1. Introduction

The Western Pacific Region (WPR) has been engaged in intensified efforts against measles through "accelerated control" and "elimination" for over 10 years. In 1996, the Regional Office of the Western Pacific (WPRO) established a "Plan of Action (POA) for Accelerated Measles Control". By 2003, the Region's vision had moved from accelerated control to elimination with the publication of a "Regional POA for Measles Elimination" which was followed by a Regional Committee (RC) resolution for measles elimination and Hepatitis B control, and publication of Field Guidelines for Measles Elimination in 2004. In 2005, the RC established 2012 as the target date for measles elimination.

2. Background

Key strategies for measles elimination

The key strategies for measles elimination include achieving very high vaccination coverage with a first and second dose of measles containing vaccine (MCV1 and MCV2) either through routine immunization or supplementary immunization activities (SIAs), sensitive and timely case-based measles surveillance, and access to a measles laboratory network to confirm or discard suspected measles cases and identify measles virus genotypes. MCV may include measles, mumps, rubella vaccine (MMR), measles-rubella vaccine (MR), or single antigen measles vaccine (M).

Partner Support

Since 1996, 30 of 37 countries and areas in the Western Pacific Region have conducted more than 63 national or sub-national measles SIAs, and by 2008, all 37 were conducting case-based surveillance with access to a WHO accredited measles laboratory network. Member States provided the greatest amount of resources for campaigns, surveillance and routine immunization. Additional support from a number of partner donors has been critical in allowing developing countries to conduct activities targeting first accelerated measles control and, beginning in 2003, elimination. These include the American Red Cross (ARC), Australian Agency for International Development (AusAID), Canadian International Development Agency (CIDA), Church of Jesus Christ of Latter Day Saints (LDS), Global Alliance for

1 WP/ICP/EPI/5.2/ 001-E
2 WPR/RC54.R3
4 WPR/RC56.R8
Vaccines and Immunization (GAVI), Japanese International Cooperation Agency (JICA), Japanese Ministry of Foreign Affairs (MOFA), Japanese National Institute of Infectious Diseases (NIID), Luxembourg Agency for Development Cooperation, Korea Centers for Disease Control (KCDC), Rotary International (District 2650), United Nations Children’s Fund (UNICEF), United Nations Foundation (UNF), U.S. Centers for Disease Control & Prevention (US CDC), and WHO.

Table 1: List of Partners/Donors for Measles Elimination, WPR, 1997-2009

<table>
<thead>
<tr>
<th>Type of Assistance</th>
<th>Partner/Donor</th>
<th>Technical</th>
<th>Financial/In-kind</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>American Red Cross</td>
<td>●</td>
<td></td>
<td>2005;2008</td>
</tr>
<tr>
<td></td>
<td>AusAID</td>
<td>●</td>
<td></td>
<td>2000-2008</td>
</tr>
<tr>
<td></td>
<td>CIDA</td>
<td>●</td>
<td></td>
<td>2000-present</td>
</tr>
<tr>
<td></td>
<td>GAVI</td>
<td>●</td>
<td></td>
<td>2000-present</td>
</tr>
<tr>
<td></td>
<td>Japan MOFA</td>
<td>●</td>
<td></td>
<td>2000-present</td>
</tr>
<tr>
<td></td>
<td>JICA</td>
<td>●</td>
<td>●</td>
<td>2000-present</td>
</tr>
<tr>
<td></td>
<td>Japan NIID</td>
<td>●</td>
<td>●</td>
<td>2000-present</td>
</tr>
<tr>
<td></td>
<td>LDS</td>
<td>●</td>
<td>●</td>
<td>2007-present</td>
</tr>
<tr>
<td></td>
<td>Luxembourg</td>
<td>●</td>
<td></td>
<td>2000-present</td>
</tr>
<tr>
<td></td>
<td>Korea CDC</td>
<td>●</td>
<td>●</td>
<td>2007-present</td>
</tr>
<tr>
<td></td>
<td>NZAID</td>
<td>●</td>
<td></td>
<td>Miscellaneous</td>
</tr>
<tr>
<td></td>
<td>Rotary District 2650</td>
<td>●</td>
<td></td>
<td>2000-present</td>
</tr>
<tr>
<td></td>
<td>UNF</td>
<td>●</td>
<td></td>
<td>2007-present</td>
</tr>
<tr>
<td></td>
<td>UNICEF</td>
<td>●</td>
<td>●</td>
<td>1997-present</td>
</tr>
<tr>
<td></td>
<td>US CDC</td>
<td>●</td>
<td>●</td>
<td>1997-present</td>
</tr>
<tr>
<td></td>
<td>WHO</td>
<td>●</td>
<td>●</td>
<td>1997-present</td>
</tr>
</tbody>
</table>

Future financial needs for measles elimination would benefit from expanding partnerships. In addition to the Member States themselves, existing external financial support structures (e.g., GAVI Immunization Service Strengthening and Health Service Strengthening funds, Global Fund Health Service Strengthening resources, Pandemic Preparedness resources, etc.) may be utilized, especially in regard to fulfilling common objectives of strengthening health and immunization services and improving the surveillance infrastructure. Moreover, as measles elimination supports achievement of MDG #4, donors wishing to support achievement of MDGs may be encouraged to support measles elimination.

