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Special report

Lessons for sustaining the elimination of measles, rubella, and congenital rubella syndrome in the Caribbean

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ABSTRACT This study searched grey literature and PubMed for strategies to sustain the elimination of measles, rubella, and congenital rubella syndrome and prevent their reintroduction in the Caribbean. Strategies were categorized at the macro, meso, and micro health levels. Macro strategies include: strong, clear, unified political and technical leadership and support; country ownership and subregional coordination of resources, policies, and programs; government investment in national immunization programs; and timely payment to the Pan American Health Organization Revolving Fund for affordable, good-quality vaccines. Including the private health sector and health workers in the tourism industry to identify and manage suspected imported cases, and finding and vaccinating every unvaccinated child, university student or frontline worker are key meso strategies. Strong social and communication programs are the key micro strategies needed to promote vaccine confidence and gain public trust. Priority macro strategies include a strengthened legislative framework supporting immunization, and policies to ring-fence the immunization budget, mitigate the rapid turnover of staff, and train new immunization managers. Establishing infrastructure to vaccinate adolescents and adults, including through the private sector, increasing the capacity to test for measles and rubella, and updating digital surveillance systems for timely decision-making are also critical meso strategies to prevent the reintroduction of these diseases. Partnerships, commitment, and collaborative efforts that contribute to elimination must be sustained, and health strategies strengthened to keep the Caribbean free of endemic transmission of measles, rubella, and congenital rubella syndrome.

Keywords Measles; rubella; rubella syndrome, congenital; vaccination; immunization programs; Caribbean Region.

The English-speaking Caribbean has an impressive record of eliminating diseases preventable by vaccination: it was the first subregion in the world to eliminate poliomyelitis in 1982, measles in 1991, diphtheria in 1995, congenital rubella syndrome (CRS) in 1999, and rubella in 2000 (1–3) (Table 1). These achievements paved the way for the elimination of rubella (2015) and measles (2016) in the Americas (4). Measles is endemic in many countries and has re-emerged in countries where it was previously eliminated (5). Nevertheless, the Caribbean remains measles- and rubella-free despite an influx of millions of tourists annually.

The 25 Dutch- and English-speaking Caribbean Community (CARICOM) countries, territories, and municipalities have a combined population of about 8 million people and host a large transitory population of tourists. After international

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TABLE 1. Year of last reported cases of measles, rubella, and congenital rubella syndrome in members of the Caribbean Public Health Agency

Member	Date of last indigenous measles case(s)	Date of last indigenous rubella case (s)	Date of last CRS case(s)	Date of last imported or import-related cases since 1991		
				Measles	**Rubella**	**CRS**
Anguilla	1990	1980	No documented case	0	0	0
Antigua and Barbuda	1990	1986	1979	2018	0	0
Aruba	1970s	1970s		0	0	2003
Bahamas (the)	1990	1998	1998	2019		
Barbados	1991	1999	1997	1991	0	0
Belize	1991	2001	1998	0	0	0
Bermuda	1990	1992	1968	0	2008	0
Bonaire	1980s	1970s/1980s	No documented case	0	0	0
British Virgin Islands	1991	1987	No documented case	0	0	0
Cayman Islands	1991	2000	1996	0	0	0
Curaçao	1970s	1986	1986	2019	0	0
Dominica	1990	2000	1994	0	0	0
Grenada	1991	1990	1990	0	0	0
Guyana	1991	1998	1998	0	0	0
Jamaica	1991	2000	1998	2011	0	0
Montserrat	1989	1982	No report prior to 1980	0	0	0
Saba	Before 1980s	Before 1980s	Before 1980s	0	0	0
Saint Eustatius	Before 1980s	Before 1980s	Before 1980s	0	0	0
Saint Kitts and Nevis	1991	1999	None reported	0	0	0
Saint Lucia	1990	1996	None reported	2019	0	0
Saint Maarten	1983	Before 1980s	Before 1980s	0	0	0
Saint Vincent and the Grenadines	1991	1997	None reported	0	0	0
Suriname	1991	1997	1999	0	0	0
Trinidad and Tobago	1991	1997	1997	1997	0	0
Turks and Caicos	1990	1987	None reported	0	0	0

