

Measles

Annual Epidemiological Report for 2022

Key facts

- In 2022, 127 cases of measles and zero deaths were reported by 15 out of 30 EU/EEA Member States. The overall notification rate was 0.3 cases per 1 000 000 population. This was significantly lower than in 2018 and 2019 (34.4 and 25.4, respectively) before the start of the SARS-CoV-2 pandemic in Europe, and slightly higher than the rate observed in 2021 (0.1). This represents a 99% decrease compared to 2018, and a 96% decrease compared to 2019.
- In 2022, age-specific notification rates decreased with increasing age, with children in the <1-year and 1–4-year age groups most affected. In 2022, 80% of the measles cases between the age of 1–4 years were unvaccinated.
- Adults aged 20 years and above accounted for 26% of the cases in 2022, with 72% of them being unvaccinated, similar to the previous years (2018–2021).
- It is likely that the observed epidemiology of measles has been impacted by the COVID-19 pandemic and the control measures implemented during that period, along with the repurposing of healthcare services and possible under-reporting of measles cases.
- Continuous high-quality surveillance, rigorous outbreak investigations and accelerated efforts to increase the uptake of both routine childhood immunisation as well as catch-up campaigns aimed at adolescents and adults, are key tools to closely monitor the measles epidemiology in the EU/EEA and close immunity gaps in the population.

Introduction

Measles is an acute, highly contagious viral disease capable of causing epidemics. It is caused by a single-stranded ribonucleic acid (RNA) virus of the genus *Morbillivirus* and the family *Paramyxoviridae*. The virus is transmitted from person to person via respiratory droplets produced when infected people cough and sneeze. Virus-containing droplets can remain in the air for several hours, and the virus remains infectious on contaminated surfaces for up to two hours.

Measles is extremely communicable, and it is estimated that 90% of non-immune people exposed to an infective individual will contract the disease. Mathematical models estimate the basic reproductive number at 12–18, i.e. the average number of secondary infections that follow a single introduction into a susceptible population. Immunisation against measles started in the 1960s and has dramatically reduced the incidence of measles in Europe. But despite overall high immunisation coverage, measles continues to cause frequent outbreaks. Globally, measles remains a leading cause of childhood deaths and an estimated 140 000 children die each year from complications caused by the disease.

Suggested citation: European Centre for Disease Prevention and Control. Measles. In: ECDC. Annual Epidemiological Report for 2022. Stockholm: ECDC; 2023.

Stockholm, April 2023

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Methods

This report is based on data for 2022 retrieved from The European Surveillance System (TESSy) on 19 February 2023. TESSy is a system for the collection, analysis and dissemination of data on communicable diseases.

For a detailed description of the methods used to produce this report, please refer to the 'Methods' chapter in the 'Introduction to the Annual Epidemiological Report' [1].

An overview of the national surveillance systems is available online [2].

A subset of the data used for this report is available through ECDC's online 'Surveillance Atlas of Infectious Diseases' [3]. Additional information may also be found on the 'Surveillance Atlas of Infectious Diseases', in relation to surveillance systems for measles and historical changes to surveillance.

ECDC has been coordinating the surveillance of measles at the European level since the transfer of EUVAC.NET (European surveillance network for selected vaccine-preventable diseases, hosted by the Statens Serum Institut, Denmark) to ECDC in 2011.

Thirty EU/EEA Member States reported measles data to ECDC. The 2008, 2012 or 2018 EU case definitions [4] were used by 26 countries, and the majority of the countries reported data from comprehensive, passive surveillance systems with national coverage. Belgium reported aggregated data since 2017, and Poland since (and including) April 2019. Up to December 2020, thirty countries (29 EU countries plus the United Kingdom) reported measles data on a routinely basis. The UK stopped reporting measles cases to TESSy in December 2020¹.

Data submitted by EU/EEA Member States are shared with the World Health Organization Regional Office for Europe (WHO/Europe) on a monthly basis, as part of the measles surveillance of the [WHO European Region](#).

Vaccination coverage estimates presented in this report were obtained from the websites of the WHO Global Health Observatory, and the WHO and UNICEF estimates of national immunization coverage (WUENIC) [5]. The method of calculating measles-containing-vaccine first-dose (MCV1) and measles-containing-vaccine second-dose (MCV2) coverage are outlined in the metadata available for each indicator online [6, 7].

Epidemiology

In 2022, a total of 127 cases of measles were reported across the EU/EEA, of which 75 (59%) were laboratory-confirmed. The remaining 52 cases were reported as, 'probable' (4%), 'possible' (35%), and 'unknown' (2%).

Fifteen countries reported measles cases in 2022 (Table 1, Figure 1). Five countries (Belgium, France, Germany, Italy and Poland) accounted for 77% of all the notified cases. The overall notification rate in 2022 was 0.3 cases per 1 000 000 population, which was significantly lower than the notification rates observed in 2018 and 2019 (34.4 and 25.4, respectively), but slightly higher than the rate (0.1) observed in 2021 (Table 1, Figure 2).

Notification rates ranged from 0 to 1.6 cases per 1 000 000 population in EU/EEA countries. Belgium reported the highest notification rate (1.6), followed by Poland (0.7), Romania (0.5), and Sweden (0.5).

In comparison, in 2021, the EU/EEA countries reported a total of 57 cases of measles, of which 39 (68%) were laboratory-confirmed, and 18 were reported as 'possible' (32%). In 2020, 1 959 cases of measles were reported in the EU/EEA (excluding the UK), of which 1 478 (75%) were laboratory-confirmed, 253 were reported as 'probable' (13%), 222 as 'possible' (11%), and six as 'unknown' (<1%). Of the reported cases in 2020, 94% occurred prior to 30 April 2020.

¹ The United Kingdom (UK) was a former Member State of the European Union (EU). The UK withdrew from the EU on 31 January 2020, but continued reporting measles cases to TESSy till December 2020.

