

GOAL 2: MEET GLOBAL AND REGIONAL ELIMINATION TARGETS: ACHIEVE MEASLES ELIMINATION (Indicator G2.2)

Highlights

- In 2016, 41% and 26% of Member States globally reached the respective MCV1 and MCV2 targets of at least 95% coverage. MCV1 coverage has stagnated at the same level for the past five years. The global MCV1 and MCV2 coverage levels were 85% and 64%, respectively – both short of the programme targets.
- Since 2010, global measles incidence has decreased 62% from 50 cases per million population in 2010 to 19 in 2016. However, only 88% of Member States reported measles surveillance data in 2016 compared to 97% in 2010. The 2016 global measles incidence is substantially higher than the global 2015 target of fewer than 5 cases per million population.
- Between 2000 and 2015¹, estimated measles deaths decreased by 79% (from 651 600 in 2000 to 134 200 in 2015); compared with no measles vaccination, an estimated 20.3 million child deaths were prevented by measles vaccination during this period. However, the target of a 95% mortality reduction by the end of 2015 was not met.
- The 2015 global milestones for MCV1 coverage and measles incidence were still not achieved in 2016. The 2015 goal for measles mortality reduction was not achieved on time either.
- In 2016, 20.8 million infants did not receive the first dose of MCV1. In decreasing order, the following six large Member States had the highest numbers of unvaccinated infants: India, Nigeria, Pakistan, Indonesia, Ethiopia, and the Democratic Republic of the Congo.
- An external mid-term review of the Global Measles and Rubella Strategic Plan 2012–2020 was conducted in 2016 and its findings reported to SAGE in October 2016.
- For Member States with routine measles coverage < 90% nationally (71 Member States in 2016), reaching and sustaining ≥ 95% coverage will require substantial additional investments over a sustained period.

DEFINITION OF INDICATOR	<p>Framework for verification of measles elimination (1) lists the following.</p> <ul style="list-style-type: none"> • Measles eradication: worldwide interruption of measles virus transmission in the presence of a surveillance system that meets specified performance indicators • Measles elimination: the absence of endemic measles transmission in a defined geographical area (e.g. region or country) for ≥12 months in the presence of a well-performing surveillance system <p><i>Note:</i> Verification of measles elimination takes place after 36 months of interrupted endemic measles virus transmission</p>
DATA SOURCES	<ul style="list-style-type: none"> • Joint Reporting Forms (JRFs) for disease incidence and WHO-UNICEF estimates of national immunization coverage (WUENIC) data for coverage rates • Progress reports of the regional verification commissions from the Regions of the Americas, Europe, and the Western

¹ The mortality estimates for 2016 were not available at the time of writing this report.

	Pacific for outbreak data and status of countries with regard to elimination as of 31 December 2016
COMMENTS ON DATA QUALITY	<ul style="list-style-type: none"> • JRFs and WUENIC data are subject to the same limitations as all other data submitted via the JRFs, as described in the 2016 GVAP Secretariat report (2) • Regional verification commission reports are only available from four regions: European Region, Region of the Americas, South-East Asia Region and the Western Pacific Region
MILESTONES	<ul style="list-style-type: none"> • Measles elimination goals by WHO region (3): <ul style="list-style-type: none"> ○ Region of the Americas: last endemic case in 2002 and verified as having eliminated measles in 2016 ○ Western Pacific Region: elimination by 2012 ○ European Region: elimination by 2015 ○ Eastern Mediterranean Region: elimination by 2020 ○ African Region: elimination by 2020 ○ South-East Asia Region: elimination by 2020

Background and progress

The impact of the measles vaccine on global public health has been tremendous. Before 1963, most of the world's population had been infected with measles virus by their 15th birthday, resulting in an estimated 100 million cases and more than 2 million deaths annually (4). By 2000, four decades of steadily increasing use of the vaccine had led to a dramatic reduction in the number of cases to just over half a million annually. In 2016, the Region of the Americas was verified as having eliminated measles.

The sixty-third World Health Assembly in 2010 endorsed three global measles targets for 2015 as milestones towards global eradication of measles;² however, progress in meeting them has been slow.

Between 2010 and 2016, global routine measles vaccine coverage stagnated at 85% – well below the 2015 target of $\geq 90\%$ (**Table 1.4**). Three of the six WHO regions have sustained measles-containing vaccine (MCV1) coverage above 90% (Region of the Americas, European Region and Western Pacific Region), one region achieved coverage between 80 and 90% (South-East Asia Region) and two regions failed to reach 80% coverage (African Region and Eastern Mediterranean Region). The number of Member States achieving the global MCV1 coverage target at the national level has decreased in 2016 as compared to 2010; 123 Member States achieved the $\geq 90\%$ MCV1 national coverage target in 2010 but only 120 achieved the target in 2016³ (**Table 1.4 and Fig. 1.7**). Middle-income countries without GAVI support have MCV1 national coverage rates comparable with high-income countries (94%), see **Table 1.5**.

² The global milestones endorsed are to: 1) exceed 90% coverage with the first dose of MCV nationally and exceed 80% vaccination coverage in every district or equivalent administrative unit; 2) reduce annual measles incidence to fewer than 5 cases per million and maintain that level; 3) reduce measles mortality by 95% or more in comparison with 2000 estimates.

³ It should be noted that the 90% MCV1 coverage target for 2015 is a milestone towards elimination. In order to achieve the regional elimination targets, vaccination coverage needs to be $> 95\%$ for two doses of MCV administered through routine immunization or routine immunization and SIAs. To prevent measles outbreaks, this high level of coverage needs to be achieved uniformly across all districts and across people in all age groups born since the introduction of measles vaccine.

Table 1.4: Number of measles cases and incidence by WHO region, 2014–2016 and baseline 2010

WHO region	WHO-UNICEF estimates for MCV1 national coverage (%)					Percentage of Member States reporting confirmed measles cases in their JRF ^a				Measles incidence per million population					Percentage of Member States with incidence less than 5 per million population				
	2016	2015	2014	2010	% change 2010–2016	2016	2015	2014	2010	2016	2015	2014	2010	% change 2010–2016	2016	2015	2014	2010	% change 2010–2016
African	72	72	72	73	-1	96	98	100	98	37	53	76	232	-84	51	52	51	30	+70
Americas	92	92	92	93	-1	94	97	100	100	0	1	2	0	0	100	97	97	100	0
Eastern Mediterranean	77	75	75	81	-5	86	100	90	90	10	33	29	17	-41	44	38	21	40	-10
European	93	94	94	93	0	85	89	77	98	5	30	19	34	-85	84	72	58	69	+21
South-East Asia	87	86	85	83	5	100	100	91	100	14	25	23	30	-53	27	45	50	36	-25
Western Pacific	96	96	96	96	0	67	63	63	92	31	35	71	27	-15	37	59	35	68	-45
Total	85	85	84	85	0	88	91	87	97	19	29	40	50	-62	69	65	57	60	+15

^a Excludes Antigua and Barbuda, Israel, Kuwait, Monaco, Niue, Nauru, Poland, Portugal, Singapore and Switzerland, which did not report measles data in the JRF.

Source: JRF data, as of 23 June 2017.

Since 2010, global reported measles incidence has decreased by 62% from 50 cases per million population in 2010 to 19 in 2016 with only one region (Region of the Americas) meeting the global 2015 target of fewer than 5 cases per million population (**Table 1.4 and Fig. 1.8**). During the same period, there was a 13.3% increase in the number of Member States (69% of Member States in 2016 compared to 60% Member States in 2010) meeting the global incidence target for 2015.

Between 2000 and 2015, estimated measles deaths decreased by 79% (from 651 600 in 2000 to 134 200 in 2015) and all regions reported substantial reductions in estimated measles mortality. However, the progress since 2010 has been too slow and the target of 95% mortality reduction was not achieved.

