus	Italy	Tabibi et al. 2013 [58]	X	X	–
Tetanus	Netherlands	Steens et al. 2010 [59]	–	X	–
Tetanus	Switzerland	de la Fuente et al. 2013 [60]	–	X	–
Varicella	Germany	Jablonka et al. 2016 [40]	–	X	–
Varicella	Switzerland	de Valliere et al. 2011 [61]	X	–	–
Varicella	Switzerland	Getaz et al. 2010 [62]	X	X	–

## Hepatitis B virus

Several studies investigated the prevalence of HBV infection among immigrants and refugees. A systematic review reported a seroprevalence of active infection of 7.2%, and an overall seroprevalence (including markers of prior infection) of 39.7%; the risk was highest for migrants from East Asia and Sub-Saharan Africa [37]. Another systematic review [9] found a prevalence of HBsAg ranging from 1.0 to 15.4%, approximately 2–6 fold higher than that of the general population.

Several studies were conducted among migrants in Italy, where HBsAg prevalence was reported to range between 6% and 9% [16–18]. HBsAg positivity rates were higher among Sub-Saharan migrants, and intermediate among those from East Europe and Northern Africa [15]. In Malta, where most migrants tested were from Somalia, only 31 out of 5000 were found HBsAg positive [20]. Among first generation migrants tested in the Netherlands, the prevalence of HBsAg was estimated to be 3.8%, [22] whereas it was 1.1% among Egyptians [27]; further studies found anti-HBc prevalence ranging from 16.8 to 20%, showing high variability in accordance with age groups and ethnicity [24]. Furthermore, prevalence of HBsAg positivity of 5.9% was found among migrants in Portugal [29].

In the UK, the prevalence of HBsAg positivity was 5.7% in a Somali community, 11.8% among Yugoslavian patients, and 9.3% among asylum seekers and refugees [32]. Among Asian migrants, it was 0.1% for people born in India, 1.5% for people born in Bangladesh, 1.8% for people born in Pakistan [35], 8.7% for Chinese people [36], and 1.7% among women coming from high prevalence countries [33]. No cases were found among 36 newly arrived migrants who were screened in London, but the sample was too small to draw any conclusion [34].

In Germany, migrant children showed higher prevalence of HBV infection compared to the native population [12]; however, no cases of HBV infection were found among 488 unaccompanied minor refugees from Syria tested in Berlin [10]. Chu et al., in 2013 [28], found migrants representing a substantial proportion of HBsAg positive and chronic cases in six Northern European Countries. Sharma et al. (2015) [11] reported that 53% of HBV carriers were born outside the EU. Finally, among HIV positive migrants, HBV prevalence was reported to be 4.5% in UK [31] and 18.6% in France [7].

As expected, a very limited number of studies produced incidence data. Studies conducted in the Netherlands found an incidence rate of HBV of 4.1/100,000 among first-generation migrants coming from endemic countries, with no change in the trend between 1992 and 2009. The incidence of acute hepatitis in Amsterdam was higher among first-generation migrants compared with the Dutch population [26]. In the study conducted

by Hahne et al. in 2012 [21], first-generation migrants showed a 13-fold higher risk of being HBsAg or HBV DNA-positive compared with the Dutch population. Asian origin represented a risk factor.

Large variations were observed also for chronic hepatitis. For example, a prevalence of chronic hepatitis of 14% among Africans and 1.6% among Latin Americans was reported in Spain [30]. However, migrants appear to be at higher risk of complications and mortality as a consequence of HBV infection [14,23,25].

Finally, only a few studies investigated HBV vaccination coverage among migrants. In Germany, a study of school age children found similar coverage for HBV vaccination among migrants and the indigenous population [13].

## Measles, mumps, and rubella

A recent systematic review highlighted the lack of harmonized data on measles outbreaks and vaccination coverage among migrants in Europe [38]. Serological studies investigated the susceptibility to measles among migrants and refugees, estimating a prevalence of seronegative individuals between 6 and 13% [40,42,43]. Children appeared to be at higher risk to be unvaccinated [40]. In Germany, foreign-born children had a three-fold higher risk of being unvaccinated, thus being more susceptible to measles. The situation is similar in Italy and Spain, with coverage rates higher among native populations than among foreign-born children [38,41]. However, Mikolajczyk reported no difference in vaccination coverage between migrant and non-migrant children [13].