3. Epidemiology

The number of reported measles cases in the WPR has decreased by several orders of magnitude since measles data were collected from member States from a peak of 3,382,000 in 1974 (pre-immunization) to approximately 146,750 in 2008 (Figure 1). This overall decrease was associated with routine administration of measles vaccine to children in WPR Member States during the period of routine EPI strengthening. However, during the subsequent periods of measles control (1990-95), accelerated control (1996-2002) and elimination (2003-present), the total number of measles cases
reported from the Region has varied but has not demonstrated any decreasing trend. However, disaggregating regional data to separate cases reported from China from cases reported from the rest of the Region reveals that the trend in the number of reported measles cases excluding China has decreased since the RC resolution for measles elimination in 2003, whereas China has reported an increasing number of cases in recent years (Figure 2).

Figure 1: Reported Measles Cases Western Pacific Region, 1974-2008

Source: WHO-UNICEF Joint Reporting Forms
Age distribution data of lab-confirmed and epidemiologically linked cases for 2007-2009 are given in Annexes 1 and 2. In any given year, regional age distribution of measles is heavily biased towards those countries that experience outbreaks and/or report the most cases—the Philippines in 2007 (64% of cases), Japan in 2008 (89% of cases), and Viet Nam in 2009 (68% of cases). Hence, in 2007, 61.2% of all regional cases were <5 years old, whereas in 2008 and 2009 (through August), only 18% and 26.9%, respectively, were <5 years old. In 2007, only 15.7% of the Region’s cases were ≥15 years old, whereas in 2008 and 2009, 56.4% and 55.4%, respectively, were ≥15 years old. Japan, Viet Nam, Australia, and to a lesser extent Singapore and Hong Kong, report a much greater percentage of cases ≥15 years old than do countries such as Cambodia, Philippines, Lao People’s Democratic Republic and Malaysia, which report primarily cases <15 years old. It is also important to note that within countries measles age distribution varies. In China, for example, large cities report cases primarily among young adults and infants, whereas in the rural areas of Western provinces young children are primarily affected. National planning therefore must carefully consider sub-national epidemiologic data to customize approaches to eliminate chains of measles transmission as countries and areas enter the endgame of measles elimination.

Genotypes of measles virus affecting the greatest number of countries and areas in the WPR from 2006-2009 include D9 in 10, H1 in 6, D4 in 4, G3 in 4 and D5 in 3 countries and areas. Remaining endemic strains include, at a minimum, H1 in China and Viet Nam and D5 in Japan. Some genotypes appear to be disappearing: the last D3 and G3 genotypes were identified in 2006 in the Philippines. Importations were common: among the four countries with D4, Australia’s was imported from India and China’s from France.
Republic of Korea reported an imported B3 case from Libya. China reported an imported D9 case from Thailand.

Deaths from measles are rarely reported in the Region. However, estimates using a natural history model indicated that the number of estimated deaths from measles has decreased by 73% from 25,000 in 2000 to 7,000 in 2007. 5

4. Costs

The costs of SIAs and developing and implementing case based measles surveillance supported by a WHO accredited laboratory were extracted from WHO/WPRO financial records since 2003, the year when the measles elimination goal was established by a regional committee resolution. These figures do not include country-specific government support or bilateral contributions, both of which are substantial, and only include countries requiring donor assistance.

Annex 3 lists the financial contributions for measles elimination in the WPR, by donor-partner, since 2003. Financial data are based on WHO financial record and do not include all forms of donor support or bilateral and in-kind donations. To date, a total of approximately US$31 million of donor funds has been invested in measles elimination, including US $15.4 million to support SIAs, US$7.6 million to support surveillance, and another US$8.0 million in technical assistance/staff costs.

Major sources of funding for measles elimination in the Western Pacific Region have come from US CDC, UN Foundation (primarily through the International Financing Facility for Immunization [IFFIm]), AusAID and the Church of Jesus Christ of Latter Day Saints. Additional donors supporting measles elimination include the American Red Cross, GAVI, Japan Ministry of Foreign Affairs, JICA, Japan NIID, Korea CDC, Luxembourg Agency for Development Cooperation, UNICEF, and WHO. Past donors that could be mobilized to renew support for measles elimination include CIDA, and NZAID.

Resource needs to achieve Regional measles elimination by 2012 are estimated at approximately US$53.9 million if monovalent measles vaccines are used in countries that currently do not use rubella containing vaccine (RCV), and US$66.1 million if MR vaccine is used exclusively in expectation that countries will soon introduce RCV. Assuming elimination is achieved in 2012, follow up SIAs, surveillance and technical support costs are estimated to be US$6.7 million (US$8.1 million if MR is used exclusively) from 2013-2015 and another US$9.1 million (US$10.5 million if MR is used exclusively) from 2016-2020. These costs do not include unexpected immunization activities in response to outbreaks. Annexes 4-7 provide the plan and estimated budget by country and area for SIAs (with and without exclusive use of MR), surveillance and lab support to achieve and then maintain

measles elimination in the WPR from 2010-2020. Annex 8 describes assumptions and methods used in developing the plan and budget.

Donors expected to contribute to achieving the measles elimination goal are the same that have provided past support. However, it is of great concern that at least two of the four historically major funding sources, AusAID and UN Foundation, are either less interested or less endowed to provide the same level of support for measles elimination in the coming years as provided in the past. New funding sources will likely be required to fill the funding gap to achieve elimination in 2012 and maintain elimination through 2020.