CRS, congenital rubella syndrome
Source: Pan American Health Organization. Measles/rubella bi-weekly bulletin [internet]. Available from: https://www.paho.org/en/measles-rubella-weekly-bulletin

travel restrictions were lifted after the coronavirus disease 2019 (COVID-19) pandemic, the Caribbean recorded 28.3 million registered tourist visits in 2022, 50% more than in 2021 (6). The risk of importation of vaccine-preventable diseases increases with travelers coming from endemic areas. While there has been no evidence of circulation of the measles virus since the last endemic case in 1991 in Dutch- and English-speaking Caribbean areas (Table 1), imported measles cases have tested the robustness of the immunization program in the Caribbean for 3 decades. Without a global target for elimination (7), the influx of tourists and gaps in immunity and surveillance exacerbated by the COVID-19 pandemic make the Caribbean vulnerable to the reintroduction of measles and other vaccine-preventable diseases. This paper reviews measles elimination in the Caribbean subregion since 1991, including best practices contributing to sustainability of measles elimination, challenges, and lessons learnt, focusing on key elements of measles, rubella, and CRS elimination and sustainability (what happened in the past) and challenges and strategies to prevent reintroduction (what is expected to happen in the future).

METHODS

Data were gathered by searching the grey literature and PubMed. In the grey literature search, the Iris site of the Pan American Health Organization (PAHO) was used to identify technical reports using the keywords measles, rubella, CRS elimination, and Caribbean. Reports on measles and rubella from oversight committees were reviewed, and interviews were conducted with Caribbean experts. The PubMed search strategy used the Medical Subject Headings (MeSH): (measles) AND (Caribbean region) AND (prevention and control) [All fields] and (rubella) OR rubella syndrome, congenital AND (Caribbean region) AND (prevention and control) [All fields]. The approach to sustaining measles, rubella, and CRS elimination and strategies to prevent re-introduction were analyzed.

The strategies were stratified into macro, meso, and micro health levels. The macro level relates to subregional and national policies, governance, and health financing development (8). The meso level relates to health strategies to operationalize and implement policies through the intersectoral and integrated health services networks (8, 9). The micro level describes service delivery interface with communities (8, 10).

RESULTS

Table 2 summarizes macro, meso, and micro health strategies to sustain the elimination of measles, rubella, and CRS and prevent their reintroduction.

TABLE 2. Macro, meso, and micro health strategies for sustaining the eliminations of measles and rubella and preventing their reintroduction in the Caribbean

Strategy	Key elements of measles, rubella, and CRS elimination and sustainability	Strategies to prevent reintroduction
Macro (policy, governance, and health financing)	• National financing • PAHO revolving fund for vaccines • Unified approach to decision-making and implementing activities • Strong government leadership • Partnerships and collaboration • Free vaccines in most islands/territories • Policies or legislation for school entry vaccination in most islands/territories	• Ring fence EPI budget through legislation • Strengthen immunization legislation • Incentivize attractive packages for EPI managers and staff to prevent attrition
Meso (implementation through intersectoral and integrated networks)	• Subregional oversight • Finding and vaccinating every susceptible child (day care, schools) and susceptible adults (health and immigration sectors and tertiary education) • Expansion of surveillance sites in private and public sectors, hotels, and cruise ship ports • Enhanced vaccination activities at border communities with collaborative actions across neighboring countries for mainland countries • Program incentives	• Ensure capacity for measles and rubella testing in Jamaica • Facilitate transport of laboratory samples through CARICOM shipping agreements • Accelerate digitalization of national immunization registers, and surveillance of vaccine-preventable diseases and events supposedly attributable to vaccination or immunization • Strengthen health systems for natural disasters • Establish adolescent and adult vaccination infrastructure that includes the private health sector
Micro (service delivery and community interface)	• Catch up, keep up, and follow up vaccination activities • Social mobilization, particularly vaccination week in the Americas • Foster family relationships with community health workers • Weekend clinics and later clinic hours for working parents • Outreach activities to identify defaulters	• Strengthen social mobilization, advocacy, communication programs, and culturally relevant messaging to build vaccine confidence • Digitalize registries that identify and message defaulters

CRS, congenital rubella syndrome; PAHO, Pan American Health Organization; EPI, Expanded Programme on Immunization; CARICOM, Caribbean Community.
Source: Prepared by the authors based on literature review.

Macro health strategies

Key strategies for sustaining the elimination of measles, rubella, and CRS include technical leadership, international partnerships, commitment from members of CARICOM, immunization legislation and policies on school-aged vaccination, national financing, and the PAHO revolving fund. Government commitment to invest in Expanded Programme on Immunization (EPI) programs and strengthen immunization legislation are necessary to prevent the reintroduction of vaccine-preventable diseases. Also important are policies to reduce the turnover of EPI managers and train new managers and staff.