Table 1. Number of measles cases and rates per 1 000 000 population by country and year, EU/EEA and the UK, 2018–2022

Country	2018		2019		2020		2021		2022		
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	ASR
Austria	77	8.7	151	17.0	25	2.8	1	0.1	1	0.1	NR
Belgium	117	10.3	496	43.3	66	5.7	7	0.6	19	1.6	NR
Bulgaria	13	1.8	1 235	176.4	257	37.0	0	0.0	1	0.1	NR
Croatia	23	5.6	52	12.8	0	0.0	0	0.0	0	0.0	0
Cyprus	15	17.4	6	6.9	1	1.1	1	1.1	0	0.0	0
Czechia	207	19.5	590	55.4	4	0.4	0	0.0	0	0.0	0
Denmark	8	1.4	15	2.6	4	0.7	0	0.0	0	0.0	0
Estonia	10	7.6	27	20.4	0	0.0	0	0.0	0	0.0	0
Finland	15	2.7	12	2.2	5	0.9	3	0.5	1	0.2	NR
France	2 919	43.6	2 636	39.2	240	3.6	16	0.2	19	0.3	NR
Germany	543	6.6	514	6.2	75	0.9	6	0.1	15	0.2	NR
Greece	2 293	213.5	45	4.2	2	0.2	0	0.0	1	0.1	NR
Hungary	14	1.4	23	2.4	0	0.0	0	0.0	0	0.0	0
Iceland	0	0.0	9	25.2	0	0.0	0	0.0	0	0.0	0
Ireland	77	15.9	74	15.1	19	3.8	0	0.0	2	0.4	NR
Italy	2 686	44.4	1 619	27.1	105	1.8	8	0.1	18	0.3	NR
Latvia	25	12.9	3	1.6	0	0.0	0	0.0	0	0.0	0
Liechtenstein	ND	NR	ND	NR	ND	NR	ND	NR	0	0	0
Lithuania	30	10.7	834	298.5	2	0.7	0	0.0	0	0.0	0
Luxembourg	4	6.6	25	40.7	0	0.0	0	0.0	0	0.0	0
Malta	5	10.5	32	64.8	2	3.9	0	0.0	0	0.0	0
Netherlands	24	1.4	84	4.9	2	0.1	0	0.0	6	0.3	NR
Norway	12	2.3	17	3.2	4	0.7	0	0.0	1	0.2	NR
Poland	340	9.0	1 423	37.5	29	0.8	13	0.3	27	0.7	NR
Portugal	171	16.6	10	1.0	9	0.9	0	0.0	0	0.0	0
Romania	6 398	327.5	1 706	87.9	1 004	51.9	0	0.0	10	0.5	NR
Slovakia	565	103.8	319	58.5	0	0.0	0	0.0	0	0.0	0
Slovenia	9	4.4	48	23.1	6	2.9	0	0.0	0	0.0	0
Spain	226	4.8	292	6.2	93	2.0	2	0.0	1	0.0	NR
Sweden	43	4.2	20	2.0	5	0.5	0	0.0	5	0.5	NR
United Kingdom	953	14.4	882	13.2	84	1.3	ND	NR	ND	NR	NR
EU/EEA	17 822	34.4	13 199	25.4	2 043	3.9	57	0.1	127	0.3	NR

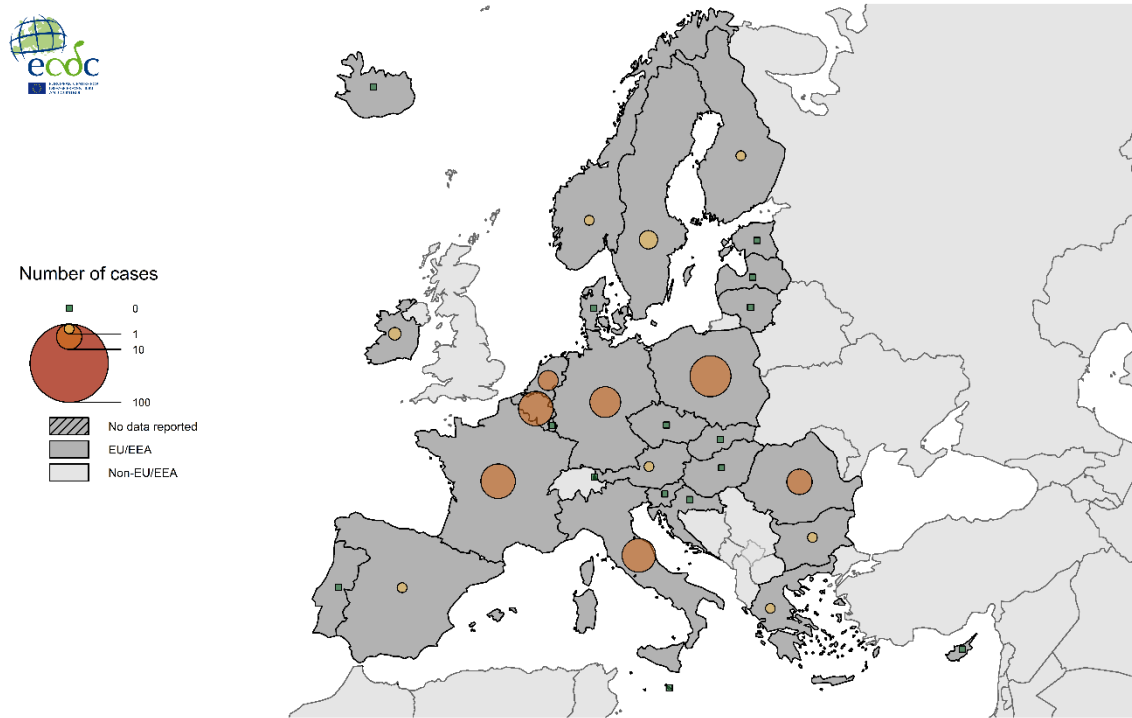
Source: Country reports from Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

ASR: age-standardised rate

ND: no data reported

NR: no rate calculated.