5. Chronology and progress

As noted above, the history of measles elimination in the Western Pacific Region can be divided into three periods – the period of measles control (1990-95), the period of accelerated measles control (1996-2002), and the period of measles elimination (2003-present).

In 35 of the 37 countries comprising the region (excluding China and Pitcairn), the weighted mean coverage of MCV1 was 80.8% during 1990–1995 (the period of measles control); this increased to 89.0% during 1996–2002 (the period of accelerated measles control) and to 91.6% during 2003–2008 (the period of measles elimination, Fig. 1). WHO estimated that MCV1 coverage in China from 2003–2007 increased from 85% in 2003 to 94% in 2007 (data not available for 2008).

In 2002, 22 countries and areas provided a routine MCV2 dose; by 2009, 30 countries and areas included MCV2 in their routine schedule. Prior to 2003, few countries reported MCV2 coverage to WHO. During 2003-2008, the number of reporting countries varied annually from 16 to 24. These country estimates were used to determine the regional weighted MCV2 coverage by year. Mean MCV2 coverage (excluding China) during 2003–2008 was 84.2%. China’s reported MCV2 coverage ranged from 84.1% to 96.4% during 2003–2007, with a mean of 92.5% (data not available for 2008). Annex 9 provides a list of WPR countries and areas, their routine MCV1 and MCV2 schedule, and reported MCV1 (WHO estimates) and MCV2 (country estimates).

With an accelerated measles control goal proposed in 1996, countries and areas that successfully had become polio-free turned their attention to measles and began conducting SIAs. During the period of accelerated measles control (1996-2002), 25 WPR countries and areas vaccinated approximately 51.6 million children with overall coverage of 91% (including Viet Nam and Cambodia that conducted rolling SIAs that began in 2002 and continued through 2003 and 2004, respectively) From 2003-2008, a total of 22 countries and areas conducted SIAs reaching another 144.3 million children with an average coverage of 93%. Annex 10 lists details regarding SIAs conducted ion WPR countries and areas since 1994.

During the measles control period (1990-1995), measles surveillance was
encouraged in every district with aggregate data reporting. During the accelerated control period (1996-2002), active surveillance with laboratory confirmation of suspected outbreaks was recommended. In the current period of measles elimination (2003-present), high-quality case-based surveillance; with access to an accredited measles laboratory network for confirmation of suspected measles cases and identification of measles genotypes.

As of 2009, all 37 countries and areas of the WPR conduct case based measles surveillance and have access to an accredited measles laboratory network. All but one (China) periodically report case based measles data to WPRO. In 2007, WHO/WPRO requested countries and areas to report core variable data on each case by the 7th of every month, and provided feedback through quarterly publication of the Measles Bulletin. From 2007 to 2009 (through August), the percentage of countries reporting monthly to WPRO (with the 21 Pacific island countries and areas [PICs] reporting as one group) increased from 51% to 80%, and the number doing so by the 7th of very month increased from 19% to 57%, respectively.

WPRO monitors surveillance quality within countries by standard indicators. The most important of these include:

1. Number of reported suspected measles cases that are discarded as non-measles
   a. Targets
      i. ≥ 2/100,000 population nationally
      ii. ≥ 1/100,000 in at least 80% of districts

2. Percentage of reported suspected cases that have adequate investigation within 48 hours of report (adequate: core variable data collected on case investigation form)
   a. Target: ≥ 80% of reported suspected cases

3. Percentage of reported suspected cases that have adequate specimens collected (adequate: collected within 28 days of rash onset)
   a. Target ≥ 80% of reported suspected cases

4. Percentage of specimens with IgM results within 7 days of receipt in lab

Table 2 lists indicator results for the Region overall, excluding Australia, China, New Zealand, and Singapore, which do not provide the core variable data required to calculate indicators

Table 2: Key measles surveillance performance indicators, WPR, 2007-09*

<table>
<thead>
<tr>
<th>Surveillance Indicator</th>
<th>Target</th>
<th>2007</th>
<th>2008</th>
<th>2009* (annualized)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National reporting of discarded measles cases</td>
<td>≥ 2 per 100 000</td>
<td>2.5</td>
<td>1.6</td>
<td>2.0</td>
</tr>
<tr>
<td>% of districts reporting 1/100 000 discarded measles cases</td>
<td>≥ 80%</td>
<td>30.6%</td>
<td>30.0%</td>
<td>34.8%</td>
</tr>
<tr>
<td>% of suspected cases with adequate investigation</td>
<td>&gt; 80%</td>
<td>26.7%</td>
<td>47.8%</td>
<td>55.8%</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>% of suspected cases with adequate blood specimens</td>
<td>&gt; 80%</td>
<td>64.7%</td>
<td>62.9%</td>
<td>76.9%</td>
</tr>
<tr>
<td>% of specimens with IgM results within 7 days of receipt in lab</td>
<td>&gt; 80%</td>
<td>79.8%</td>
<td>76.3%</td>
<td>59.5%</td>
</tr>
</tbody>
</table>

*As of August 2009*

Indicator data by country and area are provided for 2008 and through August 2009 in Annex 11.

