In 2013, member states of the World Health Organization (WHO) South-East Asia Region* (SEAR) adopted the goal of measles elimination and rubella and congenital rubella syndrome control† by 2020 (1). In 2014, to provide impetus toward achieving this goal, the Regional Director declared measles elimination and rubella control one of the Regional Flagship Priorities. In 2019, SEAR member states declared a revised goal of eliminating both measles and rubella§ by 2023 (2). The recommended strategies to achieve elimination include 1) achieving and maintaining ≥95% coverage with 2 doses of measles- and rubella-containing vaccine in every district through routine or supplementary immunization activities¶ (SIAs); 2) developing and sustaining a sensitive and timely case-based surveillance system that meets recommended performance indicators**; 3) developing and maintaining an accredited laboratory network; 4) achieving timely identification, investigation, and response to measles outbreaks; and 5) collaborating with other public health initiatives to achieve the preceding four strategies. This report updates a previous report and describes progress toward measles elimination in SEAR during 2003–2020 (3). In 2002, coverage with the first dose of a measles-containing vaccine in routine immunization (MCV1) was 70%, and only three countries in SEAR had added a second routine dose of measles-containing vaccine in routine immunization (MCV2). During 2003–2020, all countries introduced MCV2, and estimated coverage with MCV1 increased 35%, from 65% to 88%, and coverage with MCV2 increased 1,233% from 6% to 80%. Approximately 938 million persons were vaccinated in SIAs. Annual reported measles incidence declined by 92%, from 57.0 to 4.8 cases per 1 million population, and estimated deaths decreased by 97%; an estimated 9.3 million deaths were averted by measles vaccination. By 2020, five countries were verified as having achieved measles elimination. To achieve measles elimination in the region by 2023, additional efforts are urgently needed to strengthen routine immunization services and improve measles-containing vaccine (MCV) coverage, conduct periodic high-quality SIAs, and strengthen measles case-based surveillance and laboratory capacity.

Immunization Activities

MCV1 was introduced in all 11 countries in SEAR before 2003 (Table 1). MCV2 was introduced in three countries (Indonesia, Sri Lanka, and Thailand) before 2003; the remaining eight countries introduced MCV2 during 2003–2020.

Countries report coverage for national and subnational MCV1 and MCV2 doses delivered through the routine immunization program to WHO and UNICEF, which use data from administrative records (vaccine doses administered divided by the estimated target population) and surveys reported by member states to estimate MCV1 and MCV2 coverage (4). Estimated MCV1 regional coverage increased 35%, from 65% in 2003 to 88% in 2020; five countries reported ≥95% MCV1 coverage in 2020 (Table 1) (Figure). The highest regional MCV1 coverage (94%) was reached in 2019, just before the start of the COVID-19 pandemic. Estimated MCV2 coverage increased 1,233%, from 6% in 2003 to 80% in 2020, with a peak of 83% in 2019; estimated MCV2 coverage in three countries was ≥95% in 2020. During 2003–2020, measles SIAs were conducted in all countries and reached approximately 938 million persons (Supplementary Table; https://stacks.cdc.gov/view/cdc/120144).

Surveillance Activities

By 2020, case-based measles surveillance with laboratory confirmation of suspected cases†† was implemented in all countries in SEAR. A measles-rubella laboratory network was established in the region by 2003 as an integral component of the WHO Global Measles and Rubella Laboratory Network. By 2020, the
TABLE 1. Estimated coverage* with the first and second dose of measles-containing vaccine, vaccination schedule,† number of reported measles cases,§§ and measles incidence,** by country — World Health Organization South-East Asia Region, 2003 and 2020