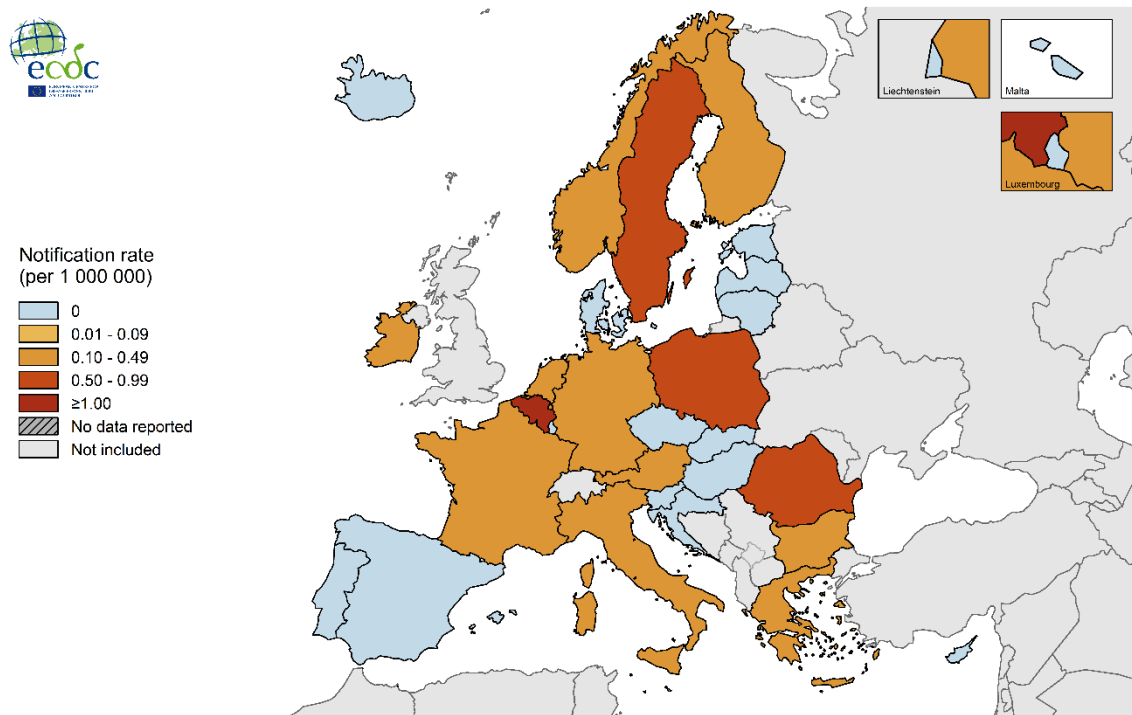
Figure 1. Number of measles cases by country, EU/EEA, 2022



Administration boundaries: © Eurographics
The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union. ECDC. Map produced on 19 February 2023.

Source: Country reports from Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

Figure 2. Number of measles cases per 1 000 000 population by country, EU/EEA, 2022

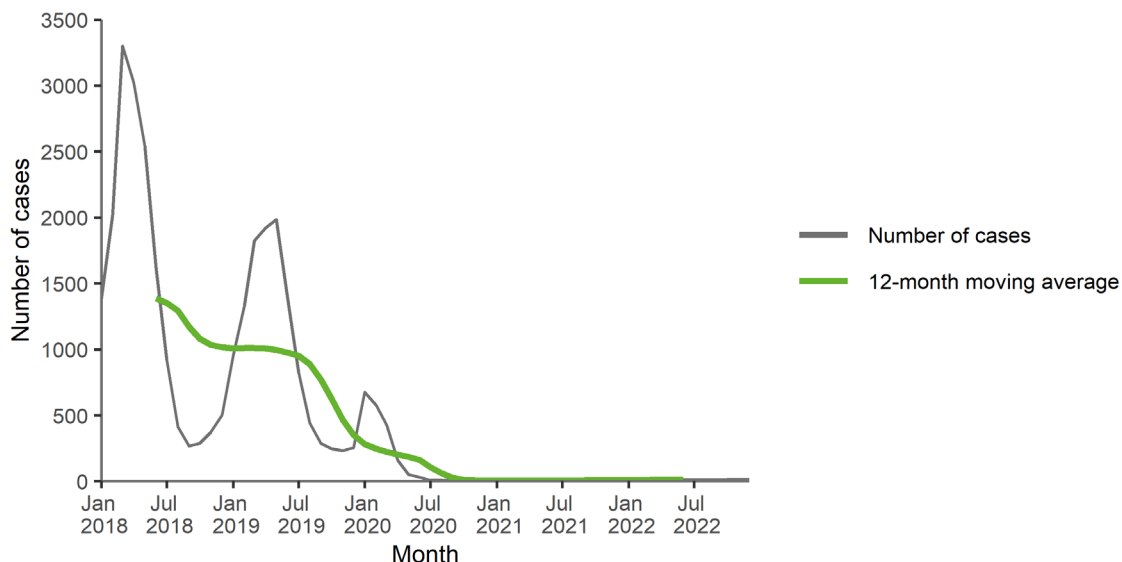


Administration boundaries: © Eurographics
The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union. ECDC. Map produced on 19 February 2023.

Seasonality and trend

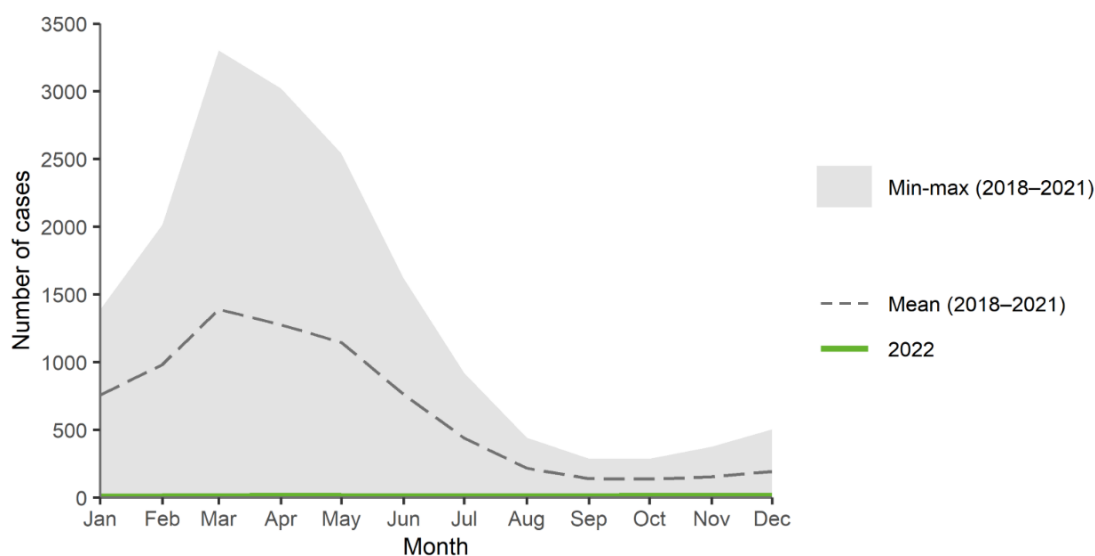
In 2022, the number of measles cases reported was low during the whole year, with a very small increase observed in March and November. This distribution is consistent with the seasonality of measles in temperate climates, where the disease occurs more frequently in winter and spring. The number of reported cases steadily decreased from 2019 onwards (Figures 3 and 4).