In spite of improvements in routine 2-dose measles immunization coverage and numerous high coverage SIAs in 30 of 37 countries and areas, regional measles incidence has not decreased appreciably since 1995. In 1989, the year prior to the measles control period, 222,498 measles cases (149.1 per million population) were reported to WHO/WPRO. In 1995, the last year of the measles control period, 76,345 cases (47.6 per million) were reported. In 2002, the last year of the measles accelerated control period, 108,568 cases (63.4 per million) were reported, and most recently, 6 years into the period of measles elimination, 146,171 cases were reported (81.7 per million) in 2008. As of August 2009, 60,792 measles cases have been reported to WPRO (assuming all 56,664 cases reported from China are confirmed cases), resulting in an annualized incidence of 50.6 per million population, and a 57% decrease in the number of cases reported during the same time period in 2008, largely as a result of a large increase in the number of Chinese provinces conducting SIAs in 2008 (N=9) and 2009 (N=13) and implementation of a national plan to eliminate measles by 2102 in Japan that includes extensive social mobilization and implementation of a 5-year rolling national SIA targeting persons 13 and 18 years old. Measles case classification data are provided by country and area for 2008 and 2009 in Annex 12.

A review of country specific data in annexes 9 and 10 reveals that monitoring regional progress towards measles elimination requires in-depth historical analysis of country-specific activities and data. As China and Japan did not begin to conduct geographically extensive SIAs until last year, it is not surprising that these two countries, which together accounted for 82% of the Region’s population, reported >97% of the Region’s cases in 2008. Figure 3 is an epidemic curve that illustrates the trend in measles incidence in the remaining countries and areas.
Before 2000, 16 (73%) of the 22 countries and areas that conducted SIAs were PICs, almost all of which have population sizes that are unlikely to sustain endemic measles virus transmission. Countries with larger populations such as Viet Nam, Republic of Korea, Malaysia, Cambodia, and Lao People’s Democratic Republic did not conduct SIAs until shortly after after polio free status was certified in the Region in 2000. Large outbreaks in Japan and the Republic of Korea in 2000 and 2001 resulted in a large increase in the number of reported cases in the Region. In response to its outbreak, Republic of Korea conducted a highly successful nation-wide SIA in 2001; following Korea, many other countries with large populations conducted measles SIAs from 2002-2004 including Cambodia, Malaysia, Philippines, and Viet Nam. These SIAs, coupled with increases in routine MCV1 and MCV2 coverage, resulted in a consistent decrease in reported measles cases from 2000 to 2005 that has been sustained through 2008. The number of measles cases reported from 35 of the 37 countries and areas of the WPR (excluding China and Japan) decreased by 96% from 83,620 in 2000 to 3,291 in 2008.

In 2002, apart from some of the PICs with <300,000 population that are unlikely to sustain endemic measles virus transmission, no country or area of the WPR could be considered to have eliminated measles. As of 2009, 25 of the Region’s countries and areas have either eliminated or nearly eliminated measles, including Republic of Korea, Australia, Macau (China, SAR), Brunei Darussalam, and the 21 PICs. In 2006, Republic of Korea declared measles eliminated after having successfully implemented WHO-recommended strategies. In Australia, measles incidence has ranged from 0.5 to 6.1 per million since 2002; case investigations and genotype analysis suggest that the majority of these cases were imported or import-related. Reported routine
vaccination coverage in Australia is high; however, sensitivity of suspected measles reporting is uncertain because surveillance performance is not monitored nationally. In Macau (China, SAR), fewer than five cases per year have been reported since 2001, corresponding to an annual incidence of zero to 8.3 per million; case investigations and genotype analysis of specimens in the past several years suggest that the majority of these cases were imported. Surveillance performance in Macau satisfies all indicator targets. Similarly, Brunei Darussalam reported only 3 cases in 2008 and no cases to date in 2009. Surveillance performance is nearing indicator targets, but is difficult to assess because of Brunei’s small population of 400,000. Routine MCV1 and MCV2 coverage has exceeded 95% since at least 2003. All 21 Pacific island countries reported zero measles cases in 2007 and 2008 after a 2006 outbreak of 132 measles cases in Fiji and SIAs conducted in 5 PICs. In 2009, only 2 of 68 suspected measles cases in Fiji were confirmed as measles and these were thought to be sporadic cases. No other PIC has confirmed measles cases in 2009. However, measles surveillance performance in the PICs does not meet indicator targets.

6. Enabling factors and challenges

Factors contributing to progress towards measles elimination include 1) high level political commitment, 2) strong routine immunization systems with school entry immunization requirements, 3) high coverage SIAs, 4) high quality case-based surveillance, and 5) for island countries and areas, very small population size and geographical isolation.

Recent commitments from China and Japan will bring the region closer to elimination. China plans to conduct the largest ever national SIA in 2010, targeting over 94 million children and adolescents over a 1-2 month period. Japan is implementing a 2008 plan to increase routine 2-dose measles coverage, conduct a 5-year rolling SIA that will ultimately protect all persons <23 years old, and strengthen surveillance. Strong SIA performance in developing countries such as Cambodia and , Lao People’s Democratic Republic which are struggling to improve routine health delivery systems, suggests that periodic follow up SIAs may be required to achieve and sustain regional measles elimination until global eradication removes the threat of importation. Therefore, the greatest challenges to achieving measles elimination in the WPR by 2012 are ensuring high coverage and quality of routine immunization and SIAs in the most populous and in the least developed countries in the Region. In order to achieve elimination by the target date of 2012, the most important factor is to obtain visible and meaningful political commitments at the highest level in each of these countries and ensure that three requirements are met:

1. Two-dose measles vaccination coverage must be sustained at high levels (95% coverage);
2. Until such high levels of vaccination coverage are achieved through routine systems, catch-up and follow-up SIAs, and SIAs targeted for special high risk populations, must achieve at least 95% coverage of their target populations to ensure high levels of population immunity;
3. High quality case based measles surveillance that is supported by an accredited laboratory network must be developed and sustained to identify residual areas of measles virus transmission and determine whether new cases result from endemic transmission or are imported or import-related.