Disease burden remains considerable among middle-income countries not supported by GAVI, with an incidence of 12 cases per million population, compared to 3 cases per million population among the high-income countries group (**Table 1.9**). However, 92% of middle-income countries not supported by GAVI had introduced MCV2 by the end of 2016, which helped to boost global coverage of MCV2 to 64% (compared to 39% in 2010) (**Fig. 1.9**). And four additional Member States have introduced a second dose of MCV into their routine immunization programmes since 2015 (to 85% – an increase of 15% of those offering the vaccine in 2010).

An external mid-term review of the Global Measles and Rubella Strategic Plan 2012–2020 was conducted in 2016 (5) and reported its findings to SAGE in October 2016. SAGE endorsed the main recommendations (6). in particular, that the basic strategies in the strategic plan are sound, and that failure to reach global targets is mainly due to lack of country ownership and global political will, as reflected in insufficient resources. SAGE also supported the key recommendations from the mid-term review for strengthening disease surveillance, among other key recommendations shown below.

- Although all six regions have measles elimination goals with the ultimate vision of a world free of measles, it is premature to set a date for eradication at this point.
- Strengthening immunization systems is critical to achieving regional elimination goals. Working to achieve measles and rubella elimination can help strengthen health systems in general and immunization systems in particular.
- The report recommends a shift from primary reliance on supplementary immunization activities (SIAs) to routine immunization services to assure two doses of MCV are delivered to the target population. Regular high-quality SIAs will still be necessary while routine immunization services are being strengthened.
- The report recommends that the measles/rubella vaccination programme be considered an indicator for the quality of the overall immunization programme and that measles/rubella incidence and measles and rubella vaccination coverage be considered as primary indicators of immunization programme performance.

In October 2016, SAGE removed the introduction criterion for the routine administration of MCV2 stressing that the addition of MCV2 in the second year of life reduces the accumulation of susceptible children by immunizing those who did not respond to MCV1 or did not receive the first dose. This measure has the further advantages of potentially lengthening the period between campaigns, helping to establish a routine visit during the second year of life to ensure the well-being of the child, and reducing the risk of outbreaks.

Among countries that provide MCV2 to infants less than 2 years of age *and* have reported coverage both for MCV1 and MCV2, the difference between MCV1 and MCV2 has gradually declined: 15% drop out in 2014; 14% drop out in 2015; 11% drop out in 2016.⁴ Although progress is being made to reduce the MCV1

⁴ For each calculation year, countries that had not introduced the vaccine for one full year were excluded.

to MCV2 coverage gap, the data highlight the missed opportunities and routine system weaknesses that contribute to suboptimal population immunity and the inability to interrupt measles virus transmission.

Many countries regularly supplement routine efforts through the use of SIAs. In 2016, 39 preventive SIAs vaccinated more than 119 million children in 24 Member States, with six of those (25%) providing one or more additional child health interventions during the SIA. Coverage was reported as $\geq 95\%$ in 56% of the 39 SIAs conducted in 2016 (based on doses administered); however, among the eight countries conducting post-SIA coverage surveys in 2016, only three estimated coverage at $\geq 95\%$.

Given these gaps in coverage and population immunity, it is not surprising that outbreaks continue to threaten the achievement and sustainability of regional elimination goals.

Regional review

In the African Region, eight countries (Congo, the Democratic Republic of the Congo, Equatorial Guinea, Ethiopia, Gabon, Liberia, Nigeria, South Sudan) experienced quite high incidence of measles in 2016. The highest was documented in Equatorial Guinea, with incidence rates of 1881 per million population, while Nigeria reported the largest number of confirmed measles with 17 136 measles cases. Outbreaks are mainly the result of suboptimal MCV1 coverage levels, poor-quality SIAs in many countries and epidemiological susceptibility to measles in older age children and adolescents. In Nigeria in particular, it was noted that the incidence was 112 per million in the Northern States, while it was 2.8 in the Southern States. On the other hand, the age-specific incidence of measles in the Northern States was 527 per million in the under-5 age group, and 152 per million in the 5–9 years age group, indicating the large immunity gaps persisting into school age.

During the Pan American Health Organization's (PAHO) 55th Directing Council on 27 September 2016, the International Expert Committee for Documenting and Verifying Measles and Rubella Elimination announced that after reviewing all of the epidemiological evidence presented by the Member States for the period 2011–2016, the Region of the Americas had eliminated measles. The Region reached the goal of eliminating endemic transmission of the measles virus in 2002 and has maintained this status for over a decade, despite constant importations of the virus from other regions in the world. However, maintaining the status in an increasingly interconnected world will be an ongoing challenge in the coming years because countries are constantly at risk of importing and reintroducing the viruses and thus undoing the progress they have made. During 2016, 93 confirmed cases of measles were reported in three countries of the Region of the Americas, reaching the lowest incidence rate in the history of the Americas (0.093 per million population). However, in that same year, there was a significant decrease in the reporting rate of suspected cases, reaching its lowest point with 1.9 per 100 000 population. The confirmed measles cases were reported in Canada (11 cases), Ecuador (1 case) and the United States (80 cases, not reported through the JRF). Thirty per cent of the cases affected adults aged 20–39 years old. Four countries conducted follow-up campaigns during 2016, achieving between 94–99% of coverage nationwide.

PAHO will propose a plan of action at the next Pan American Sanitary Conference to guarantee the sustainability of measles and rubella elimination during the period 2018–2023. The plan's objective is to maintain a high level of immunity against these viruses in the general population and maintain high-quality surveillance systems to avoid the re-establishment of endemic transmission.

The Eastern Mediterranean Region has seen a significant decrease in the reported numbers of cases in 2016 (6139 cases) compared to 2015 (21 418 cases). In 2016, outbreaks occurred in Afghanistan, Pakistan, Sudan and Yemen. The majority of the reported outbreaks affected children under 10 years of age, indicating poor implementation of routine vaccination and poor quality of SIAs.

In the European Region, 2016 saw the lowest number of measles cases in the Region (4167 cases) reported in 45 countries that submitted measles data (including zero reporting) through the JRF. However, transmission and outbreaks continued in a number of countries. Romania and Italy had the most cases (64%) and the highest incidence of the disease. The majority of the reported cases in 2016 were of unvaccinated people. One third of the cases were among children aged 1–4 years.

The South-East Asia Region has made significant progress towards measles elimination in 2016. Countries of the Region have initiated implementation of activities outlined in the Strategic Plan for Measles Elimination and Rubella and Congenital Rubella Syndrome Control in the South-East Asia Region⁵. India continued to report the most cases (17 250) of measles followed by Indonesia (6962), of the 82 006 cases reported in the South-East Asia Region overall. In 2016, the measles virus continued to circulate in most countries of the Region, except in Bhutan, the Democratic People's Republic of Korea and the Maldives. (While 45 cases were reported in Bhutan in 2016, these were attributed to importations, based on epidemiological and virological investigations.) While the completeness and quality of investigations of suspect cases varied among countries, it is clear that the main cause of continued measles cases in most countries of the Region was low coverage with measles vaccine, despite two doses of MCV being a part of the routine schedule in all 11 countries of the Region. Coverage with MCV1 in routine immunization has increased to 87% in 2016. However, nearly 4.5 million children remain unvaccinated with MCV annually (2.9 million in India and 1.2 million in Indonesia). Around 6.8 million children were reached with measles/rubella-containing vaccine (M/RCV) in 2016 through mass-vaccination campaigns. Phased, wide-age range, mass-vaccination campaigns with measles-rubella vaccine are planned for India and Indonesia during 2017–2018, targeting more than 470 million children aged 9 months to 15 years. Approximately 3260 suspected outbreaks were reported in the Region in 2016, 63% of which were investigated (compared to 57% investigated in 2015). All countries investigated 100% of the reported outbreaks except India (55%) and Indonesia (70%). The measles rubella laboratory network in the Region has expanded from 23 laboratories in 2012 to 39 WHO-accredited laboratories in 2016, with an additional six laboratories foreseen to join the network in 2017. Nearly 35 000 samples were tested by the network in 2016.

