Working to Eliminate Measles Around the Globe

Accessible version: https://youtu.be/zla8WLSUCdE

June 16, 2015
Measles Virus

- RNA virus
  - Family: Paramyxoviridae
  - Genus: Morbillivirus

- Humans are the only reservoir

- Airborne transmission via aerosolized respiratory secretions from coughing or sneezing

- After 7–21 day incubation period, clinical symptoms develop

- Accompanied by immunosuppression, often leading to secondary bacterial infections
MEASLES DISEASE

- Highly contagious
- Vaccine preventable
- Typically occurs in childhood
- Classic rash and fever clinical presentation
- Severe complications: pneumonia, diarrhea, encephalitis, death
- Case-fatality ratio: 0.1%–10%

Photo courtesy of Professor Samuel Katz, Duke University Medical Center
Top Ten Causes of Death Worldwide in Children Under 5 Years, 2000

- Perinatal Conditions
- Lower Respiratory Infections
- Diarrheal Diseases
- Malaria
- Measles
- Congenital Anomalies
- HIV
- Pertussis
- Tetanus
- Malnutrition

Deaths (thousands)

World Health Organization (WHO), Global Burden of Disease 2000 Project
Measles is Highly Contagious and Prevented by Vaccination

- **Safe and highly effective vaccine**
  - Licensed in 1963
  - Requires cold chain for storage

- **Immunity and vaccination coverage needs to be high**
  - Over 90% to interrupt transmission and prevent epidemics

- **WHO recommends 2 doses for children**
  - 2 doses protects 97%–99% of children
  - 1 dose protects
    - 85% at 9 months
    - ≥95% at 12 months

Efforts to Eradicate Smallpox and Polio Support Measles Elimination

- **Smallpox (achieved)**
  - Integrated measles control efforts in 20 West Africa countries
  - Contributed to WHO’s Expanded Program on Immunization (EPI)
  - Lives have been saved and resources are able to be directed to other public health priorities

- **Polio (nearly there)**
  - Infrastructure to eradicate polio designed to be integrated with activities to eliminate measles
  - Challenges (e.g., insecurity) have delayed reaching goal
  - Lessons learned from polio can be transferred to MR eradication
  - Much harder than anticipated, but worth the investment
  - The POLIO ENDGAME has begun and in countries that have eliminated polio, assets are being transitioned
“Measles eradication should be done.”
World Health Assembly, 2011

PAHO Goal: The Americas

Worldwide Measles Initiative

Last case in the Americas

GVAP Worldwide Goal: Eliminate in 5 of 6 WHO Regions

Measles Eradication?


PAHO: Pan-American Health Organization
GVAP: Global Vaccine Action Plan
Global Measles Vaccination Targets by 2015

1. **Increase prevention** – Increase measles vaccination coverage for first dose (MCV1)
   - At least 90% nationally and at least 80% at district levels

2. **Decrease disease** – Reduce reported incidence of measles to fewer than 5 cases per million population

3. **Decrease deaths** – Reduce measles mortality 95%, based on number of deaths estimated in 2000
Global Vaccine Action Plan (GVAP)  
Measles & Rubella Initiative Goals

- Use combined measles and rubella vaccine
- Eliminate measles and rubella in 5 of 6 WHO regions by 2020
Worldwide Measles First-Dose (MCV1) Vaccination Coverage Stagnating

MCV1 Vaccination Coverage by WHO Region

Goal: 90% or higher

AFR: African region
SEAR: South-East Asia region
AMR: Region of the Americas
EUR: European region
EMR: Eastern Mediterranean region
WPR: Western Pacific region

WHO/UNICEF coverage estimates 2013 revision, July 16, 2014
Measles First-Dose Vaccination (MCV1) Coverage by Country – Goal is 90% or Higher

AFR: African region
AMR: Region of the Americas
SEAR: South-East Asia region
EUR: European region
EMR: Eastern Mediterranean region
WPR: Western Pacific region

WHO/UNICEF coverage estimates 2013 revision, July 16, 2014
Vaccination Campaigns Are Effective
But Sustained Efforts Are Essential

Reported Measles Cases by Month of Onset,
Western Pacific Region, 2010–2015

China conducted large MCV campaigns in October 2010,
leading to substantial reduction in cases

Measles Incidence (Cases per 1 million population) 2012: 5.9 2013: 17.2 2014: 43.8

Measles and rubella monthly country reports to WHO, as of April 20, 2015
Reported Cases of Measles Drop as Measles Second Dose (MCV2) Coverage Increases

South-East Asia Region (SEAR), 2003–2013

India two-dose strategy, including large vaccination campaigns, 2010

Cases


SEAR MCV1 coverage
SEAR MCV2 coverage

MMWR 2015;64:613–7

§ Others include Bangladesh, Bhutan, DPR Korea, Maldives, Myanmar, Nepal, Sri Lanka, Thailand, and Timor-Leste

MCV1: First dose of measles containing vaccine

MMWR 2015;64:613–7
Implementing Measles Second Dose (MCV2)

- In 2013, global coverage of MCV2 was only 53%
- Increasing vaccination efforts can increase two-dose coverage
  - Routine Immunization (RI) practices
    - As children are born and grow
  - Supplementary Immunization Activities (SIA)
    - Catch-up campaigns to reach large populations and different at-risk age groups
    - Opportunity to provide additional services beyond immunizations
Introducing Measles Second Dose (MCV2) into Routine Immunization Schedule