7. Certification and validation

WPRO plans to convene an Expert Committee that includes global and regional representation in 2010 to define the process and criteria for validation of measles elimination at the national and regional level. It is likely that criteria will be based on the demonstration of

1. absence of circulating endemic measles virus for at least one year
2. adequate surveillance and genotype data
3. validation of high population immunity

Specific criteria such as the current indicators for monitoring progress towards measles elimination and other data (e.g., serosurvey data) may be used to fulfill the three general criteria above, but it is unlikely that any single specific indicator will be required to pass or fail validation.

In considering countries and areas that have been measles free but may experience importation of measles virus and subsequent secondary transmission, re-establishment of endemic transmission would likely be defined as the presence of a chain of transmission of laboratory-confirmed virus that continues uninterrupted for a period of twelve months or more as demonstrated by epidemiological and laboratory evidence.

National committees likely would be established to determine measles elimination status within their countries and, when they believe that ample evidence exists to satisfy the 3 general criteria above, to submit that evidence to the regional expert certification committee to validate elimination status in respective countries and areas. PICs may be validated group-wise.

Ultimately, the regional measles elimination certification committee would certify the region as having eliminated measles.

8. Measles elimination and health systems

An investment in measles elimination provides multiple benefits to child survival in addition to decreased morbidity and mortality from measles. The WHO/UNICEF Western Pacific Regional Child Survival Strategy identifies measles immunization coverage as one of the core indicators to track progress in child survival, and integrated management of childhood illness (IMCI) protocols seek to utilize opportunities to provide MCV and other vaccines to children presenting to health facilities. Measles elimination contributes to achieving millennium development goal (MDG) # 4: "Reduce by 2/3, between 1990 and 2015, the under 5 mortality rate." Given the synergies with and benefits to child survival that measles elimination activities provides,
it is not surprising that one of the three indicators for monitoring progress towards achieving MDG # 4 is the "proportion of 1 year-old children immunized against measles."

Benefits provided by measles elimination activities are many. First, prevention of measles infection prevents the increased susceptibility to and mortality from pneumonia and diarrhea that lasts for months following infection. Diarrhea and pneumonia cause 36% of deaths among children under 5 years old globally, and 31% of all under five deaths in the Western Pacific Region. Second, the need to achieve 95% coverage with 2 doses of MCV requires program managers at every level to re-focus efforts on strengthening routine immunization service coverage and quality using strategies recommended in the Global Immunization Vision and Strategy. Third, administering a second dose of measles vaccine at 18-24 months creates a platform for other interventions such as DTP4, OPV4, vitamin A, deworming medicine, and growth monitoring. Fourth, provision of nutritional supplements such as vitamin A with routine MCV1 and during SIAs provides additional protection of children against disease, and prevention of measles infection also prevents depletion of limited stores of Vitamin A that would then render the child more susceptible to any infection. Fifth, establishing school entry requirements provides an opportunity to ensure fully immunized status of children with all antigens, decreases child absenteeism from school and parental absenteeism from work, and strengthens collaboration between health and education ministries, establishing relationships that will help promote school health overall. Finally, developing microplans, intensified multi-level supervision, and use of standardized monitoring indicators and requirements to report, analyze, interpret and feedback data builds capacity to strengthen planning, monitoring, supervision and surveillance and data management systems thereby benefitting the entire health sector.

Measles elimination activities also provide opportunities to accelerate control of or eliminate rubella. Currently 29 countries and areas use rubella containing vaccine (RCV) for routine immunization, and many have used MR or MMR during measles SIAs. Laboratories routinely test for anti-rubella IgM in serologic specimens from suspected measles cases that are IgM negative for measles, thereby establishing a rubella burden.

Regrettably, an increasing array of donor funded initiatives may be displacing measles elimination as a beneficiary of donor partner investment. The Global Fund to Fight AIDS, TB and Malaria, pandemic preparedness, and an increasing trend to finance health systems strengthening as opposed to perceived "vertical" programs threaten the viability of measles elimination plans. Several historical donor partners for measles elimination in the WPR have shifted the targets of their health investments to the detriment of measles elimination needs in the Region.

9. Programmatic Feasibility and Plans

The WPR can achieve measles elimination by 2012 if political commitment transforms this health initiative into a national priority in member states,
thereby mobilizing and motivating all government and societal resources to implement the three requirements mentioned at the end of section 6. The status of and prognosis for measles elimination by 2012 differs by country and area. As noted above, 25 countries and areas have already eliminated or nearly eliminated measles, including the 21 PICs, Australia, Brunei Darussalam, Macau (China, SAR), and Republic of Korea. In addition, Singapore and Hong Kong (China, SAR) are very likely to eliminate measles because of their strong health infrastructures and very high two-dose measles coverage.