Following a historically low level of measles transmission in 2012, the Western Pacific Region has experienced a resurgence of measles in 2013–2016. Measles incidence, however, started to decline after 2014 (**Table 1.4**). In 2016, 57 879 measles cases including confirmed and compatible cases were reported. Of these, 30 273 cases (52%) were from Mongolia and 24 820 cases (43%) were from China. In September 2016, 28 countries or areas in the Region were verified by the (measles) regional verification commission (RVC) to have interrupted endemic measles virus transmission for at least 36 months.

These events illustrate the need for sustained efforts to raise and maintain high levels of immunization coverage even in areas where elimination-level control has previously been attained. Every opportunity to address system bottlenecks and to increase routine immunization coverage should be seized. The introduction of a routine second dose of MCV and SIAs provide such opportunities. For example, SIAs have been shown to contribute to strengthening the routine immunization programme through improving several aspects including health-worker skills and knowledge, social mobilization, cold chain and logistics and integration of other public health interventions (7,8). The establishment of RVCs for measles elimination and their corresponding national verification committees (NVCs) has helped to refine the understanding of the barriers to elimination and build stronger national commitment to achieving elimination goals (**Table 1.5**).

Regional verification commissions

⁵ Strategic plan for Measles Elimination and Rubella and Congenital Rubella Syndrome Control in the South-East Asia Region 2014–2020:

http://www.searo.who.int/entity/immunization/documents/sear_mr_strategic_plan_2014_2020.pdf

The Region of the Americas has the longest standing RVC. In September 2016, the regional verification commission in the Americas Region declared the Region free of endemic Measles (**Table 1.6**) (9).

At the Western Pacific Region RVC meeting in 2016 (**Table 1.7**), Australia, Brunei Darussalam, Cambodia, China, Hong Kong Special Administrative Region (SAR), China, Macao SAR, Japan and the Republic of Korea were verified as having achieved or sustained measles elimination based on a verification-standard epidemiological surveillance system supported by accredited laboratories.

In the European Region (**Table 1.8**), 51 of 53 Member States have established NVCs and at the RVC meeting in October 2016, 24 (45%) Member States were documented to have interrupted endemic measles transmission for more than 36 months.

In the Eastern Mediterranean Region, a regional verification guide was drafted but no RVC has yet been established. However, NVCs were established in 9 of 22 Member States. Three countries or areas in the region (Bahrain, Oman and the West Bank and Gaza Strip) are ready for verification once the RVC is established.

The South-East Asia Region has established an RVC and the framework for verification of measles and control of rubella/CRS has been finalized in 2016. In 2017, the RVC has verified two countries as having eliminated measles (Bhutan and the Maldives).

In 2016, the African Region has started the process of establishing the RVC and the first RVC meeting is scheduled for 2017. Compared to 2015, there has been some progress globally in terms of the number of regions with RVCs and significant progress in the number of Member States that have established NVCs, particularly in the South-East Asia Region.

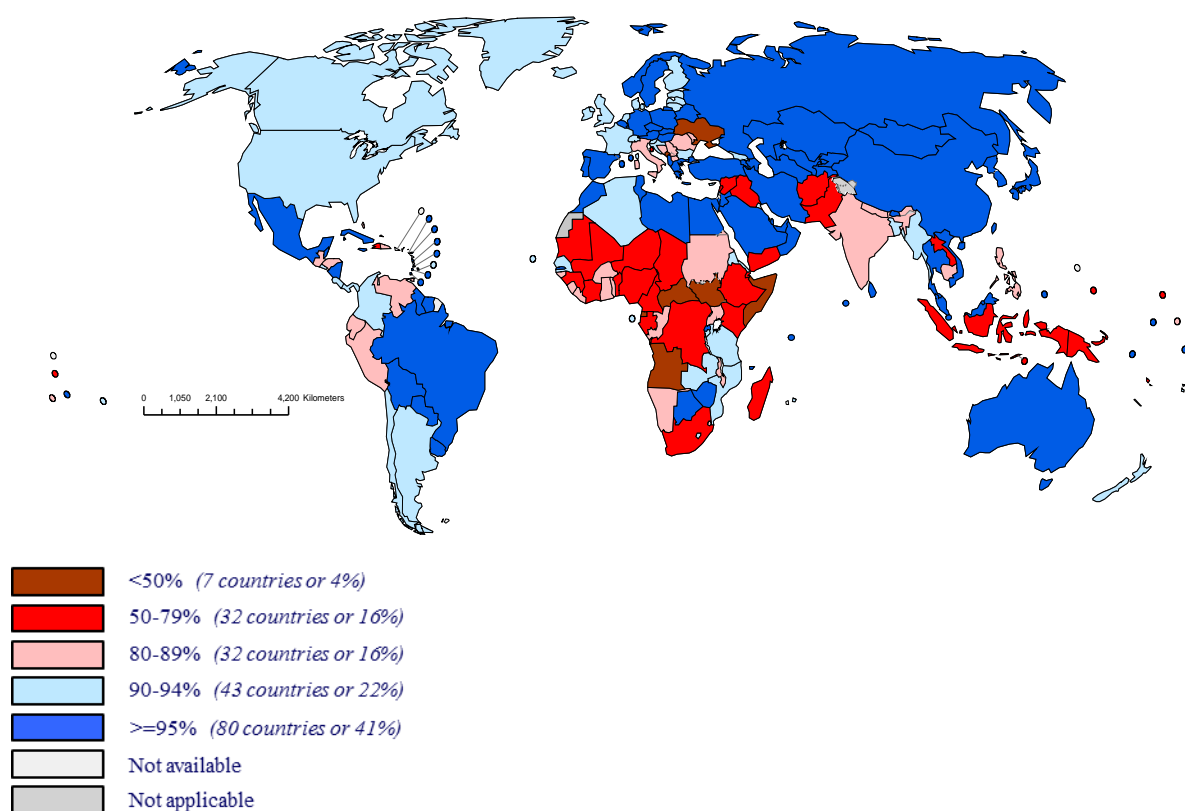
Conclusion

The year 2016 has seen some improvement in global measles incidence, in the proportion of countries achieving the global 2015 incidence targets, in MCV2 coverage levels (**Figure 1.9**) and in the number of RVCs and NVCs established. However, coverage with MCV1 has remained stagnant and major outbreaks continue to occur in five of the six WHO regions. Many of the outbreaks are affecting school-aged children and adults making it more challenging for countries to close the immunity gaps and prevent outbreaks. The 2015 global targets and remaining regional targets remain off track.

In decreasing order, the following six large Member States had the highest number of infants that did not receive the first dose of MCV1 in 2016: India, Nigeria, Pakistan, Indonesia, Ethiopia, and the Democratic Republic of the Congo (**Fig. 1.10**). For these countries, one could highlight the importance of strengthening health systems to achieve higher immunization coverage. Routine MCV1 coverage in these countries has either shown little progress or has declined since 2010, and the reported measles incidence remains high. In addition, discrepancies between administrative data and survey data on immunization coverage, particularly for SIAs, remain a problem. Immunization coverage reported from administrative sources is often much higher than the coverage reported from surveys.