| Country   | MCV schedule† and vaccine type | WHO/UNICEF estimated coverage,* % | Measles incidence*** | MCV schedule† and vaccine type | WHO/UNICEF estimated coverage,* % | Measles incidence*** | % Change, 2003–2020 |
|-----------|---------------------------------|---------------------------------|----------------------|---------------------------------|---------------------------------|----------------------|----------------------|
|           | MCV1 | MCV2 | MCV1 | MCV2 | MCV1 | MCV2 | MCV1 | MCV2 | MCV1 | MCV2 | MCV1 | MCV2 | MCV1 | MCV2 | MCV1 | MCV2 | MCV1 | MCV2 | MCV1 | MCV2 | MCV1 | MCV2 | MCV1 | MCV2 | MCV1 | MCV2 | MCV1 | MCV2 |
| Bangladesh | M, 9 mos | —TT | 76 | —TT | 4,067 | 29.8 | MR, 9 mos | MR, 15 mos | 97 | 93 | 2,410 | 14.4 | 28 | −52 |
| Bhutan    | M, 9 mos | —TT | 88 | —TT | 0 | 0.0 | MMR, 9 mos | MMR, 24 mos | 93 | 92 | 0 | 0.0 | 6 | 0 |
| Burma§§    | M, 9 mos | —TT | 80 | —TT | 830 | 17.7 | MR, 9 mos | MR, 18 mos | 91 | 90 | 444 | 8.3 | 14 | −53 |
| India     | M, 9 mos | —TT | 60 | —TT | 47,147 | 42.2 | MR, 9 mos | MR, 16–24 mos | 89 | 81 | 5,604 | 4.0 | 48 | −91 |
| Indonesia | M, 9 mos | M, 7 yrs¶¶ | 74 | 21¶¶ | 24,457 | 109.6 | MR, 9 mos | MR, 18 mos*** | 76 | 60 | 524 | 1.9 | 3 | −98 |
| Maldives  | M, 9 mos | —TT | 96 | —TT | 75 | 252.3 | MR, 9 mos | MMR, 18 mos | 99 | 96 | 15 | 29.2 | 3 | −88 |
| Nepal     | M, 9 mos | —TT | 75 | —TT | 13,344 | 519.6 | MR, 9 mos | MR, 15 mos | 87 | 74 | 388 | 13.2 | 16 | −97 |
| North Korea | M, 9 mos | —TT | 95 | —TT | 0 | 0.0 | MR, 9 mos | MR, 15 mos | 99 | 99 | 0 | 0.0 | 4 | 0 |
| Sri Lanka | M, 9–12 mos††† | MR, 3 yrs | 99 | 90 | 65 | 3.4 | MMR, 1 yr | MMR, 3 yrs | 96 | 96 | 2 | 0.1 | −3 | −97 |
| Thailand | M, 9 mos | MMR, 6 yrs | 96 | 92 | 4,519 | 69.8 | MMR, 9 mos | MMR, 2.5 yrs | 96 | 87 | NR§§§ | 0 | −3 | −99 |
| Timor-Leste | M, 9 mos | —TT | 55 | —TT | 94 | 101.4 | MR, 9 mos | MR, 18 mos | 79 | 78 | 2 | 1.5 | 44 | −99 |
| Region overall | NA | NA | 65 | 6 | 94,598 | 57.0 | NA | NA | 88 | 80 | 9,389 | 4.8 | 35 | −92 |

Abbreviations: JRF = Joint Reporting Form; M = measles; MCV = measles-containing vaccine; MCV1 = first dose of MCV in routine immunization; MCV2 = second dose of MCV in routine immunization; MMR = measles-mumps-rubella; MR = measles-rubella; NA = not applicable; NR = not reported; WHO = World Health Organization.

* Data were from WHO and UNICEF estimates, 2021 revision (as of July 2022). http://immunizationdata.who.int
** Measles incidence is calculated based on the reported measles cases and population by member states through WHO/UNICEF JRF.
*** Cases per 1 million population.
††* MCV2 was not introduced into routine immunization.
§§*** WHO/UNICEF uses the U.S. Department of State’s short-form name “Burma”; WHO uses “Myanmar.”
¶¶¶ Subnational introduction in schools of West Java at age 7 years.
§§§ MMR third dose administered in schools at grade 1.
†††† Changed in 2011 from age 9 months to 9–12 months.
§§§§ Thailand did not report measles case data to the JRF in 2020.
*‡‡ Could not be calculated.

Among isolates from patients during 2017–2020, measles virus genotypes detected and reported in the region included D8 in the nine countries with endemic measles†††; B3 in Bangladesh, Burma,§§§ India, Sri Lanka, and Thailand; D4 mainly in India; and H1 in Burma, India, Sri Lanka, and Thailand. However, genotype information is available for fewer than 1% of all confirmed measles cases in the region.