Ten Member States are at risk of not eliminating measles by 2012. These include two high income (Japan, New Zealand), one upper middle income (Malaysia), four lower middle income (China, Mongolia, Papua New Guinea, Philippines), and three low income (Cambodia, Lao People’s Democratic Republic, and Viet Nam) countries. Most are taking steps to overcome their particular challenges. Donor support is needed for most of the lower middle income and low income countries. However, in an environment of diminishing donor support, transformational national political commitment must translate into financial and human resource mobilization and inter-sectoral social mobilization.

Japan experienced a large measles epidemic in 2007-2008 involving tens of thousands of young adults and children primarily because of immunity gaps that had not been previously addressed. Measles incidence was 85.5 in 2008. In response, Japan developed a National Measles Elimination Plan that includes

1. advocacy for increasing routine MCV2 coverage at 5-7 years of age
2. a 5-year rolling SIA for 13 and 18 year old cohorts beginning in May 2008;
3. establishing measles as a nationally notifiable disease and creating a nation-wide case based surveillance system for measles and rubella (previously a sentinel system was used)
4. establishing national and sub-national Measles Elimination Councils to oversee the measles elimination plans and monitor progress

Preliminary data reported by Japan at the June 2009 WPR Technical Advisory Group meeting indicated that SIA coverage among 13 and 18 year olds was approximately 66% and 58%, respectively, in 2008, the first year of the initiative. Japan reported in the WHO/UNICEF Joint Reporting Form that MCV2 coverage was 78% in 2008. In spite of these less than optimal coverage, measles incidence decreased from 85.5 per million in 2008 to 6.5 per million in 2009 (annualized). Implementation of Japan’s National Measles Elimination Plan will be more likely to succeed in eliminating endemic measles virus transmission by 2012 if higher levels of MCV2 and SIA coverage are achieved. School entry immunization requirements for students of all ages may be one method of achieving such high coverage.

New Zealand has had relatively and chronically low MCV1 coverage (79-84% since 2003), has not reported MCV2 coverage and conducted one SIA in
1997 reaching only 300,000 (75% of the target) children 2-10 years old. A large outbreak began in May 2009 affecting a wide age group of persons, including young adults. As of August 2009, 171 confirmed cases (60.4 per million) were reported. In response, the government has extended insurance benefits for measles vaccination to older children and young adults, with a resulting increase in utilization. However, this relatively limited approach may not be adequate to achieve elimination. As with other developed countries with high rates of matriculation, school immunization requirements for students of all ages would help ensure high levels of population immunity.

Malaysia remains with endemic measles virus circulation despite reaching 94% of children 7-15 years old in a 2004 SIA and maintaining national MCV1 coverage at ≥90% for at least 5 year (except in 2004). Routine MCV2 coverage usually has not been reported. Measles incidence was 12.3 per million in 2008 and 15.6 in 2009 (annualized). Cases are mostly unvaccinated, and predominantly young: in 2008, 65% were <5 years and 17% were ≥15 years old. In 2008, 5 states had measles incidence >10 per million, and in 2009, high annualized measles incidence has continued in three of the same states as of June 2009: Terengganu (247.2 per million), Kelantan (51.3 per million), and Selangkor (19.0 per million). Pahang State reported 21.6 per million cases. Identifying and targeting specific groups at risk for low vaccination coverage through sub-national SIAs, implementing school entry requirements for all ages, and changing the MCV2 schedule to 18-24 months to close immunity gaps targeting would likely be sufficient to eliminate measles by 2012.

Among the lower middle income countries, indeed among all Member States, China is in a class by itself. China, with 75% of the region’s population, has always reported the majority of the region’s cases. In 2008, China had the highest measles incidence in the Region (98.4 per million population) and reported 90% of the Region’s 146,171 measles cases. Commitment to measles elimination in China has been gradually increasing. From 2003 -2007, only 8 (26%) of China’s 31 provinces had conducted catch-up SIAs. Beginning In 2008, China began to intensify its measles elimination activities with five additional provinces conducting catch-up SIAs; 11 more provinces are conducting catch-up SIAs in 2009. Also in 2008, China began scaling up measles vaccine manufacturing capacity to provide sufficient vaccine to conduct a nation-wide measles campaign planned for September or October 2010. Although not yet finalized, current plans include vaccinating approximately 96 million children in three different age groups: 5 provinces will target children 8 months – 14 years old (target=36 million); 3 provinces will target children 8 months – 6 years old (target = 2.7 million), and 23 provinces that have already recently conducted catch-up or follow up SIAs will target children 8 months to 4 years old (target=57.5 million). This nation-wide measles SIA will be the largest in world history, and if conducted uniformly well, should resolve at least two of the three major challenges for measles elimination in China: large numbers of unvaccinated children residing primarily in western provinces and a substantial number of “floating” (i.e., migrant) children that had not been reached during previous SIAs. Achieving very high coverage uniformly across China will likely require exceptional political
leadership at the highest level including President Hu Jintao, Premier Wen Jiabao and the State Council to mobilize all of civil society for a successful national campaign. Also, as the central government will not provide operational funds for the SIA, donors are requested to provide US$5 million to support operational costs in western provinces. Increasing numbers of adult and infant cases in large cities are a third challenge that the 2010 SIA will not address. China will likely require additional special approaches targeting these at risk groups in order to eliminate measles virus transmission by 2012. Universal implementation of school entry requirements for students of all ages (including university) and immunization of adult workers in large factories may be two such approaches.