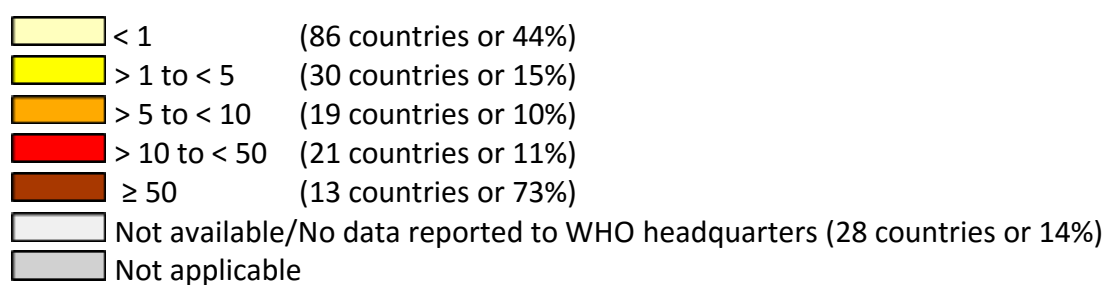
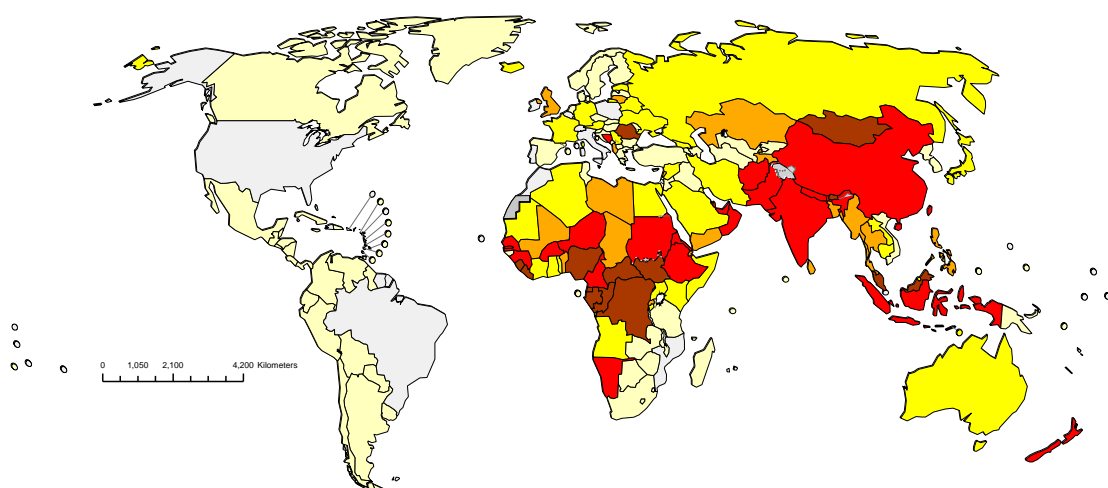
Measles is a highly infectious disease, and its elimination requires very high and homogeneous population immunity and a high-quality surveillance system. Without a robust routine programme, elimination is very difficult to achieve and cannot be sustained. For Member States that are now at < 90% coverage nationally, reaching $\geq 95\%$ coverage will require substantial additional investments over a sustained period. The gap between MCV1 and MCV2 coverage highlights the missed opportunities and routine system weaknesses that contribute to suboptimal population immunity and the inability to interrupt measles virus transmission.

Fig. 1.7. Immunization coverage (%) with first dose of MCV1 in infants per country, 2016



Source: WHO-UNICEF coverage estimates 2016 revision, July 2017.

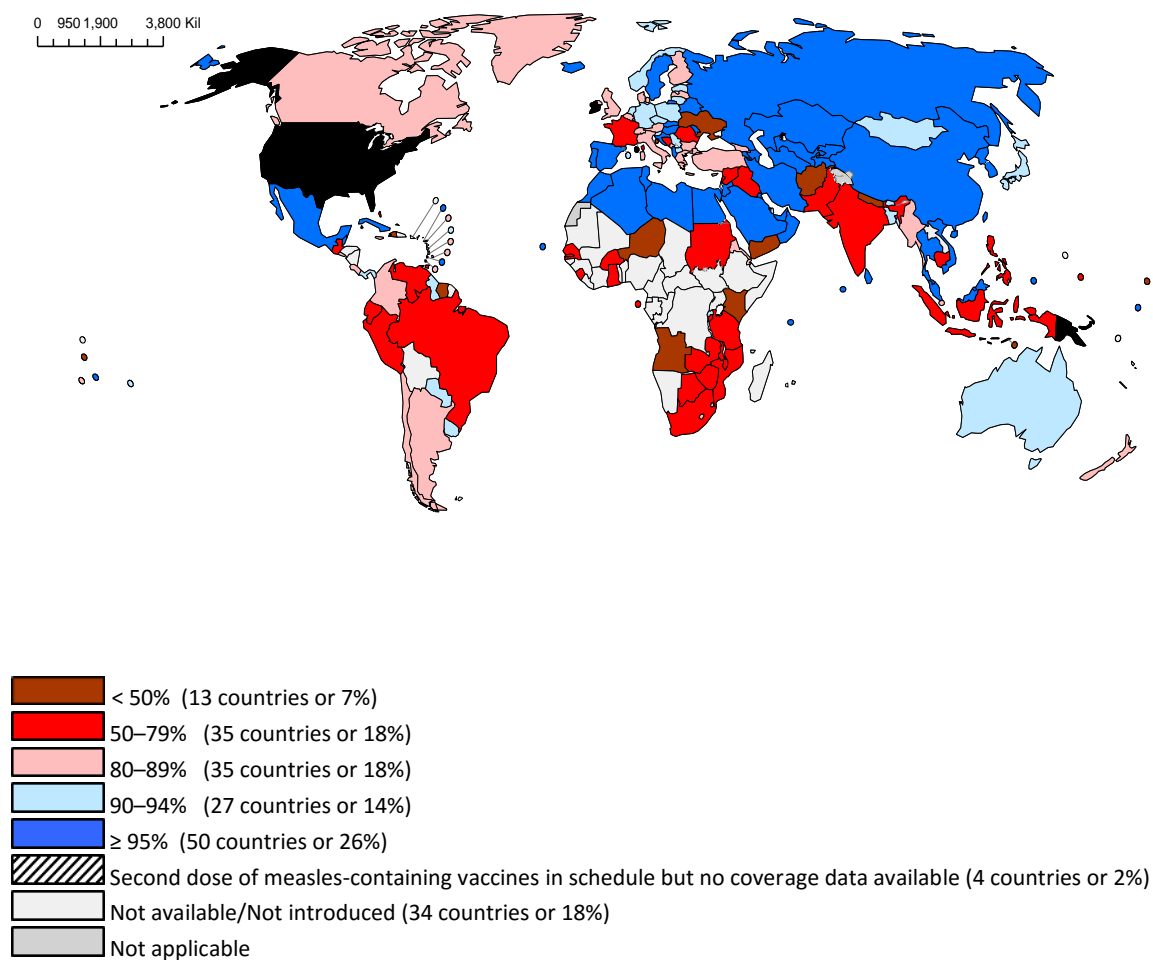
Fig.1.8. Reported measles incidence rate^a per country, 2016



^a Per million population

Source: JRF data, as of 23 June 2017.

Fig. 1.9: Immunization coverage with routine MCV2 by national schedule for infants, 2016



Source: WHO-UNICEF coverage estimates, 2016 revision.

Table 1.5: Progress towards measles elimination, by WHO region (as of 31 December 2016)

WHO region	Target year for measles elimination in region	RVC established	Regional measles elimination verification report provided for 2015 and 2016 data	Member States that have established an NVC <i>n</i> (% of total)	Established NVCs that submitted annual reports <i>n</i> (% of total) ^a	Member States that were verified free of endemic measles based on 2016 reporting <i>n</i> (% of total) ^b
African	2020	No	No	None	Not applicable	Not applicable
Americas ^e	2000	Yes	Yes	24 (100%)	24 (100%)	44/44 (100%)
Eastern Mediterranean	2020	No	No	9 (43%)	Not applicable	Not applicable
European	2015	Yes	Yes	51 (96%)	51 (100%)	24(79%) ^c
South-East Asia	2020	Yes	Yes	11 (100%)	11 (100%)	2 (18%)
Western Pacific	2012	Yes	Yes	27 ^d (100)	17 (100) ^d	7 ^f (26%)

a Percentage represents the total number of established NVCs, not the total number of Member States.

b Percentage represents the total number of Member States, not the total number of established NVCs.