Information on measles outbreaks was reported by Williams: [38] among 12,132 notified cases in 32 European countries in 2006–2007, 1.7% were defined as ‘imported’. Outbreaks occurred in Ireland (2009–2010), France (2008–2010), Germany (2008), Greece (2010), and Italy (2006–2007) involved, in particular, nomadic Roma populations. In Norway, a measles outbreak affected 10 children, 8 of whom were of Somali origin. Jones et al. (2016) [39] recently reported a measles outbreak in the refugee camp of Calais, between January and February 2016; overall, 10 refugees, 2 health workers, and 1 volunteer were confirmed positive to measles. After the outbreak, a mass vaccination campaign was conducted in the camp, covering 60% of the target population.

Concerning mumps, Jablonka analyzed 678 newly arrived refugees, finding 10.2% of seronegative individuals [40].

Studies conducted in Sweden and in the UK showed that migrant women were less likely to be immunized for rubella than native women; in the former group, 10% were found to be seronegative [55,56]. In particular, odd ratios of 4.2 and 5.0 were found for women born in Sub-Saharan Africa and in South Asia, respectively, compared

**Table 2.** Coverage of vaccinations in 2014 (%).

Vaccine	Code	Syria	Iraq	Afghanistan	Albania	Pakistan	Eritrea	Italy	Greece	Germany	Denmark	Sweden
Bacille de Calmette-Guérin	BCG	81	95	86	99	85	97	—	—	—	—	—
Diphtheria-tetanus-pertussis 1st dose	DTP1	65	77	82	99	79	97	98	99	98	96	99
Diphtheria-tetanus-pertussis 3rd dose	DTP3	43	64	75	98	72	94	94	99	96	94	98
HepB 3rd dose	HepB3	71	62	75	98	72	94	94	96	87	—	53
HBV birth dose	HepB_BD	78	43	4	99	—	—	—	—	—	—	—
Haemophilus influenzae 3rd	Hib3	43	64	75	98	72	94	94	99	94	94	98
MeaslesContainingVaccine 1st dose	MCV1	54	57	66	98	61	96	86	97	97	90	98
MeaslesContainingVaccine 2nd dose	MCV2	49	57	39	98	52	—	—	83	92	84	95
Maternalimmunization with ≥2 doses of tetanus toxoid	PAB	92	72	70	92	75	94	—	—	—	—	—
PneumococcalConjugate Vaccine	PCV3	—	—	40	99	72	—	55	96	69	93	97
Polio vaccine 3rd dose	Pol3	52	67	75	98	72	94	94	99	95	94	98
Rotavirus	RotaC	—	29	—	—	—	25	—	—	—	—	—

European countries.

to UK-born women [56]. In Germany, 2.2% of 678 newly arrived refugees were seronegative [40].

### Polio

After more than 10 years without polio, the disease re-emerged in Syria in 2013, after being detected in the sewers of Israel, Gaza, and Egypt [49]. This could represent a threat for European countries with low vaccination rates [4,48]. In Ukraine, for example, the coverage among children is around 50% [63], and a few cases of vaccine-derived polioviruses (VDPVs) have already been reported in 2014 [64]. However, no studies reported cases of wild poliovirus infection among Syrian refugees in Europe [50,54].

The vaccination coverage for Sabin-like polioviruses has been estimated less than 15% among Syrian children refugees in Germany [50], while in Italy, 99% of 1277 migrants were found having high levels of immunity against polioviruses [51–53]. In France, among HIV-infected migrants, the vaccination coverage against poliovirus was 64.4% [7].

### Tetanus

Several studies investigated the vaccination coverage against tetanus among migrants, finding lower rate in comparison to EU-born individuals. In Italy, 91% of Italian and other European workers resulted protected against tetanus in comparison with 81% of non-EU workers; [58] Egyptian and Moroccan workers also had a higher risk of inadequate immunization status [57]. In the Netherlands, lower tetanus seroprevalences were found among first-generation migrants from non-Western countries who were born before 1984 [59]. In Switzerland, among 92 newly arrived migrant children, only 27% had antibodies against diphtheria-tetanus-pertussis (DTP) consistent with previous vaccination [60]. Among HIV-positive individuals studied in Austria, migrants had a lower probability of being protected against tetanus [6], whereas the prevalence of antibodies against tetanus among HIV-infected migrants in France was 70.7% [7].