Figure 3. Number of measles cases by month and year, EU/EEA, 2018–2022



Source: Country reports from Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

Figure 4. Number of measles cases by month, EU/EEA, 2022 and 2018–2021



Source: Country reports from Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

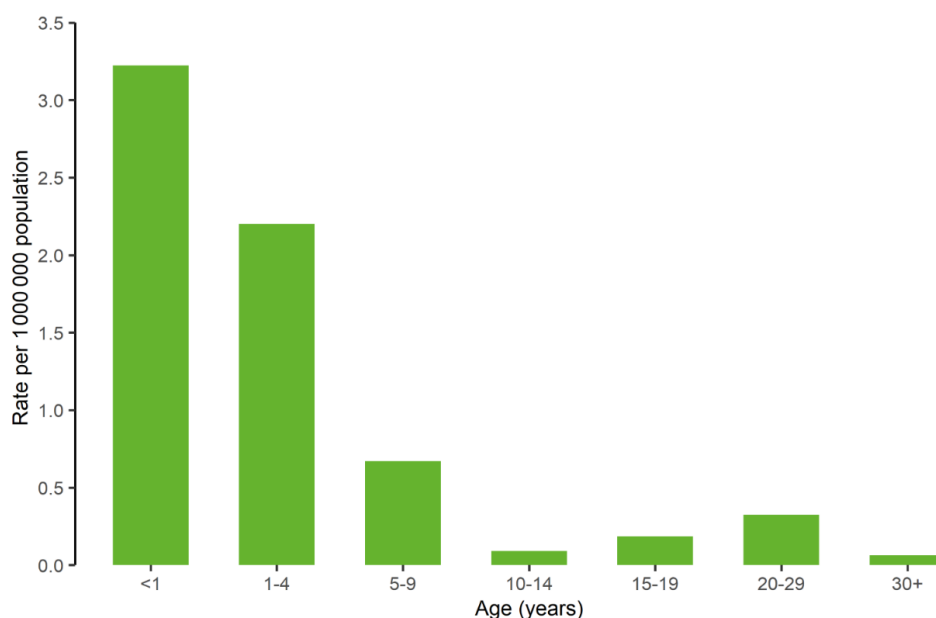
Age and gender

In 2022, infants aged <1 year was the most affected age group (notification rate of 3.2 cases per 1 000 000 population), followed by children aged 1–4 years (notification rate 2.2 cases per 1 000 000 population) (Figure 5). Overall, measles was more common among males (0.26 cases per 1 000 000 population) than females (0.22 cases per 1 000 000 population). However, this was not significant, with a rate ratio of 1.2:1 (95% confidence interval: 0.9–1.5%).

The highest age-specific rates per 1 000 000 population were reported by Belgium, in infants aged <1 year (12.2) and children aged 1–4 years (10.3); by France, in infants aged <1 year (7.2), and by Romania and Sweden in children aged 1–4 years (7.3 and 6.2, respectively).

For the 100 cases with known age (79% of the total), the distribution of case numbers by age group were: 11% aged <1, 35% aged 1–4, 14% aged 5–9, 3% aged 10–14, 4% aged 15–19, 15% aged 20–29, and 18% aged 30+ years. Overall, 37% of the cases were aged above 14 years. The median age of cases across all the EU/EEA countries which submitted case-based data in 2022, was five years of age (interquartile range, IQR: 5–44). In comparison, during the period 2018–2021, the median age of cases was between eight and 19 years of age.

Figure 5. Number of measles cases per 1 000 000 population, by age, EU/EEA, 2022



Source: Country reports from Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

Vaccination status

Data on vaccination status were available for 69 measles cases (54%) reported in 2022. Of these cases, 55 (80%) were unvaccinated, five (7%) were vaccinated with one dose of measles-containing-vaccine (MCV), eight (12%) were vaccinated with two doses, and one case (1%) was vaccinated with an unknown number of doses (Figure 6).

Among the cases with known vaccination status, the highest proportion of unvaccinated cases by age group was among those aged <1 year (100%). This is a group which is not routinely targeted by vaccination against measles, mumps, and rubella (MMR) in most countries. This age group is followed by those aged 30+ years (90%), 1–4 years (80%), and 5–9 years (64%). The vaccination status of cases was more likely to be unknown with increasing age, accounting for 46% and 44% of the cases aged 20–29 years and 30+ years, respectively.

For the years 2018–2022, the overall distribution of cases by age group and vaccination status, followed the same pattern, with the unvaccinated population in the age groups, 0–9 years and >20 years, attributing for approximately 85% of the total cases (Figure 7).

The proportion of children aged 1–4 years who were unvaccinated in 2022 (80%) was similar to what was observed in the period from 2018–2021, in which 80% of the children in the 1–4-year and 98% in the <1-year age groups were unvaccinated.