^c 24 of these countries were verified as having been free of endemic measles for 36 months or longer. An additional 13 were documented to have interrupted endemic measles transmission for at least 12 months. As of September 2017, 33 of these countries were verified as having been free of endemic measles for 36 months or longer. An additional, and the other 9 were documented to have interrupted endemic measles transmission for at least 12 months.

^d 13 Pacific Island countries formed one joint subregional verification committee (they are: Cook Islands, Fiji, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, Niue, Palau, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu). China, Hong Kong SAR and Macao SAR established their own Committees in addition to the Chinese NVC. There are a total of 16 NVCs and 1 SRVC for the 27 Member States in the Western Pacific Region.

^e Countries in the Americas are not providing annual reports to NVCs as both measles and rubella have been eliminated. In 2016, 22 of 24 NVCs submitted (for the second time) verification reports with 2012–2015 data.

^f In September 2016, 7 countries or areas were verified as having achieved or sustained measles elimination: Australia, Brunei Darussalam, Cambodia, China, Hong Kong, SAR, China, Macao SAR, Japan and the Republic of Korea.

Table 1.6: Progress towards measles elimination in the Region of the Americas (as of 31 December 2016)

Status according to Pan American Health Organization (PAHO) Region definitions ^a	Number of countries/territories n (% of total)	Countries/territories
Measles elimination verified	44 (100)	35 countries + 6 British Overseas Territories + 3 Netherland Antilles

^a Pan American Health Organization (PAHO) Region definitions:

- Measles elimination verified: Verify interruption of endemic measles, rubella and congenital rubella syndrome cases in all countries of the Americas for a period of at least 3 years from the last known endemic case, in the presence of high-quality surveillance.
- Interrupted endemic transmission for ≥ 12 months: Absence of endemic measles transmission for a period equal or greater than 12 months, in the presence of a well-performing surveillance system.

Table 1.7: Progress towards measles elimination in the Western Pacific Region (as of 31 December 2016)

Status according to Western Pacific Region definitions ^a	Number of countries <i>n</i> (% of total)	Countries or areas
Elimination verified	7 (26%)	Australia, Brunei Darussalam, Cambodia, China, Hong Kong SAR, China, Macao SAR, Japan, Republic of Korea
Possibly ready for verification, but additional data required	3 (11%)	New Zealand, Singapore, Pacific islands subregion
Does not yet fulfil the criteria for verified elimination	6 (22%)	China ^b , Lao People's Democratic Republic, Malaysia, Papua New Guinea, Philippines, Viet Nam

^a Western Pacific Region definitions:

- Elimination verified: The interruption of endemic measles virus transmission for ≥ 36 months in the presence of verification-standard surveillance and genotyping evidence that supports the interruption of endemic measles virus transmission. Australia, China, Macao SAR, Mongolia and the Republic of Korea were verified again in March 2015 (as well as in March 2014) as having interrupted measles virus transmission for more than 3 + 1 years. Brunei Darussalam, Cambodia and Japan were verified in March 2015 as having interrupted measles virus transmission for more than 3 years. Note: During the 2016 RVC meeting, it was confirmed that the measles outbreak in Mongolia that started in March 2015 and lasted until June 2016 was from endemic transmission of an H1 virus that had re-established itself in Mongolia.
- Possibly ready for verification, additional data required: After reviewing the first reports prepared by the NVCs, the RVC determined that interruption may have been achieved, but more detailed epidemiological data were needed to verify measles elimination.
- Endemic transmission: The existence of continuous transmission of indigenous or imported measles virus that persists for ≥ 12 months in the nation.

^b Data apply to all parts of China excluding China, Hong Kong SAR and China, Macao SAR.

Table 1.8: Progress towards measles elimination in the European Region (as of 31 December 2016)*

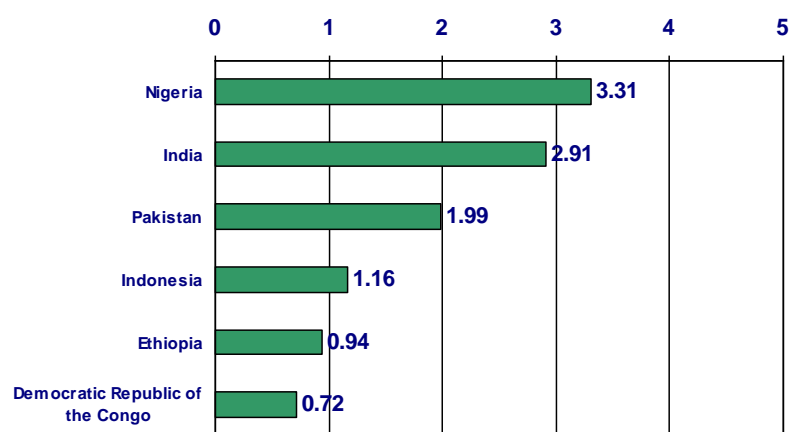
Status using European Region definitions^a	Number of countries n (% of total)	Countries or areas
Interrupted endemic transmission for ≥ 36 months	24 (45)	Albania, Andorra, Armenia, Azerbaijan, Belarus, Bulgaria, Cyprus, Czech Republic, Estonia, Finland, Hungary, Israel, Latvia, Luxembourg, Malta, Netherlands, Norway, Portugal, Republic of Moldova, Slovakia, Slovenia, Sweden, Tajikistan, Turkmenistan
Interrupted endemic transmission for ≥ 12 months but < 36 months	13 (25)	Austria, Croatia, Denmark, Greece, Iceland, Ireland, Lithuania, Montenegro, Russian Federation, Spain, The former Yugoslav Republic of Macedonia, United Kingdom of Great Britain and Northern Ireland, Uzbekistan
Endemic transmission	14 (26)	Belgium, Bosnia and Herzegovina, France, Georgia, Germany, Italy, Kazakhstan, Kyrgyzstan, Poland, Romania, Serbia, Switzerland, Turkey, Ukraine
No report submitted	2 (4)	Monaco, San Marino

^a European Region definitions:

- Interrupted endemic transmission for ≥ 36 months: Absence of endemic measles transmission from 2012–2014 in the presence of a well-performing surveillance system.
- Interrupted endemic transmission for ≥ 12 months but < 36 months: Absence of endemic measles transmission at least in 2014 in the presence of a well-performing surveillance system.
- Endemic transmission: Continuous transmission of indigenous or imported measles virus that has persisted for a period of 12 months or more in the Member State. (Note: this definition differs from that stated in the WHO Weekly Epidemiological Record.)
- No report submitted: Not available because the country does not have a functioning NVC or failed to submit the annual status report.

* As of September 2017, 33 of these countries were verified as having been free of endemic measles for 36 months or longer. An additional 9 countries were documented to have interrupted endemic measles transmission for at least 12 months.

Fig. 1.10: Countries with the largest numbers of infants unvaccinated with MCV1, in millions, 2016



Source: WHO-UNICEF coverage estimates 2016 revision.