Meso health strategies

Effective public health strategies for population immunity, high vaccine coverage, and surveillance were achieved through integrated networks in schools, day-care centers, the hotel cruise ship industry, immigration, and the private sector (e.g., pediatricians), coupled with program incentives. Partnerships with the airlines to ensure timely delivery of laboratory samples, increasing laboratory testing capacity, improving infrastructure for adolescent and adult immunization, and digitalizing EPI registries are needed to strengthen sustainability efforts.

Micro health strategies

Sustainability strategies focus on gaining public trust through social mobilization and communication programs. Community health workers know the children in island states with small populations, so fostering relationships with families and community leaders and motivating involvement in immunization activities is easier. Outreach activities, later opening hours, and weekend clinics are service delivery strategies to reach defaulters. Culturally relevant messaging and digitalized tracking and contact of defaulters can enhance sustainability efforts.

DISCUSSION

Key elements of measles, rubella, and CRS elimination and sustainability

Leadership and support. Caribbean countries eliminated measles, rubella, and CRS with the last indigenous cases reported in 1991, 2000 and 1998, respectively (Table 1). The work to achieve these goals was under the leadership of Dr. Ciro de Quadros, team leader of PAHO's EPI from 1977 to 2002, the technical team that worked with him, and the leaders of the country programs. Both Dr. de Quadros and Mr. Henry Smith, the first Immunization Officer for the Caribbean (1977–1995), gained experience through smallpox eradication in Africa. Dr. de Quadros and his team worked with the EPI managers and their teams to test elimination strategies for polio in the small island populations and built on this experience to eliminate measles, rubella, and CRS. The technical leadership to support the elimination agenda was strong, clear, and unified. It emphasized country ownership to ensure a sustainable EPI infrastructure to deliver routine vaccination, implement surveillance, and focus on eliminating one disease at a time. PAHO provided technical assistance, surveillance, and laboratory support through the Caribbean Epidemiology Centre (CAREC), and several international agencies and nongovernmental organizations provided valuable support in funding, vaccines, supplies, and cold chain equipment (1–3).

On the retirement of Henry Smith, Caribbean advisers to the EPI program came to play important roles in supporting and sustaining measles, rubella, and CRS elimination for more than 2 decades.

Commitment of CARICOM member states. To understand the success of disease elimination and its sustainability, one needs to understand the role of CARICOM and its Council for Human and Social Development (COHSOD) which sets regional goals and coordinates subregional efforts. Caribbean governments committed resources for their EPI programs and elimination and sustainability efforts. Governments provide 90–100% of the cost of the immunization program. There was horizontal cooperation among countries and costed annual national plans of action. COHSOD, with technical guidance and support of PAHO and the World Health Organization (WHO), proposed resolutions to eliminate, in turn, polio, measles, rubella, and CRS from the Caribbean through coordinated, simultaneous mass vaccination catch-up and follow-up campaigns (11). Most countries mandated vaccination for school entry through legislation under the education, public health, or free-standing vaccination acts (12). After the last case of polio was recorded in the English-speaking Caribbean in 1982, CARICOM health ministers resolved in 1988 to eliminate measles by 1995 and rubella and CRS by the end of 2000. The PAHO technical adviser, in collaboration with the CARICOM secretariat, gives an annual report on sustaining measles, rubella and CRS elimination to the ministers responsible for health in CARICOM. Further commitment to sustaining elimination gains was evident when health ministers of the Caribbean agreed to strengthen national immunization programs in the Declaration of Nassau in 2023 (13).

PAHO revolving fund for vaccines. The PAHO/WHO revolving fund for vaccines allows countries that require relatively small quantities of vaccines to access high-quality vaccines at significant cost savings of up to 90%, with timely delivery and a 60-day line of credit. This fund was put into operation in 1978 and vaccines required for South and Central America and the Caribbean are ordered through a tender system from WHO prequalified manufacturers (1–3).

Effective public health strategies for population immunity. Within the Caribbean subregion, vaccination of children is mainly done by the public health sector free of charge through their network of clinics. The private sector administers vaccines to about 10% of each birth cohort.

Population immunity was achieved after large measles outbreaks during 1981–1990, with more than 43 000 cases reported, mainly in Bahamas, Guyana, Jamaica, and Trinidad and Tobago. An average of 4 814 cases were recorded annually, with 18 deaths. The measles elimination strategy devised by PAHO included: (i) a mass vaccination campaign (catch-up) targeting all children aged 9 months to 14 years; (ii) improvement of surveillance for monitoring the progress of measles elimination; (iii) routine measles vaccination coverage of 95% in each birth cohort; and (iv) follow-up vaccination campaigns to avoid an accumulation of susceptible children equivalent to the birth cohort (14).