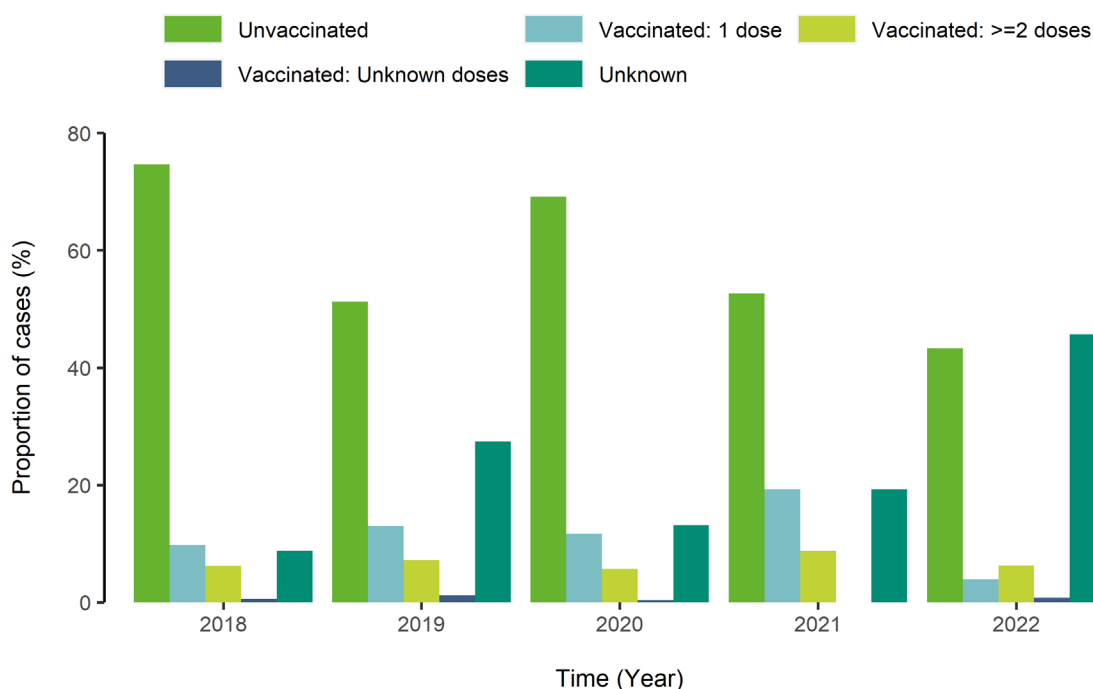
In 2022, 26% of reported measles cases were among adults (>20 years) with 72% of them being unvaccinated. Similar to the period from 2018–2021, in which adult cases consisted of 39% of the total reported measles cases (73% being unvaccinated).

Vaccination coverage

Data on vaccination coverage for the first and second doses of measles-containing-vaccine (MCV) were available up to 2021. In 2021, the overall population-weighted vaccination coverage for the EU/EEA countries was 93% for the first dose and 89% for the second dose (Table 2). Fifteen countries reported a decrease in the vaccination coverage for the first dose of measles (range -1 to -14%) compared to the coverage reported in 2018, and fourteen countries reported a decrease in coverage for the second dose (range -1 to -89%).

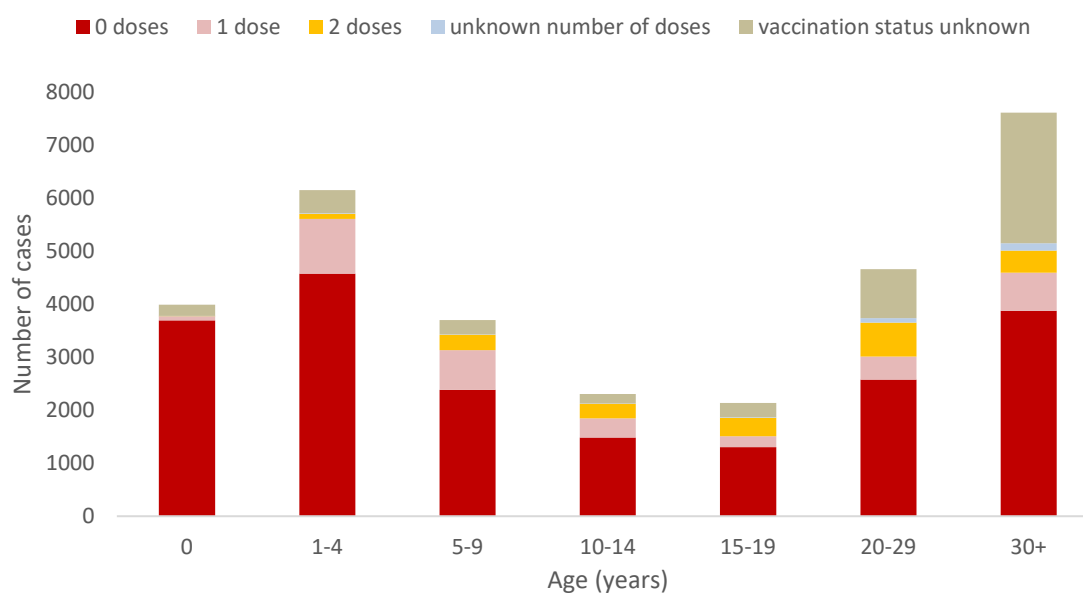
Moreover, six countries reported an increase in vaccination coverage for the first dose (range 1–2%) and seven countries for the second dose (1–7%). Fifteen countries (50%) reported a coverage of $\geq 95\%$ for the first dose. Only five countries (17%) (Hungary, Norway, Poland, Portugal, and Slovakia) had a coverage of $\geq 95\%$ for the second dose (Figure 8, Figure 9).

Figure 6. Proportion of measles cases by vaccination status and year, EU/EEA, 2018–2022



Source: Country reports from Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

Figure 7. Number of measles cases by age group and vaccination status, EU/EEA, 2018–2022 (n=31 339)



Source: Country reports from Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

Outcome

The outcome of disease was available for 72 (57%) cases reported in 2022. No deaths attributable to measles were reported either in 2022 or in 2021. In 2020 and 2019, two and nine deaths were reported, respectively.

Hospitalisation and complications

Hospitalisation status was available for 60 (47%) cases, of which 20 (33%) were hospitalised in 2022. Among the hospitalised cases, one case was vaccinated, 15 had not received any measles-containing-vaccine, and four cases had unknown vaccination status. No complications were reported for six (30%) cases. The majority of the hospitalised cases (75%) were reported by France, Germany, and Romania.