Mongolia has reported two dose measles coverage in excess of 95% at least since 2003, and was the first country in the WPR to conduct a measles SIA (in 1994), reaching 75% of children 3-8 years old. Since then, Mongolia conducted 3 more measles SIAs with substantial overlap in target ages: an SIA in 1996 reached 98% of children 9 months – 10 years old; an SIA in 2000 vaccinated 96% of 9 month – 8 year old children; and an SIA in 2007 reached 97% of children 2-10 years old. Surveillance needs improvement, with suspected cases in 2008 reported primarily from Ulan Bataar and two other Aimag (provinces). Nevertheless, 31 cases (all lab confirmed) were reported in 2008 as a result of active surveillance in the main national hospital, resulting in an incidence of 11.7 per million. Surveillance training conducted in 2009 has helped improve surveillance quality. As of August 2009, the discarded measles case rate was 5.5 (annualized), with 43% of Aimag reporting at least 1 discarded measles case per 100,000 population. Only 3 (2.9%) of 102 suspected cases with blood specimens were IgM positive against measles. Improving the representativeness of suspected measles case reporting, investigation and specimen collection (including specimens for virus detection) from all 21 Aimag is urgently needed to identify potentially undetected chains of measles virus transmission. As with other countries, Mongolia also would benefit from a school entry immunization requirement to ensure uniformly high two-dose measles coverage by the time of school entry.

Papua New Guinea (PNG) reported MCV1 coverage at 9-11 months of age ranged from 37-54% from 2003-2008. However, as a very large percentage of children (~30%) are accessible only through outreach patrols that are conducted once every 6-18 months, many children receive MCV1 after 12 months of age. In fact, a recent review of national data revealed that a minimum of 80% of children likely receive routine MCV1 by the 2nd or 3rd birthday. SIAs were conducted in 1997 (coverage=84% of 9-59 month old children), 2003-05 (coverage =76% of 6 month-10 year old children) and 2008-09 (coverage=83% of 6 month – 6 year children). As surveillance is not sensitive, measles incidence is unknown. It is possible that the geographic remoteness and sparseness of much of the population may allow measles elimination to occur with lower levels of population immunity than is usually recommended. However, the current priority for PNG is to improve case based measles reporting, investigation, and specimen collection rates to determine the true incidence and epidemiologic characteristics of measles. In addition, it is important that outreach patrols are conducted at least quarterly,
and with 80% coverage, that PNG consider providing MCV2 at 18-24 months. As primary school enrollment is 60% for males and 50% for females (MICS), school entry requirements may help improve coverage, but will not be sufficient to achieve high population immunity among school age children. Follow up SIAs are planned in 2010 and 2012.

The Philippines, despite 3 nation-wide SIAs in 1996, 2004 and 2007, remains with residual transmission of measles virus. Catch up SIA coverage in 1996 was 85% and did not result in any appreciable decrease in reported measles cases. A follow up SIA in 2004 (Ligtas Tigdas) reached 95% of children 9 months – 7 years old, and a second follow up in 2007 (Knock Out Tigdas) reached 95% of children 9-48 months old. Routine MCV1 coverage at 9-11 months of age had been chronically low at 80-85%, but a downward revision of the target population denominator resulted in MCV1 coverage of 92-93% from 2005-2007 that decreased to 86% in 2008. Incidence was 9.8 per million in 2008 and 6.1 in 2009 (annualized). In both 2008 and 2009, more than 70% of cases were <10 years old; 20-25% were 5-9 years of age. In 2009, 38% of cases 1-4 years old were unvaccinated and 38% received a single dose of MCV; among cases 5-9 years old, 56% were unvaccinated and 33% had received a single dose. The Philippines will begin implementing a 2-dose strategy later in 2009 with MMR administered at 18-24 months of age. To close immunity gaps. School entry immunization requirements for students of all ages would ensure high immunization coverage across a wide age. Identifying and targeting special at risk populations with low school enrollment may also be needed. Another follow up or wide age range SIA may be required in 2011 or 2012 to further improve population immunity and achieve elimination.

Among the low income countries, Lao People’s Democratic Republic (PDR) suffers from problems of health infrastructure that does not support high routine MCV coverage. In Lao PDR, MCV1 coverage at 9 months of age ranged from 36-52% from 2003-2008. However, a catch up SIA conducted in 2007 reached 96% of the target population. Only 2 cases were lab-confirmed or epidemiologically linked in 2008 and both were ≥ 15 years old. However, 72 such cases were identified in 2009, resulting in an annualized incidence of 17.8 per million. Interestingly, 62% of the 2009 cases were 5-14 years old; only 18% were 1-4 years old. Many lived in areas with low SIA coverage. With such low routine immunization coverage, Lao PDR will have to conduct frequent follow up SIAs to prevent accumulation of susceptible children. In addition, wider age range sub-populations with low 2007 SIA coverage should be identified and targeted in a sub-national SIA. With 86% of males and 81% of females enrolled in primary school (MICS 2005-06), school entry immunization requirements would be a useful way to help ensure high coverage among 5-14 year old children.