### Diphtheria

In France, Mullaert found a seroprevalence rate of 69% of antibodies against diphtheria among HIV-infected migrants [7], whereas no difference in IgG against diphtheria between HIV-infected migrants and non-migrants was reported in Austria [6]. Finally, a case of diphtheria was reported in 2015 in an Afghani asylum seeker in Finland [8].



**Table 3.** Syria loss of % coverage in 5 years.

Vaccine	Code	% coverage in 2010	% coverage in 2014	Loss of % coverage
Bacille de Calmette–Guerin	BCG	97	81	16
Diphtheriatetanuspertussis 1st dose	DTP1	89	65	24
Diphtheriatetanuspertussis 3rd dose	DTP3	80	43	37
HBV 3th dose	HepB3	84	71	13
HBV 1st dose	HepB_BD	97	78	19
Haemophilusinfluentiae 3rd	Hib3	80	43	37
MeaslesContainingVaccin 1st dose	MCV1	82	54	28
MeaslesContainingVaccin 2nd dose	MCV2	82	49	33
Live births protected (PAB) through maternal immunization with at least two doses of tetanus toxoid	PAB	94	92	2
PneumococcalConjugate Vaccine	PCV3			
Polio vaccine 3rd dose	Pol3	83	52	31
Rotavirus	RotaC			

### Pertussis

Little information is available on pertussis among migrants in Europe. In Austria, the immunization rate for pertussis was 1% among 711 HIV patients, but no difference was found between migrants and non migrants [6].

### Meningitis

Data on vaccination coverage against meningococcal infection/disease among migrants are not available. Mateen et al. (2012) [47] reported a total of 477 visits for meningitis (for a total of 3816 camp-months) in 19 refugee camps covering approximately 1.6 million displaced persons worldwide. In Southern Italy, two cases of invasive meningococcal meningitis due to the serogroup W135 were reported among migrants coming from Mali and Eritrea, and one case occurred in a person working in a migrant camp [44]. In Turkey, one case of serogroup B meningococcal meningitis was reported in 2014 in a 11-year-old Syrian refugee [46]. Finally, Tafuri et al. (2012) [45] carried out a meningococcal carriage study among 253 healthy migrants in Italy, finding 5.1% healthy carriers; interestingly, 6 isolates (46.1%) were autoagglutinable, four (30.8%) strains belonged to serogroup W, and three (23.1%) to serogroup Y.

### Varicella

In Germany, among 678 newly arrived migrants, in 2016, 3.3% were seronegative for IgG against varicella was. In Switzerland, in 2008, the attack rate of Varicella among asylum seekers was 2.8% [61], and a Swiss study found 14 out of 110 inmates to be susceptible for varicella in a prison where migrants were predominant [62].

### Vaccines coverage in countries of origin of migrants

Table 2 presents vaccine coverage data for 2014, according to the estimates of WHO and Unicef, for six of the most frequent countries of origin of migrants arriving in Europe since 2012: Syria, Afghanistan, Iraq, Albania, Pakistan, and Eritrea [65]. Concerning measles containing

vaccines (MCV1), both Syria and Iraq showed rates below 60%, Pakistan 61%, Afghanistan 66%, while both Albania and Eritrea were estimated to have rates higher than 95%. Similar rates were reported for polio vaccines, with Syria, Iraq, Pakistan, and Afghanistan showing an estimated coverage of 52, 67, 72, and 75%, respectively, while Albania and Eritrea had an estimated coverage of 98 and 96%, respectively. With regard to vaccination against hepatitis B, Syria showed a 71% coverage, Iraq 62%, Afghanistan 75%, Pakistan 72%, Albania 98%, and Eritrea 94%. Finally, as the diphtheria–tetanus–pertussis vaccination was concerned, Syria had a coverage of 65%, Pakistan 72%, Iraq 77%, Afghanistan 82%, Albania 99%, and Eritrea 97%. Table 3 shows the case of Syria: because of the conflict occurred since 2010, vaccination rates declined on average of 24% in 2014. In particular, anti-polio vaccination coverage decreased from 83 to 52%.

### Discussion

Migrants are exposed to malnutrition, unsanitary conditions, displacement, and overcrowding, and often escape from war and social disasters which affect national vaccination strategies [66]. In 2016, WHO–UNHCR–UNICEF stated that migrants, asylum seekers, and refugees should have ‘non-discriminatory and equitable’ access to vaccinations. The three international agencies recommended to vaccinate migrants, avoiding delays, in accordance with the immunization schedule of the hosting country, and to provide migrants with documentation of the vaccinations administered, in order to avoid duplications [67].