Among all the reported cases in 2022, data on complications were reported for 29 (23%) cases, 19 of which (66%) had no complications. Reported complications included six cases of pneumonia and two cases of otitis media. Unspecified complications ('other') were reported for two cases. Of these 10 cases reported with complications, only one case was vaccinated.

Importations

In 2022, importation status was available for 68 (54%) cases. Of these cases, 22 (32%) were classified as imported in 2022, and one as import-related (1.5%). Nine countries (France, Germany, Ireland, Italy, the Netherlands, Norway, Romania, Spain, and Sweden) reported imported measles cases for 2022. Two of them (Norway and Spain) reported only imported measles cases for 2022 (a total of two cases). The median age of these cases was 6.5 years (range 0–44 years).

Among the 22 imported cases for which a single probable country of infection was available, most were thought to have acquired the infection in Africa (47%), Asia (42%), and Europe (11%). The proportion of imported measles cases for 2022 appeared to be higher compared to the previous years: eight (14%) cases in 2021, 63 (3%) cases in 2020, and 653 (5%) cases in 2019.

Table 2. Vaccination coverage for first dose of a measles-containing-vaccine and second dose of a measles-containing-vaccine, EU/EEA, 2018–2021

Country	2018		2019		2020		2021		Percentage of change* (2018-2021)	
	Dose 1	Dose 2	Dose 1	Dose 2	Dose 1	Dose 2	Dose 1	Dose 2	Dose 1	Dose 2
Austria	94.0	84.0	95.0	86.0	95.0	88.0	95.0	88.0	1%	5%
Belgium	96.0	85.0	96.0	85.0	96.0	85.0	96.0	85.0	0%	0%
Bulgaria	93.0	87.0	95.0	95.0	88.0	84.0	89.0	86.0	-4%	-1%
Croatia	93.0	95.0	93.0	95.0	91.0	91.0	89.0	90.0	-4%	-5%
Cyprus	90.0	88.0	86.0	88.0	86.0	88.0	86.0	88.0	-4%	0%
Czechia	96.0	84.0	92.0	87.0	94.0	90.0	97.0	90.0	1%	7%
Denmark	95.0	90.0	96.0	90.0	94.0	90.0	95.0	94.0	0%	4%
Estonia	87.0	88.0	88.0	90.0	91.0	87.0	89.0	84.0	2%	-5%
Finland	96.0	93.0	96.0	93.0	95.0	93.0	93.0	93.0	-3%	0%
France	90.0	83.0	92.0	86.0	92.0	86.0	92.0	86.0	2%	4%
Germany	97.0	93.0	97.0	93.0	97.0	93.0	97.0	93.0	0%	0%
Greece	97.0	83.0	97.0	83.0	97.0	83.0	97.0	83.0	0%	0%
Hungary	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	0%	0%
Iceland	93.0	95.0	93.0	94.0	93.0	93.0	92.0	10.0	-1%	-89%
Ireland	92.0	NR	91.0	NR	92.0	NR	90.0	NR	-2%	-
Italy	93.0	89.0	94.0	88.0	92.0	86.0	92.0	86.0	-1%	-3%
Latvia	98.0	94.0	99.0	96.0	99.0	94.0	97.0	85.0	-1%	-10%
Liechtenstein	ND	ND	ND	ND	ND	ND	ND	ND	-	-
Lithuania	92.0	92.0	93.0	93.0	90.0	91.0	88.0	88.0	-4%	-4%
Luxembourg	99.0	90.0	99.0	90.0	99.0	90.0	99.0	90.0	0%	0%
Malta	96.0	95.0	96.0	95.0	95.0	99.0	90.0	93.0	-6%	-2%
Netherlands	93.0	89.0	94.0	90.0	94.0	89.0	93.0	90.0	0%	1%
Norway	96.0	93.0	97.0	95.0	97.0	95.0	97.0	95.0	1%	2%
Poland	93.0	92.0	93.0	92.0	80.0	95.0	80.0	95.0	-14%	3%
Portugal	99.0	96.0	99.0	96.0	99.0	95.0	98.0	95.0	-1%	-1%
Romania	90.0	81.0	90.0	76.0	87.0	75.0	86.0	75.0	-4%	-7%
Slovakia	96.0	97.0	96.0	98.0	96.0	98.0	95.0	96.0	-1%	-1%
Slovenia	93.0	94.0	94.0	94.0	94.0	91.0	95.0	91.0	2%	-3%
Spain	98.0	94.0	98.0	94.0	96.0	94.0	95.0	91.0	-3%	-3%
Sweden	97.0	94.0	97.0	93.0	97.0	92.0	97.0	91.0	0%	-3%
EU/EEA**	94.1	89.4	94.4	89.6	93.1	89.7	92.9	89.4	-	-

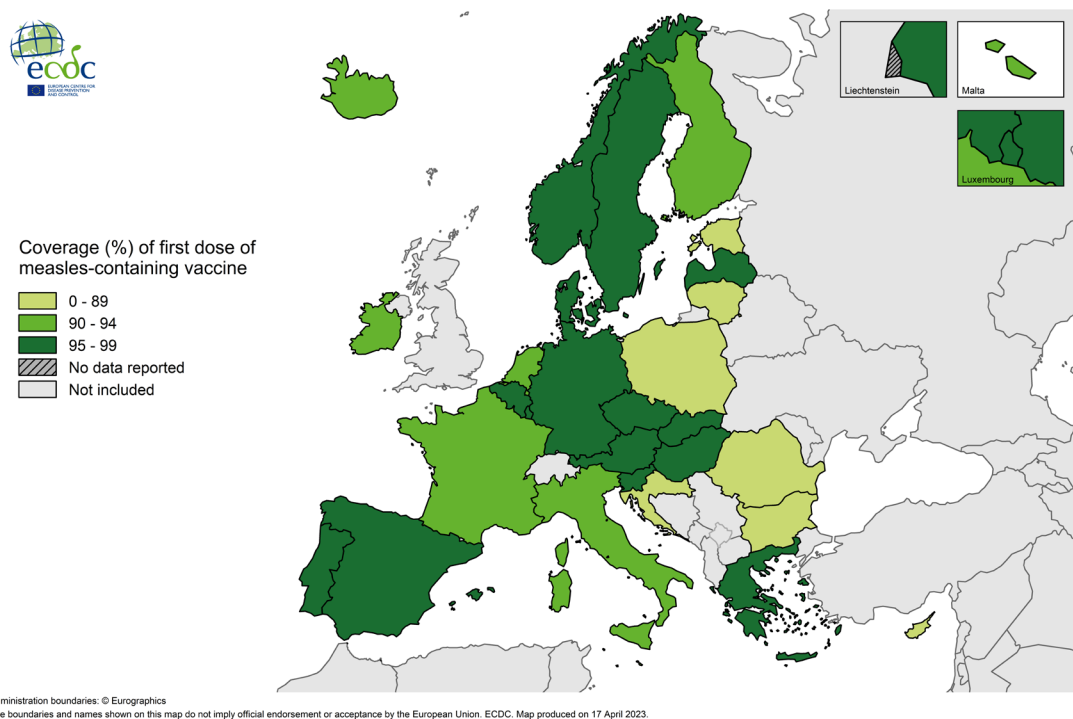
Source: WHO Immunization Data Portal, WHO and UNICEF estimates of national immunization coverage (WUENIC), from Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