During the so-called Big Bang in May 1991, 94% of the targeted 1.9 million children aged 9 months to 14 years were vaccinated in that month. Since this mass catch-up campaign, high routine vaccine coverage has been maintained through so-called keep-up and follow-up campaigns and outreach vaccination activities. The natural immunity that occurred in 1981–1990 due to the measles outbreaks, high vaccination coverage, and periodic mass campaigns ensured the sustainability of measles elimination (15).

Rubella immunization and elimination were economically justified (16) and the following strategies were implemented: mass vaccination of children and adults of both sexes aged 1–39 years using a measles-containing vaccine; surveillance of fever and rash and CRS; and vaccination of 95% of each birth cohort using two doses of the measles–rubella or mumps–measles–rubella (MMR) vaccine. A mass vaccination campaign targeting adults was conducted to ensure women in the reproductive age group were immune to rubella, thereby preventing CRS in infants of susceptible women. Natural immunity in previous rubella outbreaks protected most adults older than 40 years. Figure 1 outlines rubella and measles elimination and sustainability in the English-speaking Caribbean countries and Suriname. The graph shows a multifaceted approach at macro, meso, and micro levels, including sustaining measles and rubella vaccine coverage with follow-up and catch-up campaigns, fever and rash surveillance, and political resolution to eliminate measles and rubella and sustain their elimination.

The same strategies used in elimination are also used for sustaining elimination. These include maintaining high coverage in birth cohorts, school-aged populations (including at the tertiary education level), immigrants, and frontline workers in tourism and health, and strong government commitment.

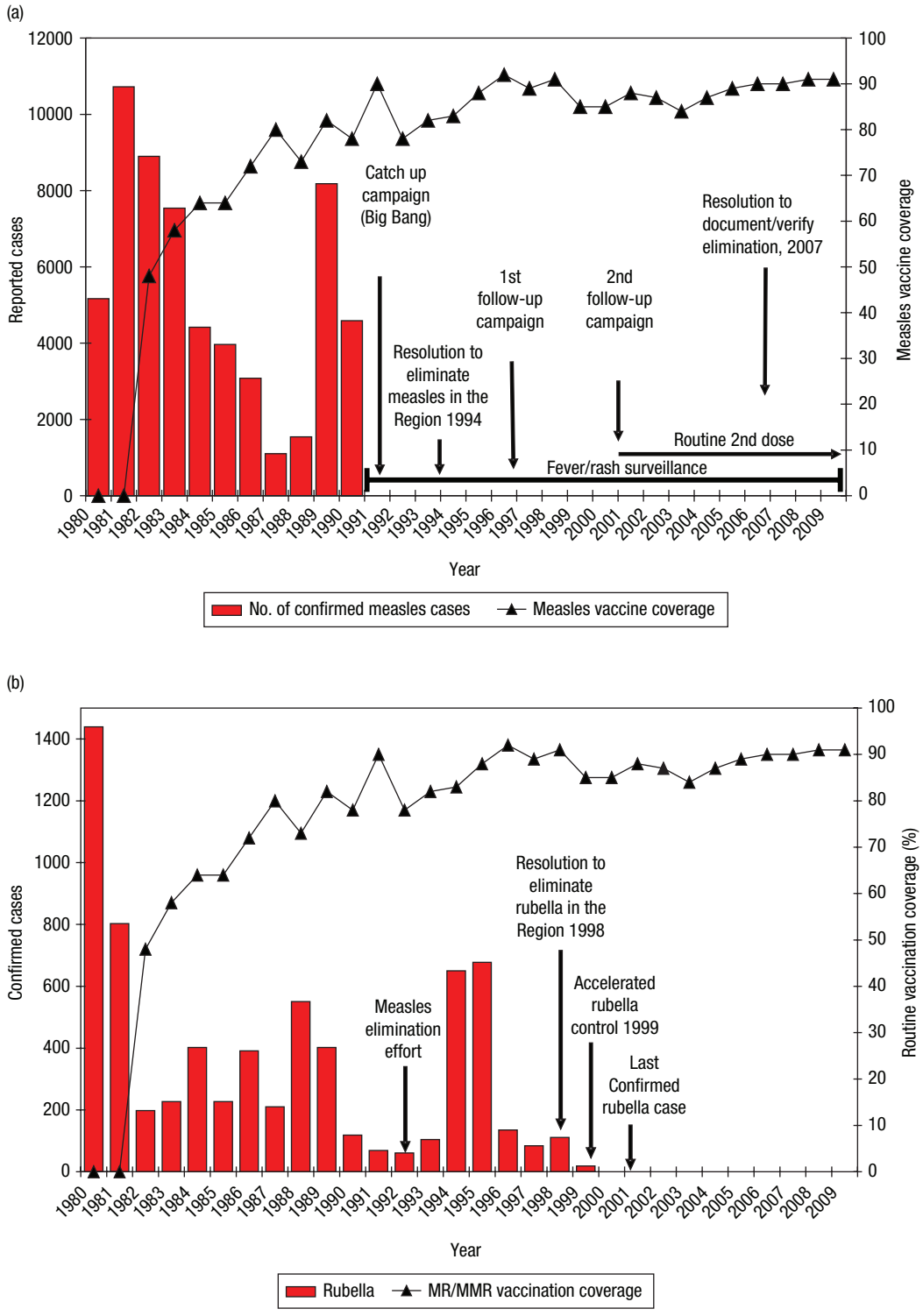
Vaccine coverage. Maintaining high vaccination coverage is essential to sustain elimination status. Vaccination coverage of 95% or more for vaccines administered is the goal for each country. Vaccination is done in the countries through fixed sites and outreach activities, along with identification and vaccination of drop-outs at home. In countries such as Belize, Guyana, and Suriname emphasis was placed on enhanced vaccination activities at border communities with collaborative actions across neighboring countries. In all countries, focus was placed on areas with high population density and communities with tourists. Vaccines are given at no cost at public health facilities and at some private health clinics in most countries. In almost all countries, the private health sector receives vaccines from the Government sector free or at cost, thereby allowing better access to vaccination in the private sector. Private clinics must submit reports of vaccines given to collect a new supply of vaccines.