Measles Case and Mortality Estimates

A previously described model for estimating measles cases and deaths (5, 6) was updated with recent data for countries in SEAR. Based on the updated model, the estimated number of measles cases decreased 84%, from 16,225,870 in 2003 to 2,552,584 in 2020; estimated annual measles deaths decreased 97%, from 163,044 to 5,649 (Table 2). During 2003–2020, compared with no vaccination, measles vaccination averted an estimated 9.3 million deaths in the region.

Regional Verification of Measles Elimination

The WHO South-East Asia Regional Verification Commission for measles and rubella elimination was
established in 2016 and developed a framework for verification of measles and rubella elimination in the region (7). Subsequently, national verification committees have been established in all 11 countries; the national committees have provided annual reports on progress toward measles elimination. As of 2020, the Regional Commission has verified measles elimination in Bhutan (2017), Maldives (2017), North Korea (2018), Sri Lanka (2019), and Timor-Leste (2018).

**Discussion**

During 2003–2020, substantial progress was made toward measles elimination in SEAR. Through implementation of the regional strategies, estimated MCV1 and MCV2 coverage increased 35% and 1,233%, respectively; reported measles incidence declined by 92%; and estimated measles deaths decreased by 97%. By the end of 2019, five of the 11 countries had been verified as having eliminated endemic measles transmission.

In September 2019, after an extensive review of the progress made and the biologic, programmatic, and financial feasibility of measles and rubella elimination, the member states in the region updated the goal to achieve measles and rubella elimination by 2023 (2). However, challenges to achieving measles elimination in SEAR exist. During the COVID-19 pandemic, routine MCV1 coverage in the region declined from a peak of 94% in 2019 to 88% in 2020, and MCV2 coverage declined from a peak of 83% (2019) to 80% (2020). In 2020, among the estimated 22.3 million infants who did not receive MCV1 worldwide, approximately 18% were from SEAR, including 3 million in India and 0.6 million in Indonesia (4). In addition, measles surveillance sensitivity declined in all countries in the region, perhaps because COVID-19 mitigation measures (e.g., physical distancing and masking) decreased transmission of measles and other respiratory viruses but also because of reductions in clinic visits for febrile rash illness resulting from movement restrictions imposed nationally and the deployment of surveillance staff members to respond to the COVID-19 pandemic. A recent independent review of progress toward measles elimination in SEAR (8) concluded that several challenges, including immunity gaps, suboptimal sensitivity of surveillance, inadequate outbreak response and preparedness, funding gaps, and the negative effects of the COVID-19 pandemic on immunization programs threaten achievement of the 2023 target.

The findings in this report are subject to at least four limitations. First, coverage estimates are based on administrative data and might be inaccurate because of errors in recording of doses administered or in estimates of the target populations. Second, surveillance data might underestimate true disease incidence...
TABLE 2. Estimated number of measles cases and deaths,* by country — World Health Organization South-East Asia Region, 2003–2020†