ND: no data reported; NR: no rate calculated.

* The percentage of change was calculated for each dose as the percentage of increase or decrease between 2018 and 2021 i.e. $((\text{coverage in 2021} - \text{coverage in 2018}) / \text{coverage in 2018}) \times 100$

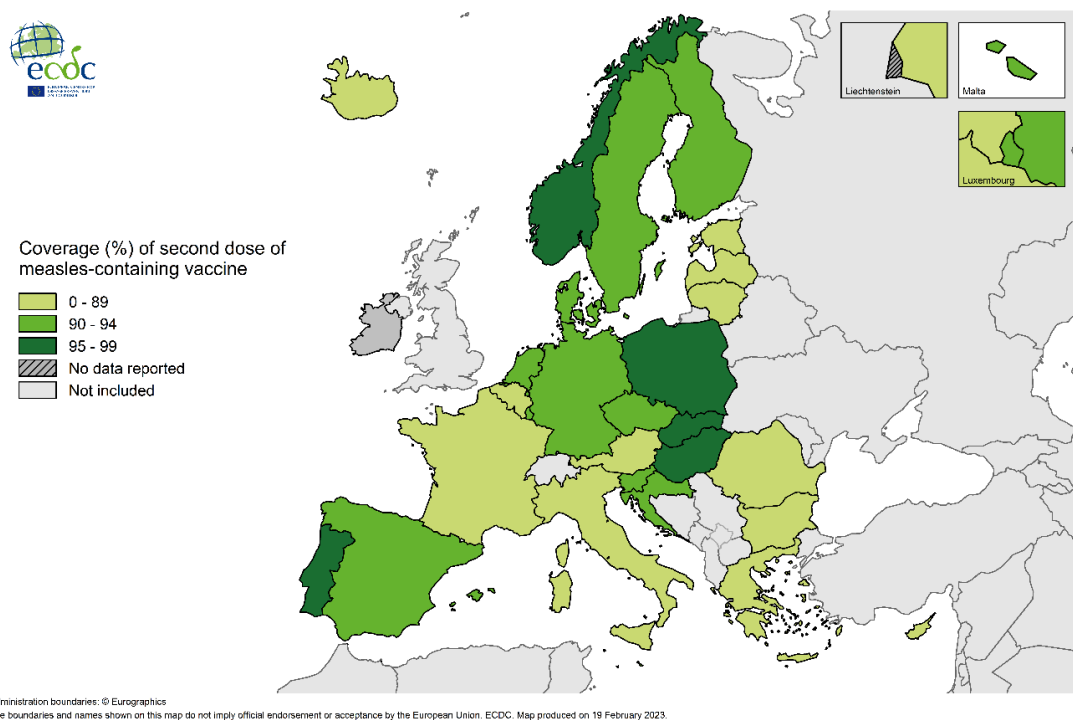
**EU/EEA: population-weighted average vaccination coverage rate

Figure 8. Vaccination coverage for the first dose of a measles-containing-vaccine, EU/EEA, 2021



Source: WHO Immunization Data Portal, WHO and UNICEF estimates of national immunization coverage (WUENIC), from Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

Figure 9. Vaccination coverage for the second dose of a measles-containing-vaccine, EU/EEA, 2021



Source: WHO Immunization Data Portal, WHO and UNICEF estimates of national immunization coverage (WUENIC), from Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

Discussion

Since the beginning of the COVID-19 pandemic in 2020, the level of measles transmission in the EU/EEA has dropped well below the pre-pandemic levels of 2018 and 2019. For 2022, the overall notification rate for the EU/EEA was 0.3 cases per 1 000 000 population, which represents a 99% and 96% decrease, respectively, compared to 2018 and 2019. Only 15 out of the 30 EU/EEA countries reported measles cases, with the notification rate ranging from 0 to 1.6 cases per 1 000 000 population. This also contrasts with previous epidemiology, where the majority of the countries reported at least one case per year.

This substantial decrease in the numbers observed from 2020 onwards, was likely due to the COVID-19 pandemic, which had an effect on epidemiology and transmission for measles, and was observed worldwide [8]. The control measures implemented during the pandemic, such as confinement strategies, closure of schools and stay-at-home directives, resulted in the reduction of social contacts. Consequently, there was a reduction in the transmission of various airborne respiratory diseases, including measles [9, 10, 11, 12]. Moreover, healthcare services had to be reprioritised during the pandemic, possibly affecting both access to healthcare and the diagnosis of measles (by clinicians or laboratories). Lastly, the pandemic was a demanding and challenging period for public health services, with a high workload and shift of focus to the reporting and control of COVID-19. This could have potentially led to the under-reporting of measles from both the clinicians and public health services, thereby, resulting in the under-estimation of measles incidence. Therefore, the reported numbers and observed epidemiology reflected in this report (including the period at the beginning of the COVID-19 pandemic) should be interpreted with caution.