The elimination strategy introduced a second dose of measles and rubella-containing vaccine in 1996 to ensure that all vaccinated children developed immunity (16). The second dose was usually administered between ages 3 and 6 years years. In keeping with the recommendations of PAHO's Technical Advisory Group on immunization to improve immunity against measles, between 2016 and 2018, Caribbean countries reduced the age to receive the MMR2 vaccine to the second year of life. Eighteen of the 25 CARICOM countries and areas now give this vaccine between 15 and 24 months.

Countries procure vaccines through the PAHO revolving fund for vaccines, which ensures access to affordable, high-quality vaccines. In the spirit of Pan-Americanism, countries are willing to lend vaccines to other countries when needed, knowing that the vaccines can be repaid through the revolving fund.

Coverage of the MMR1 vaccine in the Caribbean declined from 96% in 2015 to 91% in 2017, with improvements made over the next 2 years (Table 3). From 2010 to 2019, MMR2 coverage ranged between 79% and 92%. A precipitous fall occurred in both MMR1 and MMR2 coverage in 2020 and 2021 due to the prioritization of activities related to COVID-19 control and

FIGURE 1. Routine MCV1 coverage and measles and rubella elimination campaigns in the English-speaking Caribbean and Suriname, 1980–2009
Panel A: Routine MCV1 coverage and measles elimination campaigns
Panel B: Rubella elimination campaigns



MCV1, measles-containing vaccine, first dose; CRS, congenital rubella syndrome; MR/MMR, measles–rubella/mumps–measles–rubella.
Source: Hashim AM. Status of the documentation and verification of measles, rubella and CRS elimination in the Caribbean sub-region, 2001. Presentation at 11th Meeting of Caribbean National Epidemiologist and Laboratory Directors, Port of Spain, 9–13 May, 2011 [cited: 2023 Dec 16]. Available from https://www3.paho.org/hq/dmdocuments/2012/12-may-hashim-status--of-documentation--of-elimination-caribbean-subregion.pdf

TABLE 3. MMR1 and MMR2 vaccine coverage in the Dutch- and English-speaking Caribbean, 2010–2022

Year	% coverage	
	MMR1	MMR2
2010	94	85
2011	94	90
2012	96	84
2013	96	81
2014	96	86
2015	96	92
2016	94	84
2017	91	83
2018	92	79
2019	94	86
2020	90	83
2021	87	81
2022	92	84

MMR, mumps–measles–rubella.
Source: World Health Organization/United Nations Children's Fund Joint Reporting Forms on Immunization: country reports.

closure of health facilities used as centers for respiratory infections. Countries have subsequently implemented catch-up and community outreach activities to find and vaccinate defaulters to improve coverage levels. However, the coverage data have not been consistently recorded for the respective birth cohorts following these campaigns, leading to an underestimation of MMR coverage.

Immunization legislation. Legislation has played an important role in the elimination strategy in the Caribbean and the Americas. Nearly all countries have policies or legislation requiring children to be vaccinated for school entry; some include day-care and preschool institutions (12). Some countries need to enact legislation. Measles and rubella vaccination is required for students attending most tertiary institutions and for persons immigrating to countries. A strengthened legislative framework is required for almost all countries.