| Country       | Estimated no. of measles cases (95% CI) | Estimated no. of measles deaths (95% CI) | Measles cases | Measles deaths | Cumulative no. of measles deaths averted by vaccination, 2003–2020 (95% CI) |
|---------------|----------------------------------------|------------------------------------------|---------------|---------------|--------------------------------------------------|
|               | 2003                                   | 2020                                    | 2003          | 2020          |                                                  |
| Bangladesh    | 874,838 (794,238–1,102,424)            | 322,731 (44,721–625,438)                | 5,969 (5,484–7,389) | 454 (63–892) | 63 (3–20) (1,282–2,012)                           |
| Bhutan        | 1,299 (442–3,404)                      | 524 (108–1,180)                         | 8 (3–20)      | 1 (0–2)       | 60 (0–88) (1,282–2,012)                          |
| Burma §       | 226,184 (195,311–263,080)              | 120,944 (104,245–140,792)               | 2,659 (2,293–3,056) | 465 (402–538) | 47 (541,464)                                    |
| India         | 13,402,107 (11,154,888–24,654,928)     | 1,442,956 (1,247,122–1,623,281)        | 146,724 (123,133–268,096) | 3,509 (3,122–3,889) | 89 (6,313,078)                                |
| Indonesia     | 1,246,487 (514,014–1,930,834)          | 454,063 (77,520–1,209,218)             | 4,170 (2,549–7,759) | 681 (137–1,912) | 64 (1,012,703–1,515,588)                      |
| Maldives      | 710 (160–1,783)                        | 112 (4–273)                             | NA ¶         | NA ¶         | 84 (NA ¶)                                       |
| Nepal         | 284,033 (84,060–524,799)               | 182,663 (16,196–259,162)               | 3,075 (919–5,638) | 506 (48–701) | 36 (231,909)                                    |
| North Korea   | 66,795 (12,907–170,701)                | 6,019 (2,245–14,544)                   | 168 (33–426)  | 7 (3–16)     | 91 (1,756–4,555)                                |
| Sri Lanka     | 325 (163–1,300)                        | 10 (5–40)                               | NA ¶         | NA ¶         | 97 (NA ¶)                                       |
| Thailand      | 122,621 (102,377–136,307)              | 22,506 (17,145–28,182)                 | 271 (228–305) | 27 (21–34)  | 82 (4,474–8,577)                                |
| Timor-Leste   | 470 (235–1,880)                        | 55 (28–220)                             | 47 (46–79)   | 1 (0–1)      | 88 (NA ¶)                                       |
| Region overall| 16,225,870 (12,885,794–28,791,441)     | 2,552,584 (1,509,338–3,902,331)        | 163,044 (134,642–292,689) | 5,649 (3,796–7,984) | 84 (7,347,415–11,343,699)                      |

Abbreviations: NA = not applicable; WHO = World Health Organization.

* A measles mortality model was used to generate estimated measles cases and deaths using the WHO/UNICEF estimates of national immunization coverage data, as well as updated surveillance data. https://doi.org/10.1016/S0140-6736(12)60522-4
† Data were from WHO and UNICEF estimates, 2021 revision (as of July 2022). http://immunizationdata.who.int
§ MMWR uses the U.S. Department of State's short-form name "Burma"; WHO uses "Myanmar."
¶ Estimated measles mortality was too low to allow reliable measurement of mortality reduction.

Summary

What is already known about this topic?

In 2002, coverage with the first dose of measles-containing vaccine (MCV1) in the World Health Organization’s South-East Asia Region (SEAR) was 70%, but only three countries had added a second routine dose of measles-containing vaccine (MCV2).

What is added by this report?

During 2003–2020, all countries in SEAR introduced MCV2, and estimated MCV1 and MCV2 coverage increased from 65% to 88% and from 6% to 80%, respectively. Reported measles incidence declined by 92%; measles vaccination averted an estimated 9.3 million deaths. Five countries achieved measles elimination by 2020, and the region adopted a 2023 goal of measles and rubella elimination.

What are the implications for public health practice?

To achieve measles elimination in SEAR by 2023, additional efforts are urgently needed to strengthen routine immunization services and improve measles-containing vaccine coverage, conduct periodic high-quality supplementary immunization activities, and strengthen measles case-based surveillance and laboratory capacity.

because not all patients seek care and not all measles cases in patients who seek care are reported. Third, genotype data are based on a limited number of sequences and might not reflect the predominant genotypes in the region. Finally, the measles estimation model might be inaccurate because of errors in the immunization coverage estimates and reported cases as well as the inherent uncertainty of estimates based on modeling.

Achieving measles elimination in SEAR by 2023 will require urgent intensified efforts by countries to implement strategies optimally and in a very short period, especially to mitigate the deleterious effects of the COVID-19 pandemic on immunization services. The 2023 target date represents an opportunity to re-energize efforts and maintain momentum in the region to achieve measles and rubella elimination.
in immunity to all vaccine-preventable diseases in recovery from the COVID-19 pandemic. As of 2020, all 11 countries in SEAR had developed national plans for elimination based on strategies outlined in the Global Measles and Rubella Strategic Plan (9) and the regional committee resolution (2). With 34.3 million surviving infants in SEAR (24% of the global total), regional measles elimination represents a substantial opportunity to decrease measles-related death and illness worldwide by 2023 (1,6,8).

Acknowledgments

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