Cambodia’s MCV1 coverage ranged from 78-80% from 2004-2007, and last year increased to 89%. A rolling catch up SIA conducted from 2002-2004 reportedly reached 100% of the target population, and a follow up SIA in 2007 achieved over 100% of children 9-59 months old. As health staff are give cash incentives to report suspected measles cases (defined as fever and
rash), a very large number of suspected cases are reported annually. In 2008, Cambodia’s discarded measles rate led the Region at 16.6 per 100,000 population. Measles incidence was 120.1 per million, but included 1,760 clinically confirmed cases and only 5 laboratory confirmed cases. No epidemiologically linked cases were identified. In 2009, among 324 confirmed cases (32.5 per million, annualized), 39 were lab confirmed and no epidemiologically linked cases were identified. With 1,952 discarded measles cases (discarded measles rate = 13.1 per 100,000) in 2009, only 2.0% of suspected cases with blood specimens were IgM positive against measles. Assuming clinically confirmed cases are similar to suspected cases with blood specimens, approximately 2.0% of the 285 clinical confirmed cases (i.e., 6 cases) are likely to be bona fide cases of measles, resulting in a “corrected” number of confirmed cases of 39 + 6 = 45 cases, or 3.0 per million. A priority for Cambodia is to evaluate the quality of measles surveillance and estimate the true incidence of measles; a joint national-international surveillance review is expected in 2010. Cambodia has indicated an interest to apply for GAVI finding of MCV2, and would be eligible for such funding in 2011, assuming MCV1 coverage can be maintained at ≥ 80% in 2009 and 2010. Introduction of MCV2 at 18-24 months would protect those 15% of vaccinated children unprotected by the first dose and possibly reach previously unvaccinated children. However, with primary school registration estimated at 91% for males and 89% for females (MICS), a school entry immunization requirement would help ensure high population immunity by school entry. A follow up SIA targeting children 9-59 months is planned for 2011.

Viet Nam is a “low income” country with a strong health infrastructure, and maintained MCV1 coverage at 9-11 months at 92-97% from 2003-2008, except for 2007 when a vaccine stock out resulted in 83% coverage. MCV2 was introduced for 6 year olds in 2006, with 18% coverage in 2007 and 97% in 2008. Viet Nam conducted a successful rolling catch up SIA in 2002-03 vaccinating 99% of children 9 months to 10 years old. In 2004 a sub-national SIA was conducted vaccinating 99% of 12-18 year olds. Another sub-national SIA was conducted in 2007 in most districts of 17 Northern provinces and in 2008 in 5 Central and Highland provinces, each reaching 97% of persons aged 1-20 or 7-20 years old. Measles incidence in Viet Nam had been relatively low since 2004 except for occasional outbreaks in isolated provinces. In the last quarter of 2008, a large outbreak involving primarily young adults (many of which were university students) ages 18-26 years began in Ha Noi and in early 2009 spread to the South and has continued through 2009. As of August, 2,222 confirmed cases (37.2 per million annualized) were reported to WHO/WPRO in 2009, a larger number without completed case investigation forms have tested IgM positive against measles and have not yet been reported. We estimate the actual number of lab-confirmed cases to be approximately 5,000. As the measles epidemic evolved, an increasing number of children <5 years old were infected, suggesting an immunity gap in this age group. As of April 2009, among 12-59 month old cases, 54% had never been vaccinated and 42% had received one measles dose; among 5-9 year old cases, 40% had never received MCV and 56% had received one dose. Viet Nam is considering conducting an SIA in 2010 targeting two age groups: 1-6 years and 19-26 years, with a subsequent change in the MCV2
schedule to 18-24 months to close the immunity gap. With a primary school enrollment rate of 94% for both males and females (MICS) and identification of post-secondary school/university students as a high risk group, school entry immunization requirements for students of all ages (including university) would seem to be a priority for Viet Nam in addition to the other interventions being considered in 2010. As Viet Nam has a national goal to eliminate measles by 2010, implementation of the strategies proposed above would seem urgent.

In summary, while each Member State has its own unique set of conditions that either favor or threaten achievement of the measles elimination goal, the strategies and tools to achieve the goal are well defined and available to all. Member States may require different geographic scopes, frequencies and target ages for SIAs (if needed), routine strengthening and optimization of MCV schedules, and attention to particular areas of surveillance underperformance. All countries would benefit from a school entry immunization requirement that, especially in countries with cases among young adults, includes post secondary school institutions (universities, training academies, etc.). All countries would benefit from strong national and sub-national political commitment from the highest level to 1) mobilize intersectoral support from government and civil society and 2) motivate both workers and beneficiaries to provide and receive measles vaccine.

A regional plan and budget for measles elimination has been developed and shared with Member States. An updated plan/budget for 2010-2020 has been provided in this report (annexes 4-7). Financial support needed to maintain measles elimination after 2012 is relatively small compared to the needs to achieve elimination. While it is difficult to determine the probability of individual countries to self-finance their measles elimination activities, some donor funding would likely be particularly important for the low and low middle income countries of Cambodia, China, Lao PDR, PNG, Philippines and Viet Nam. Because of the critical importance of China to regional success and the low income status of most western provinces, donor support for China’s 2010 historic, nation-wide SIA is particularly important. Finally, support for the lower middle income PICs (e.g., Kiribati, Federated States of Micronesia, Samoa, Solomon Islands, Vanuatu) to maintain high population immunity against measles virus importation is also needed.

A global commitment to measles eradication through a WHA resolution could catalyze political support for measles elimination in countries that have not yet demonstrated strong political commitment for the goal. It could also motivate existing and new donor partners to provide greater financial assistance to countries within reach but without adequate resources to achieve the goal. Such new found national and donor commitment could well propel the WPR forward to become the next WHO Region to achieve its 2012 measles elimination goal and, in so doing, create a tipping point that motivates countries in other Regions to do likewise.