Effective public health strategies to improve surveillance. Finding and vaccinating every child and finding and investigating every suspected case are the key to sustaining elimination. Before measles elimination, case-based surveillance was used for reporting measles cases. As part of the measles elimination strategy, the surveillance system was strengthened to improve sensitivity and ensure routine weekly reporting on suspected cases from a wide cross-section of hospitals and clinics in both the public and private health sectors, including negative reporting. Laboratory diagnosis and community investigations using standard reporting and investigation forms are integral to case detection and control (17). Software developed by PAHO was used to report suspected cases by CAREC and PAHO and prepare weekly surveillance bulletins (18). As immunization coverage improved and measles and rubella cases declined, a more sensitive case definition was needed. A suspected measles case was initially defined as fever, rash, and one of either cough, coryza, or conjunctivitis. With the integration of measles and rubella surveillance, a suspected case is now defined as a case of fever and generalized rash. Blood specimens are required to confirm the diagnosis of measles and rubella. At the first contact of the case with the health sector, an investigation form is completed and specimen(s) are taken for diagnostic purposes. This first contact strategy allows for early diagnosis and follow-up.

CRS surveillance was enhanced in 2004 with the investigation and follow-up of neonates and infants whose specimens were submitted for TORCH testing. Some countries routinely screen pregnant women for rubella antibodies and vaccinate those testing negative in the postpartum period.

Weekly review of the investigation forms, identifying the areas requiring strengthening, and working with countries to amend deficits in clinical information and investigations are ongoing activities. The number of surveillance sites in countries in both public and private health sectors continues to expand. Almost all imported measles or rubella cases visit private health facilities for care. Therefore, training and awareness activities are essential for the private health sector. Hotels and cruise ship ports are used as surveillance sites for fever and rash cases, and they also report weekly in some countries.

During 1991–2020, nine imported and one import-related cases of measles were reported in seven countries: Barbados (1991), Trinidad and Tobago (1997), Jamaica (2011), Antigua and Barbuda (2018), and Bahamas, Curacao and Saint Lucia (2019) (Table 1). The last imported measles case was reported by Saint Lucia in a cruise ship crew member infected in Denmark with genotype D8. All imported cases were from Europe. Bermuda reported one imported rubella case in 2008. All these imported cases were tourists, identified primarily within the private sector, where the first contact strategy used for measles elimination in the Caribbean was implemented. In this strategy, specimens are taken for diagnosis at first contact with the health sector, an investigation report is completed, and the persons are isolated. The inclusion of the private health sector and healthcare workers in the tourism sector are key strategies used by all countries. Public–private partnership played and continues to play a pivotal role in the sustainability of measles, rubella and CRS elimination.

Social mobilization. Social mobilization occurs annually during vaccination week in April as a strategy for sustaining elimination. This week includes catch-up and public outreach activities, which facilitate sensitization in schools, communities, and workplaces. These activities during vaccination week use social media, health fairs, and community and school awareness through skits and songs. These activities need to be sustained and their impact evaluated.

Program incentives – awards. Two awards are presented to countries at the annual EPI managers' meeting as incentives for improving surveillance and vaccination coverage (1). Countries are encouraged to have annual evaluation meetings and institute similar awards nationally. These can stimulate competition and help to strengthen surveillance and vaccination coverage.

Oversight committees. The Caribbean Commission for Monitoring and Re-verification of Measles and Rubella Elimination, established in 2018, has provided oversight to ensure the sustainability of measles elimination. The Caribbean Immunization Technical Advisory Group established by CARICOM in 2018 (11) provides technical guidance and oversight of the immunization programs. This group has proposed model immunization legislation (12), which CARICOM has agreed to support. At these oversight committee meetings and the annual meetings of Caribbean EPI managers, priority discussions include disease elimination and strategies to sustain the gains.

Challenges in these programs are discussed and recommendations to strengthen EPI programs, close immunity gaps, and improve surveillance indicators are made to the policy-makers in countries.

CARICOM leadership in sustaining the elimination of measles, rubella, and CRS. The history of eliminating measles, rubella, and CRS in the Caribbean is integral to the sustainability of the program. Resolutions and decisions are taken by the most senior health officials, the ministers responsible for health in the respective countries. Decisions are usually accompanied by the required funding. Health teams demonstrate buy-in and advocate with their policy-makers before resolutions are made. The strategy of having CARICOM set elimination goals presents a collective, collaborative, coordinated, and unified approach to decision-making and implementation of activities.