However, access to the full vaccination schedule through follow-up vaccinations is difficult to ensure, because reaching the migrants’ populations poses several challenges:

- (1) migrants are moving throughout European countries, and many vaccines must be given in consecutive doses, at regular pre-scheduled time intervals;
- (2) Screening services for VPDs and vaccination are not always provided to migrants or are not

easily accessible and centered on migrants' needs [68–71];

- (3) there is often no information on the immunization status of migrants and refugees. Williams et al. (2016) [38] found a lack of systematic data collection in European countries concerning cases, immunization coverage, and determinants of non-immunization for measles, mumps, and rubella (MMR). Moreover, they highlight the lack of harmonized indicators across different European countries;
- (4) hosting countries are facing severe economic crisis, challenging migrants' access to National Healthcare Services (NHS) and exacerbating risks of infectious diseases for migrants [72];
- (5) migrants often refuse vaccination and registration by medical authorities for the fear of legal consequences;
- (6) the lack of coordination among public health authorities of neighboring countries may determine either duplications or lack of vaccine administration [38,73].

To tackle bottlenecks and obstacles to vaccination, WHO proposes to tailor immunization services and to strengthen communication and social mobilization toward specific population targets. In particular, communication campaigns should clarify the advantages of vaccination and the complete lack of legal consequences [74]. Additional approaches to foster vaccination coverage among migrants might consist in: (i) implementing and offering screening campaigns for VPDs to newly arrived migrants [75,76]; (ii) promoting a strong epidemiologic surveillance for new cases of VPDs, developing a set of indicators harmonized at European level in order to monitor the prevalence and the immunity coverage of native and migrants' populations, and starting to realizing vaccination registries for newly arrived migrants; (iii) promoting collaboration among public health authorities of European Countries to share vaccination policies, information on vaccination campaigns performed and, whether possible, vaccine supplies; (iv) promoting public-private partnership to overcome economic problems in the offer of vaccinations to migrants that may derive from NHS crisis.

According to ECDC, the vaccination status of migrants and refugees arriving in Europe should be assessed firstly through their documentation (i.e. vaccination card); however, when the documentation is missed, migrants should be considered unvaccinated and, thus, they should be vaccinated in accordance to the local recommended schedule. Moreover, economic evaluations proved the cost effectiveness of screening campaigns for HBV and varicella infection [75,76] To this end, it should be considered that vaccines administration without a previous screening may expose some refugees

to over-vaccination, increasing the risk of rare adverse events related to vaccine administration, particularly for attenuated live viral vaccines. Thus, friendly methods for rapid immunological assessment of vaccination coverage may help detecting the real immunological status of migrants and refugees, avoiding over-vaccination.

MMR and polio vaccines should be prioritized [32]. Besides MMR and polio, priority should be given also to the prevention of other highly contagious diseases and/or to those diseases causing severe health consequences, such as hepatitis B, diphtheria, tetanus, and pertussis. In particular, vaccination against polio should be considered a high priority, especially for people coming from countries where polioviruses are still being detected, such as Afghanistan and Pakistan, and from other high-risk countries, such as Nigeria and Somalia, or from those countries which remain vulnerable to potential international spread, including Cameroon, Equatorial Guinea, Ethiopia, Iraq, Israel and Palestine, Syria [33]. *Haemophilus influenza* should be considered for children until the age of six years. If possible, vaccines should be combined to facilitate the administration. In case of shortage, vaccination of children should be prioritized, but adults should receive at least one dose of the tetanus–diphtheria–polio vaccine.

In densely populated settings, such as reception centers, additional vaccinations against a series of infectious agents should be considered; in particular, vaccination against meningococcal disease, preferably with vaccines against meningococcal serogroups A, C, W and Y, varicella, invasive pneumococcal disease, and influenza during the cold season should be ensured [32,33].

## Conclusions

Migrants and refugees are vulnerable population groups that need to be protected. They may be at risk of severe infectious diseases because coming from countries affected by endemic infections, and/or because exposed to infectious agents in promiscuous and overcrowded contexts during their journey to Europe. In many cases, migrants come from countries with health systems disrupted by war and other crises, thus with low efficiency of basic services, such as those offering vaccinations. Providing vaccination services to this vulnerable population is crucial, in order to protect migrants as well as the hosting community. In few words, offering medical assistance is a duty, but taking care of vulnerable people ensuring vaccination services is also a way to convert a critical situation into an opportunity.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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