Table 1.9: MCV1 coverage and measles incidence per million population by income category and Gavi Alliance support, 2010–2016

Income group and GAVI support	WHO-UNICEF estimates for MCV1 national coverage (%)					Percentage of Member States reporting confirmed measles cases in their JRF				Measles incidence per million population					Percentage of Member States with incidence less than 5 per million population				
	2016	2015	2014	2010	% change 2010–2016	2016	2015	2014	2010	2016	2015	2014	2010	% change 2010–2016	2016	2015	2014	2010	% change 2010–2016
Gavi-supported countries	78	78	78	78	0	97	99	96	99	28	46	47	81	65	54	51	50	40	33
Middle-income countries w/o GAVI support	94	94	93	95	1	90	86	87	97	12	20	46	32	59	75	70	65	72	4
High-income countries	94	94	94	93	-1	75	89	79	96	3	4	5	8	63	86	78	59	72	19
Total	85	85	84	85	0	88	91	87	97	19	29	40	50	62	68	65	57	60	15

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GOAL 2: MEET GLOBAL AND REGIONAL ELIMINATION TARGETS: ACHIEVE RUBELLA AND CONGENITAL RUBELLA SYNDROME ELIMINATION

(Indicator G2.3)

Highlights

- The number of countries using rubella-containing vaccine (RCV) in their national programme continues to steadily increase. As of December 2016, 152 Member States had introduced rubella vaccines; coverage, however, varies from 13% to 96% depending on the region. Only 42 Member States had not introduced RCV into their routine immunization programme.
- An external mid-term review of the Global Measles and Rubella Strategic Plan 2012–2020 (1) was conducted in 2016 and its findings reported to SAGE in October 2016. SAGE endorsed the main recommendations of the review, including the following.
 - The incorporation of rubella vaccination into the immunization programme needs to be accelerated – it should be accorded equivalent emphasis as measles.
 - Congenital Rubella Syndrome (CRS) surveillance should be implemented either at sentinel or national level, especially in countries using measles–rubella vaccine (MR).
- Two WHO regions (the African Region and the Eastern Mediterranean Region) still do not have rubella elimination or control targets.
- Rubella and CRS surveillance systems are weak and cases remain underreported, particularly in Member States that have not yet introduced RCV and/or do not have rubella control or elimination goals. Hence, global rubella and CRS surveillance data do not reflect the true burden of these diseases.
- Failure to fully integrate prevention of rubella and CRS with measles elimination activities represents a major missed opportunity for immunization and integrated disease surveillance.

DEFINITION OF INDICATOR	<ul style="list-style-type: none"> Rubella and CRS elimination: The absence of endemic rubella virus transmission in a defined geographical area (e.g. region or country) for ≥ 12 months and the absence of CRS cases associated with endemic transmission in the presence of a well-performing surveillance system <p><i>Note 1:</i> There may be a time lag (up to 9 months) in occurrence of CRS cases after interruption of rubella virus transmission has occurred. Evidence of the absence of continuing rubella transmission from CRS cases is needed because CRS cases excrete rubella virus for up to 12 months after birth</p> <p><i>Note 2:</i> Verification of rubella elimination takes place after 36 months of interrupted rubella virus transmission</p>
DATA SOURCES	<ul style="list-style-type: none"> WHO-UNICEF Joint Reporting Forms (JRFs) for disease incidence and WHO-UNICEF Estimates of National Immunization Coverage (WUENIC) data for coverage rates are subject to the same limitations as all other data submitted via the JRFs, as described in the 2013 report of the GVAP Secretariat (2) Coverage estimates for the first dose of rubella-containing vaccine are based on WHO and UNICEF estimates of coverage of measles-containing vaccine
COMMENTS ON DATA QUALITY	<ul style="list-style-type: none"> None
MILESTONES	<ul style="list-style-type: none"> Americas: Rubella eliminated in 2009 and the International Expert Committee for Measles and Rubella Elimination verified the Region as rubella and CRS free in April 2015 European: Rubella elimination by 2015 Western Pacific: Rubella elimination pledged but no target date set South-East Asia: Rubella control by 2020 African: No target Eastern Mediterranean: No target

Background and progress

As of December 2016, 152 (78%) Member States had introduced RCV, with 42 Member States yet to introduce the vaccine. Average coverage globally has steadily increased from 35% in 2010 to 47% in 2016; coverage, however, varies from 13% in the African Region to 96% in the Western Pacific Region⁶ (**Table 1.10**). In 2017 an additional 16 countries will introduce rubella vaccine into their routine schedules after having completed MR catch-up campaigns.

In 2016, the global incidence of rubella was estimated to be 4.03 per million population (reported by 163 (84%) Member States, (**Table 1.10 and Fig. 1.11**). Rubella surveillance is weak in many countries, especially among the countries that have not yet introduced the vaccine. Further, the total number of Member

⁶ Calculation of coverage takes into account all birth cohorts regardless of the introduction status of RCV.

States reporting rubella incidence to WHO has decreased since 2010 (170 Member States (88%), which may also partly explain the decreasing reported incidence (**Table 1.10**).

In total, the number of Member States that reported CRS figures in 2016 (122, 63%) has remained basically the same since 2015 (128, 66%) (**Table 1.11**). The very low reported global incidence is probably more a sign of the lack of/weak CRS surveillance systems outside the Americas and Europe, so the true global burden of disease is unknown. Encouragingly, a growing number of Member States outside these two regions are establishing CRS surveillance systems.

Regional review

The Region of the Americas achieved rubella and congenital rubella syndrome elimination in 2009; the last endemic rubella case was reported in 2009 in Buenos Aires, Argentina and the last endemic CRS case was reported in 2009 in Brazil. In 2015, the Region was verified as having eliminated rubella and CRS. In 2016, two rubella cases were confirmed in Canada and the United States respectively. Genotype 2B was identified in the rubella case reported by the United States, likely imported from India. No genotype was identified in the case reported by Canada. In 2016, the United States reported 2 confirmed CRS cases of one female and one male born in the states of Illinois and Maryland respectively. The mothers of these two cases are from Nigeria and Pakistan; genotypes 1G and 2B were identified.

Fifty-two of the Member States in the European Region use the combined measles–mumps–rubella vaccine (MMR), while Tajikistan is using MR vaccine in a two-dose schedule. Based on JRF data, the number of rubella cases reported in the region dropped by 97% between 2010 ($n=10\,551$) and 2016 ($n=358$). Twenty-four Member States (45%) were verified as having eliminated rubella in 2016. In addition, 11 Member States (21%) had interrupted rubella transmission for more than 12 months but less than 36 (3). In 2016, most of the rubella cases occurred in Poland even though no cases were reported on the JRF. Countries that reported cases through the JRF in 2016 included the Ukraine ($n=150$) and Germany ($n=95$).

In 2014, the Regional Committee for the Western Pacific endorsed the Regional Framework for Implementation of the Global Vaccine Action Plan in the Western Pacific Region and its specified immunization goals, including the regional rubella elimination goal (target date to be determined). The number of reported rubella cases has been declining in the Western Pacific Region since 2011 (from 76 022 in 2011 to 5446 in 2016) with the majority of cases being reported from China, Viet Nam, Japan and the Philippines. Reported CRS cases in the Region have increased since 2015 (5 in 2015 and 19 cases in 2016) with most cases being reported from Viet Nam (4 in 2015 and 18 in 2016, respectively). Very few countries in the Region have established CRS surveillance.

The South-East Asia Region has made significant progress towards rubella and CRS control. RCV has been introduced in eight of 11 Member States. Of the remaining three Member States, India and Indonesia have started to introduce RCV in 2017, while the Democratic People's Republic of Korea is yet to finalize a plan to introduce rubella vaccine in routine immunization. In 2016, 10 361 confirmed cases of rubella were reported. India continued to report the most confirmed cases (8274), followed by Indonesia (1238) and Nepal (656). Surveillance for CRS only started as a WHO-supported activity after the September 2013 Regional Committee resolution. Eight of the 11 Member States have initiated sentinel site CRS surveillance; the other three conduct CRS surveillance as part of an integrated disease surveillance programme. A total of 319 confirmed cases of CRS were reported in 2016 with Indonesia reporting the highest number (174) followed by Bangladesh (87) Nepal (33) and India (25).

Although the Eastern Mediterranean Region has not yet set a rubella elimination goal, 13 countries (60%) have set a national target for rubella/CRS elimination and 11 countries are now implementing CRS surveillance. In 2016, 1981 confirmed cases of rubella were reported by the countries of the Eastern Mediterranean Region. The majority of these (90%) were reported from three countries (Sudan 996), Pakistan (648) and the United Arab Emirates (132), two of which (Sudan and Pakistan) have not yet introduced RCV. So far, only one of the six countries eligible for GAVI support (Yemen) has benefited from GAVI support to conduct SIAs of RCV with introduction completed in 2015.