Challenges and strategies to prevent reintroduction

Building vaccine confidence. Decades after elimination, most of the population, including many health providers, are unaware of the morbidity and mortality caused by measles and rubella, and social acceptance of childhood vaccination has decreased. This situation, along with misinformation to discredit the benefits of vaccination, has increased vaccine hesitancy in some people. Social mobilization and advocacy are now crucial to keep the prevention of these diseases to the fore among the population and health-care workers.

Strong social and communication programs are needed to create public trust and promote the value of vaccines to complement evidence-based public health strategies. Community engagement can offer insights into low uptake and can investigate gaps between intention and action to vaccinate to enable better design of interventions. Using social and commercial marketing principles, evidence-based best practices, engagement with communication professionals and community stakeholders, and culturally relevant messaging, innovative strategies can be developed to better inform and mobilize communities (19). The aim is for Caribbean people to perceive immunization services positively, as a social norm and a right, and necessary to protect their health. The involvement of all sectors of society will help improve vaccine uptake (20).

Addressing rapid turnover of EPI managers and staff. A committed cadre of vaccination staff and community outreach workers responsible for a defined number of children fosters sustainability. Rapid turnover of EPI managers and staff threatens this process. Recommended strategies to handle the migration of the health workforce have been described and need to be applied (21).

Laboratory services. The Caribbean has faced a challenge to meet the surveillance indicator of 80% of samples received in the reference laboratory within 5 days and only met this target in 2016 and 2019 (Table 4). The CARPHA laboratory in Trinidad and Tobago conducts the measles and rubella testing for English-speaking countries and areas as well as for Haiti and Honduras. As countries have to pay to send samples by air to CARPHA, samples are batched and sent weekly. Bermuda uses a reference laboratory in the United States, and Dutch-speaking countries send samples to the Kingdom of the Netherlands or French Saint Martin. In islands with small populations, there are not enough cases to ensure laboratory competency in each island, and larger islands such as Jamaica need to ensure capacity for measles and rubella testing. Shipping agreements paid through CARICOM as part of trade and transport agreements should be put in place to facilitate the transport of samples (22).

Legislation to ring-fence the EPI budget. Despite the political commitment in Caribbean countries to support EPI programs, challenges exist in ensuring timely payments for vaccines and supplies. Continued advocacy is needed to ensure that program funds are protected. Legislation to ring-fence the budget for vaccine programs is also needed.

Lessons from COVID-19 for sustainability. The decline in EPI programs and other essential health services during the COVID-19 pandemic highlighted the importance of maintaining these services during disasters. Exploring evidence-based strategies to strengthen health systems during subsequent natural disasters will help limit future disruption to EPI programs (23). Most Caribbean countries need to establish an infrastructure for adolescent and adult vaccination that includes the private health sector, where about 50% of the adult population access primary health care. During the COVID-19 pandemic, the public sector nurses who do childhood vaccinations were called on to vaccinate adults and EPI vaccination coverage fell.

TABLE 4. Measles and rubella surveillance indicators in the Dutch- and English-speaking Caribbean, 2011–2022

Year	Sites reporting weekly (%)	Cases investigated within 48 hours (%)	Cases with adequate samples taken (%)	Samples received by laboratory within 5 days (%)	Results returned within 4 days (%)	Cases discarded by laboratory analysis (%)
2011	99	99	96	35	95	97
2012	98	89	97	26	96	100
2013	96	90	91	20	95	99
2014	82	89	83	12	84	94
2015	90	97	92	16	76	96
2016	98	88	98	20	72	94
2017	84	88	98	21	77	97
2018	95	90	98	16	76	94
2019	96	86	98	9	83	98
2020	96	60	96	22	76	96
2021	97	62	77	0	92	77
2022	95	27	95	3	92	98

Source: Prepared by authors based on information in the Pan American Health Organization integrated surveillance information system database.

Digitalizing EPI and surveillance systems. The digitalization of national immunization registers, surveillance of vaccine-preventable diseases, and adverse events supposedly attributable to vaccines or immunization will significantly improve the efficiency and productivity of health staff and facilitate the inclusion of new vaccines in the EPI program, enhancing the scope of diseases for which it can offer protection.

Conclusions

Measles, rubella, and CRS elimination was established in the Caribbean through strong leadership, cooperation, coordinated public health measures, and vaccine confidence. Growing misinformation and vaccine hesitancy have created a need for immunization programs to develop strategies to create vaccine confidence and bridge immunity gaps exacerbated by the COVID-19 pandemic. Countries must invest more in EPI programs, including adolescent and adult vaccination infrastructure, multisectoral involvement (e.g., hotels and cruises for surveillance), and digitalization of EPI and surveillance systems for timely decision-making. Legislation that contributes to eliminating several vaccine-preventable diseases in the Caribbean needs to be strengthened. Stronger immunization programs will ensure the sustainability of measles elimination and set the stage for future elimination targets.