The European Regional Verification Commission for Measles and Rubella Elimination (RVC) recognises that the COVID-19 pandemic has affected measles and rubella elimination and verification activities. During the tenth RVC meeting, it was concluded that 19 EU/EEA Member States provided evidence to demonstrate the elimination of endemic measles, whereas four countries were considered endemic, three countries were considered to have re-established measles transmission, and for two countries, the status is still pending. The RVC recommended that continuous efforts are needed in order to collect higher quality data and have a deeper understanding of measles epidemiology. Moreover, immunisation programmes need to be enhanced and re-prioritised as a vital part of essential health services, taking into account the constraints due to COVID-19 immunisation and response activities [13]. At the meeting of the Strategic Advisory Group of Experts on Immunization (SAGE) in March 2023, it was noted that one of the highest priorities for 2023–2025 was the strengthening of routine immunisation programs (including catch-up programs) for measles and other outbreak-prone diseases [14].

The overall epidemiological profile of measles cases confirms what was observed in previous years. Measles still affects all age groups, but infants below one year of age, remain the group with the highest incidence. Infants are generally too young to be eligible for or protected by direct vaccination and should therefore be protected by herd immunity. A total of 80% of the reported cases between one and four years of age was unvaccinated in 2022. This is the age group in which most EU/EEA countries administer the first measles dose through their national vaccination programmes. A number of countries also administer both the first and second doses between one and four years of age. Reported data for 2022, similar to what was reported in previous years, indicate that despite the fact that current vaccination programmes in the EU/EEA specifically target children in this age group, a number of children are not reached.

Unvaccinated adults continued to be affected in 2022, which serves as a reminder that measles is not only a childhood disease. For the period 2018–2021, 39% of measles cases reported were above the age of 20 years and 73% of these cases were unvaccinated. In 2022, adults aged above 20 years accounted for 26% of the reported cases, and 72% were unvaccinated.

The total number of reported cases was very low for 2022: 33% of the cases were hospitalised, compared to 55% of the cases reported in 2019 [15]. Data should be interpreted with caution due to the low numbers and change of social/healthcare practices during the pandemic.

Measles continued to spread in 2022 and importation of cases between countries was also reported. Although the proportion of imported cases was higher in 2022 compared to previous years, data should be interpreted with caution for the reasons already highlighted above. When the overall vaccination coverage is low, the virus finds its way towards pockets of susceptible populations. Thus, transmission may occur and could lead to extensive outbreaks. Situations in which importations have been contained, even small outbreaks can create a severe burden on the health system in countries that have eliminated measles. Again, this illustrates the importance of maintaining a high-immunisation coverage [16].

The latest WHO estimates of national immunisation coverage show that the overall vaccine coverage estimates, remained within the same levels over the last four years in the EU/EEA. However, only four EU/EEA countries (Hungary, Norway, Portugal, and Slovakia) reported at least 95% vaccination coverage for both the first and second doses of measles-containing-vaccine in 2021, compared to seven countries (Bulgaria, Hungary, Latvia, Malta, Norway, Portugal, and Slovakia) in 2019 (Table 2).

The impact of the COVID-19 pandemic on routine immunisation services should be considered. During the COVID-19 pandemic, the vulnerability of national immunisation programmes was observed globally, with a sharp decline in immunisation coverage during the first quarter of 2020 [17]. One stark example comes from Iceland, where the second dose of measles-containing-vaccine coverage dropped from 95% in 2018 to 10% in 2021, due to the de-prioritisation of MMR administration in schools which resulted out of the need to accommodate COVID-19 vaccinations during that year [18]. However aside from this, within the EU/EEA, the immunisation programs generally appeared to be more resilient. Many countries were able to achieve similar vaccination coverage during 2020 and 2021, to what they reported for 2018 and 2019. The dedication and efforts of healthcare staff rolling out these programmes in the EU/EEA countries should be commended.

However, it is critical to note that even in the pre-pandemic period, very few countries had achieved at least 95% vaccination coverage of the first dose of measles-containing-vaccine; and even fewer achieved at least 95% coverage for the second dose. The number of countries meeting these coverage targets declined further during the pandemic. The observed vaccine coverage estimates highlight that in most countries routine childhood immunisation against measles is below the level recommended to achieve and sustain measles elimination [19]. The recently developed [European Immunization Agenda \(EIA2030\)](#) stressed the importance of building more resilient immunisation systems and structures, based on the key pillars of immunisation equity, life-course immunisation, and tailored local solutions that address vaccination demands and acceptance in the population [17].

During 2017–2019, France (2018), Germany (2019) and Italy (2017) implemented mandatory vaccination policies, mostly through school-based mechanisms. Preliminary results show an increase of vaccination coverage in the groups targeted by these policies. However, further analysis will be needed to confirm the long-term effects of this approach and the impact of other concomitant factors. A recent modelling study underlined that in countries with large immunity gaps, additional measures may be needed for individuals currently not targeted by these programmes in order to interrupt measles circulation [20].

Public health implications

Compared to the years before 2020, since the start of the COVID-19 pandemic and continuing into 2022, low numbers of reported measles cases have been observed in the EU/EEA. The COVID-19 pandemic may have had a positive impact in reducing measles transmission across the EU/EEA, however the impact on vaccination coverage varied by country. Compared with pre-pandemic levels, some countries saw a decline in coverage estimates, some maintained similar coverage, and others reported small improvements. However overall, a majority of EU/EEA countries have not reached or sustained high vaccination coverage of $\geq 95\%$ with two doses of measles-containing-vaccine. Given the sub-optimal vaccination coverage in a number of countries, it is likely that in the future increases in the number of reported cases across the EU/EEA will be observed again. Continuous enhanced epidemiological surveillance and investigation of measles outbreaks are the cornerstones for measles to be controlled and eliminated. In order to strive for the highest coverage, it is critical to include hard-to-reach populations (refugees, immigrants, asylum seekers and Roma populations) in immunisation programmes (including catch-up campaigns). Accelerated efforts to improve immunisation campaigns and increase vaccine acceptance are necessary in order to achieve regional measles elimination targets and sustain a high vaccination coverage of $\geq 95\%$ with two doses of measles-containing-vaccine [17, 21].

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