The African Region does not yet have a rubella elimination target. However, countries are being supported to use the opportunity of the implementation of measles elimination strategies to address rubella and CRS. In 2016, the Region reported 4157 rubella cases through the JRF. As of December 2016, nine countries have introduced RCV in their routine immunization schedules. In 2017, an additional 14 Member States⁷ will introduce rubella vaccine into their routine schedules after having completed MR catch-up campaigns.

Conclusion

A new phase of accelerated rubella control and CRS prevention has begun, marked by a 2011 WHO position paper, which recommended a strategy consistent with rubella and CRS elimination (4), the inclusion of rubella elimination in five WHO regions by 2020 as a disease control target in the Global Vaccine Action Plan (2012), and GAVI support for the introduction of rubella vaccine in countries meeting the eligibility criteria. As All WHO regions have measles elimination goals, in countries that meet the rubella introduction criteria, it would be a missed opportunity not to include rubella elimination as a disease target. This is because, rubella and measles elimination use similar strategies, rubella vaccine is combined with measles vaccine (as MR/MMR or MMRV), and fever and maculopapular rash surveillance is used for the detection of both measles and rubella.

Figures 1.12 and 1.13 describe the global and regional rubella vaccine coverage rates. The coverage with RCV increases with increasing income; the lowest coverage is reported in countries eligible for GAVI support, but these countries have made the most progress since 2010. This is largely attributed to the increased numbers of these countries that have introduced the vaccine since 2010 (**Table 1.12**).

Several key challenges remain.

- Building support for additional regions to adopt elimination goals. This includes ensuring that all Member States can achieve and maintain the minimum coverage ($\geq 80\%$) through routine services and/or in SIAs required for introduction of RCV.
- Advocating for resources and a secure vaccine supply needed to meet the European Region's elimination goal.
- Ensuring high routine coverage ($\geq 95\%$) of RCV1 and RCV2 (the same figure used for measles coverage is used here because RCV is bundled with MCV as MR or MMR).
- Ensuring high-quality MR SIAs that reach at least 95% of targeted children, as verified through surveys.
- Strengthening synergies between rubella and measles surveillance and expanding CRS surveillance – commitment at all levels of government as well as involvement of the private sector is needed to address these challenges.

⁷ Angola, Benin, Botswana, Burundi, Congo, Cote d'Ivoire, Kenya, Lesotho, Malawi, Mauritania, Mozambique, Namibia, Swaziland and Zambia.

For countries eligible for Gavi support, the challenge is in capitalizing on the available resources for RCV introduction while ensuring sufficient political and financial commitment to assure the sustainability of the programme.

Financial support from GAVI together with the leadership, coordination and technical expertise from the Measles & Rubella Initiative, provide an opportunity for Member States and regions to accelerate progress in rubella control and CRS prevention. Rubella elimination has been achieved and verified in the Americas and the European Region is the next region closest to achieving rubella elimination. Substantially greater commitment and investment by Member States and the global immunization community will be required to reach the GVAP target of rubella elimination in five WHO regions by 2020.

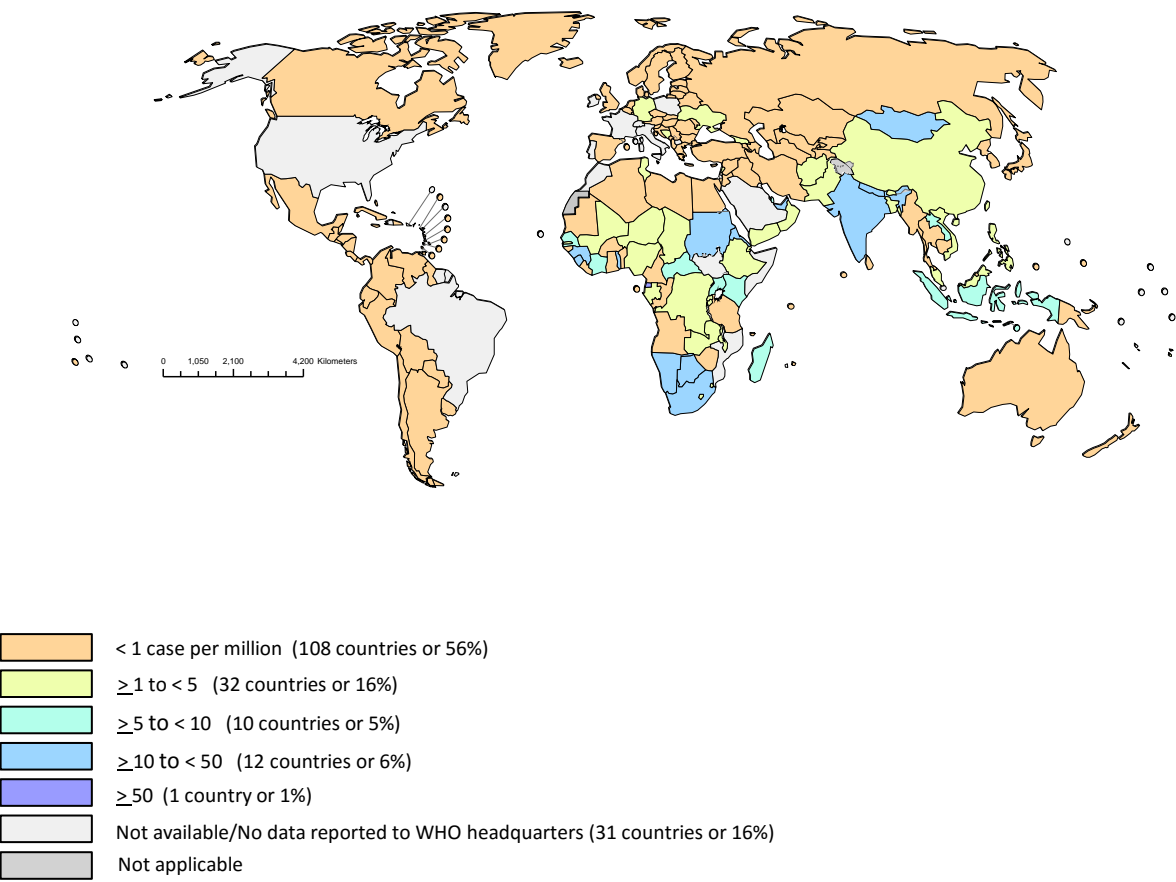
Table 1.9: Rubella cases^a and incidence by WHO region, 2014–2016 and baseline 2010

WHO region	RCV1 national coverage (%)					Percentage of Member States reporting on rubella in their JRF				Rubella incidence per million population					Percentage of Member States with incidence less than five per million population				
	2016	2015	2014	2010	% change 2010–2016	2016	2015	2014	2010	2016	2015	2014	2010	% change 2010–2016	2016	2015	2014	2010	% change 2010–2016
African	13	12	9	0		94	94	94	79	4.25	5.54	7.82	3.87	10	68	66	52	70	-3
Americas	93	92	92	92	1	86	100	100	100	0.002	0.005	0.01	0.02	-90	100	100	100	100	0
Eastern Mediterranean	46	45	42	38	21	81	86	91	81	3.42	2.99	4.65	3.53	-3	82	83	79	65	26
European	93	94	94	93	0	83	83	72	93	0.497	0.83	0.98	14.22	-97	100	93	95	86	16
South-East Asia	15	15	13	3	400	100	100	100	82	7.42	3.38	5.09	26.11	-72	64	73	82	33	94
Western Pacific	96	96	89	61	57	63	56	59	85	2.9	5.04	6.92	25.75	-89	88	73	81	83	6
Total	47	47	44	35	34	84	86	84	88	4.03	3.32	4.8	14.93	-73	86	83	80	80	8

^a Coverage estimates for the 1st dose of rubella-containing vaccine are based on WHO and UNICEF estimates of coverage of measles-containing vaccine.

Source: JRF data, as of 12 July 2017.