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Enseñanzas útiles para mantener la eliminación del sarampión, la rubéola y el síndrome de rubéola congénita en el Caribe

RESUMEN En este estudio se realizó una búsqueda en la bibliografía gris y en PubMed sobre estrategias para mantener la eliminación del sarampión, la rubéola y el síndrome de rubéola congénita y prevenir su reintroducción en el Caribe. Las estrategias se clasificaron en los niveles de salud macro, meso y micro. Las macroestrategias incluyen: liderazgo y respaldo políticos y técnicos fuertes, claros y unificados; asunción de responsabilidades por parte de los países y coordinación subregional de recursos, políticas y programas; inversión gubernamental en programas nacionales de inmunización; y pago puntual al Fondo Rotatorio de la Organización Panamericana de la Salud para vacunas asequibles y de buena calidad. Las mesoestrategias clave consisten en incluir al sector privado de la salud y a los trabajadores de salud del sector turístico en la detección y el manejo de los casos sospechosos importados, y en encontrar y vacunar a todas las personas no vacunadas de la población infantil, la población universitaria o el personal de primera línea. Las microestrategias clave para promover la aceptación de las vacunas y lograr la confianza del público consisten en programas sociales y de comunicación potentes. Las macroestrategias prioritarias incluyen un fortalecimiento del marco legislativo que respalde la inmunización y políticas para blindar el presupuesto de inmunización, mitigar la elevada rotación de personal y capacitar a nuevos gerentes de los servicios de inmunización. La creación de infraestructuras para la vacunación de la población adolescente y adulta, incluso en el sector privado, el aumento de la capacidad para realizar pruebas de detección del sarampión y la rubéola, y la actualización de los sistemas digitales de vigilancia para la toma de decisiones oportunas son también mesoestrategias fundamentales para prevenir la reintroducción de estas enfermedades. Deben mantenerse las asociaciones, el compromiso y los esfuerzos de colaboración que contribuyen a su eliminación, y deben reforzarse las estrategias de salud orientadas a mantener al Caribe libre de transmisión endémica del sarampión, la rubéola y el síndrome de rubéola congénita.

Palabras clave Sarampión; rubéola (sarampión alemán); síndrome de rubéola congénita; vacunación; programas de inmunización; Región del Caribe.

Lições para manter a eliminação de sarampo, rubéola e síndrome da rubéola congênita no Caribe

RESUMO Este estudo pesquisou na literatura cinzenta e na base de dados PubMed estratégias para manter a eliminação de sarampo, rubéola e síndrome da rubéola congênita e evitar sua reintrodução no Caribe. As estratégias foram agrupadas nos níveis macro, meso e micro do sistema de saúde. Entre as macroestratégias estão: liderança e apoio político e técnico sólidos, explícitos e unificados; apropriação pelos países e coordenação sub-regional de recursos, políticas e programas; investimento do governo em programas nacionais de imunização; e pagamento pontual ao Fundo Rotativo da Organização Pan-Americana da Saúde para vacinas de boa qualidade a preços acessíveis. As principais mesoestratégias são a inclusão da rede privada de saúde e de profissionais de saúde no setor de turismo a fim de identificar e manejar suspeitas de casos importados e localizar e vacinar todas as crianças, estudantes universitários ou trabalhadores na linha de frente não vacinados. A existência de fortes programas sociais e de comunicação são as principais microestratégias necessárias para promover a aceitação das vacinas e conquistar a confiança da população. As macroestratégias prioritárias compreendem o fortalecimento de um marco legislativo em apoio à imunização, além de políticas para proteger o orçamento para a imunização, reduzir a alta rotatividade de pessoal e capacitar novos gestores na área de imunização. Criar uma infraestrutura para vacinar adolescentes e adultos, inclusive por meio do setor privado, aumentar a capacidade de testagem para sarampo e rubéola e atualizar os sistemas digitais de vigilância para que as decisões sejam tomadas em tempo hábil também são mesoestratégias essenciais para evitar a reintrodução dessas doenças. É preciso manter parcerias, compromissos e esforços colaborativos que contribuam para a eliminação e fortalecer as estratégias de saúde a fim de manter o Caribe livre da transmissão endêmica de sarampo, rubéola e síndrome da rubéola congênita.

Palavras-chave Sarampo; rubéola (sarampo alemão); síndrome da rubéola congênita; vacinação; programas de imunização; Região do Caribe.