Fig. 1.11: Reported rubella incidence rate^a per country, 2016



^a Per million population

Source: JRF (as of 23 June 2017)

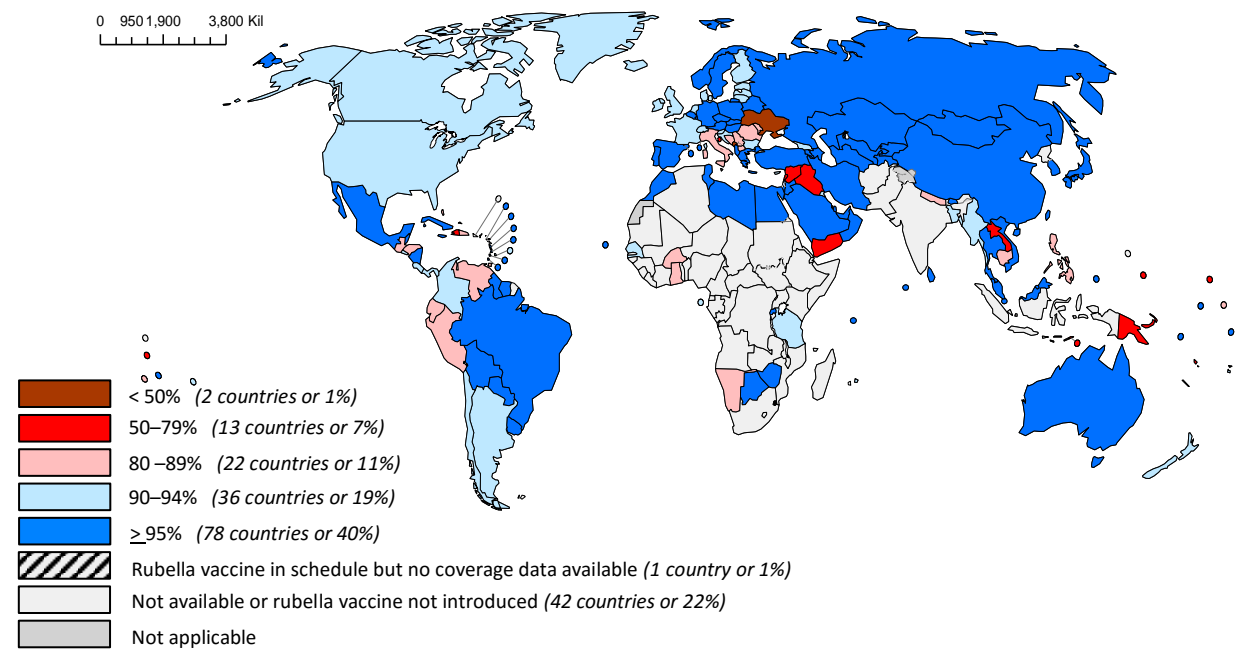
Table 1.10: Congenital rubella syndrome cases^a and incidence by region, 2014–2016

WHO region	Percentage of Member States reporting on CRS in their JRF				CRS incidence per million population					Percentage of Member States with incidence less than five per million population				
	2016	2015	2014	2010	2016	2015	2014	2010	% change 2010–2016	2016	2015	2014	2010	% change 2010–2016
African Region	45	49	36	32	0.04	0.28	0.08	0.13	-69	100	100	100	94	6
Region of the Americas	86	97	100	100	0	0.002	0	0	0	100	100	100	100	0
Eastern Mediterranean region	43	48	38	48	0.05	0	0.01	0.03	67	100	100	100	90	11
European Region	77	77	68	83	0.009	0.018	0.045	0.003	200	100	100	100	100	0
South-East Asia Region	82	82	73	36	0.09	0.32	0.28	0.09	0	100	100	100	100	0
Western Pacific Region	44	41	44	70	0.06	0.02	0.04	0	0	100	100	100	100	0
Total	63	66	60	65	0.05	0.09	0.05	0.01	400	100	100	100	98	2

^a Coverage estimates for the 1st dose of rubella-containing vaccine are based on WHO and UNICEF estimates of coverage of measles-containing vaccine.

Source: JRF data, as of 12 July 2017.

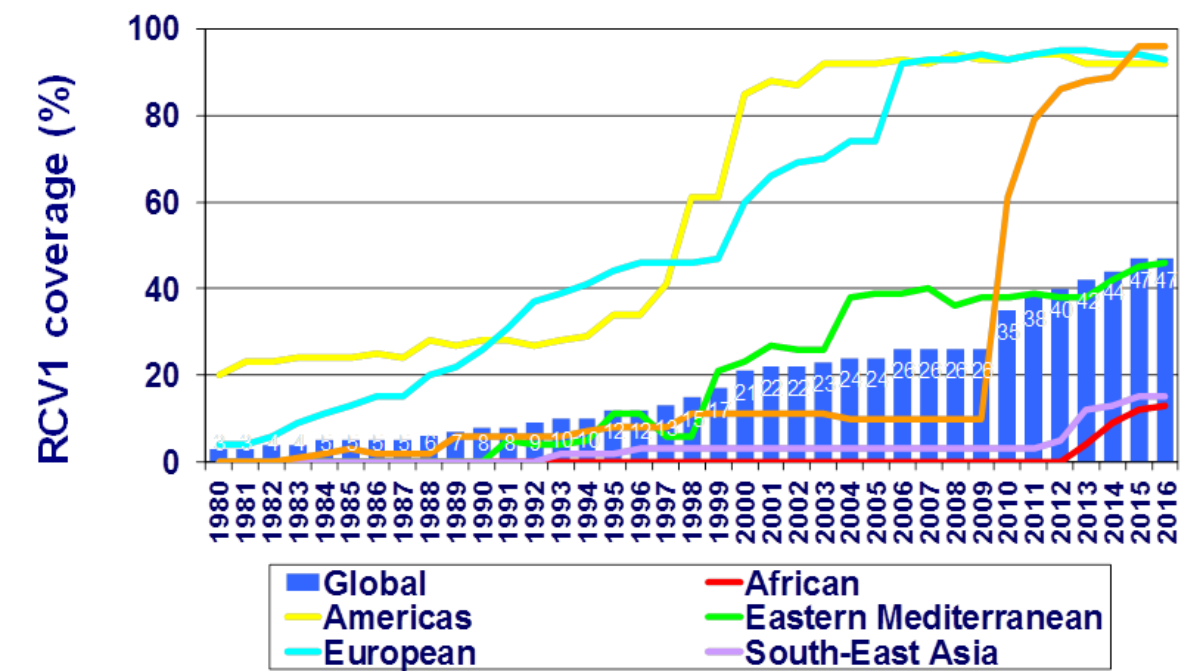
Fig. 1.12: Immunization coverage with rubella-containing vaccines^a in infants, 2016



^a Coverage estimates for the 1st dose of rubella-containing vaccine are based on WHO and UNICEF estimates of coverage of measles-containing vaccine.

Source: WHO-UNICEF coverage estimates 2016 revision.

Fig. 1.13: Rubella-containing vaccine coverage^a by WHO region, 1980–2016



^a Coverage estimates for the 1st dose of rubella-containing vaccine are based on WHO and UNICEF estimates of coverage of measles-containing vaccine.

Source: WHO-UNICEF coverage estimates 2016 revision

Table 1.11: Coverage of RCV and rubella incidence by income category and GAVI Alliance support

Income group and GAVI support	RCV1 national coverage (%)					Percentage of Member States reporting on rubella in their JRF				Rubella incidence per million population				
	2016	2015	2014	2010	% change 2010–2016	2016	2015	2014	2010	2016	2015	2014	2010	% change 2010–2016
Gavi-supported countries	17	17	12	4	325	92	90	92	82	6.03	4.17	5.93	14.7	-59
Middle-income countries w/o GAVI support	94	94	94	93	1	75	84	75	91	0.71	0.498	0.66	4.98	-86
High-income countries	90	89	89	74	22	83	83	83	91	2.25	3.36	4.9	18.77	-88
Total	47	47	44	35	34	84	86	84	88	4.03	3.32	4.8	14.93	-73

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