- Each year, more countries introduce MCV2 into RI schedule
- Establishes child health platform for 2nd year of life
- Opportunity to catch-up other vaccines and offer other services

RI: Routine immunizations
Immunization Vaccines and Biologicals, WHO, as of March 5, 2015
43 Measles SIAs in 28 Countries Reached Over 210 Million Children in 2014

81% SIAs integrated other interventions

Integrated interventions:
- OPV – 13
- Vitamin A – 8
- De-worming – 5
- Bed nets or other – 2

SIA: Supplemental immunization activities
OPV: Oral polio vaccine
Immunization Vaccines and Biologicals, WHO, as of May 25, 2015
Reduction in Estimated Measles Deaths, 1985–2013

2015 Global Target: Measles mortality reduction of 95% vs. 2000 estimates

1985–2013: 87% decrease

2000–2013
75% decrease
15.6 million deaths prevented

MMWR 2014;63:1034-8
India Retooling to Eliminate Measles and Rubella

- Strong political commitment
- Polio sites switching to laboratory-supported measles surveillance
- In 2010–2011, measles SIAs reached 119 million children
- In 2016–2018, nationwide MR SIAs will reach 450 million children under 15 years of age

Over 40,000 reporting sites in India

1 dot = 20 reporting sites

SIA: Supplemental immunization activity
MR: Measles and rubella
Incorporating Lessons and Infrastructure from Polio Eradication Efforts

- Build on existing infrastructure and investments
- Build on knowledge gained through polio eradication efforts
  - Adapt to areas of insecurity
- Sustain political leadership and field worker motivation
  - Use innovative strategies
- Ensure management capacity and program accountability
- Sustain gains to continue improving routine EPI
Supporting What Works to Eliminate Measles and Rubella

- Secure long-term funding (global and national)
- Engage communities to reach the underserved
- Strengthen routine immunizations
- Integrate surveillance
- Refine strategies through innovation
We Are Working Towards A World Without Measles!
The Role of the Global Measles and Rubella Laboratory Network

Paul A. Rota, PhD
Measles Team Lead,
Measles, Mumps, Rubella, Herpesviruses Laboratory Branch,
Division of Viral Diseases,
National Center for Immunization and Respiratory Diseases
Laboratory Surveillance for Measles and Rubella Elimination

- Competent and sustainable laboratory support for global surveillance
- Provided by the WHO Global Measles and Rubella Laboratory Network (GMRLN)
Global Measles and Rubella Laboratory Network (GMRLN)

- Initiated in 2000
- Built on Global Polio Laboratory Network model
- Multi-tiered structure
  - 3 Global Specialized Laboratories
    - CDC, PHE-UK, NIID-Japan
  - 14 Regional Reference Laboratories
  - 161 National Laboratories
    - 586 Subnational laboratories (including 362 subnational laboratories in China)

- 7 Global/Regional Laboratory Coordinators

Dr. M Mulders, WHO Headquarters
Strengths of the GMRLN

- Standardized testing and reporting structure
- Excellent quality control
- Timely results that drive public health decision making
- Alignment with national public health priorities
- Local lab management and control
- Integrated testing includes other vaccine preventable diseases
  - Measles, rubella, Yellow fever, Japanese encephalitis, rotavirus and hepatitis B
Roles of the GMRLN

- Confirm cases of suspected measles or rubella
- Determine genetic relationships of circulating strains
- Measure population immunity
Laboratory Confirmation of Suspected Measles Cases

- Distinguish measles and rubella cases from other febrile rash illnesses
- Detection of measles or rubella specific IgM in a serum sample taken at first contact with patient
- Detection of viral RNA by RT-PCR

IgM: Immunoglobulin M
RT-PCR: Real time polymerase chain reaction
Increasing Workload of the GMRLN

Serum Samples Tested for Measles IgM, 2006–2014

Thousands of Tests

- Annual
- Monthly

Dr. M Mulders, WHO Headquarters
Genetic Characterization of Measles Viruses to Track Transmission

Map transmission pathways and document interruption of transmission

Importation of genotype B3

Importation of genotype D9

Global transmission of measles viruses from the Philippines, 2014
Measles Nucleotide Surveillance (MeaNS)

- Global genetic sequence database for measles
- Maintained at Public Health England
- Governance from labs in all WHO regions
- Over 22,000 sequences in database
  - Available to participating labs
  - Discussion of open sharing
- Rapid sequence analysis and strain detection
MeaNS Provides Summaries of the Global Distribution of Measles Genotypes

Distribution of measles genotypes: Mar 2014 to Feb 2015

WHO and MeaNS
Laboratories perform seroprevalence studies to verify vaccination coverage
Challenges for the GMRLN

- Financial sustainability
- Laboratory network expansion (e.g., India)
- Introduction of new laboratory methods
- Sustain and expand quality control program
- Integration with surveillance for VPDs
- Development of effective test strategies for low incidence settings
- Increased workload with national and regional verification of measles elimination

VPD: Vaccine preventable disease
New Technologies on the Horizon

- **New or improved serologic testing methods and assays**
  - High throughput neutralization
  - High throughput seroprevalence
  - Point-of-Care (WHO, PHE)

- **New or improved molecular assays**
  - Whole genome sequencing
  - Next generation sequencing (AMD)

- **Vaccine development**
  - Microneedle patches (GA Tech)
Thanks to the GMRLN and Measles and Rubella Teams at CDC

12th Annual Global Measles and Rubella Laboratory Network Meeting, September 2014, Istanbul, Turkey
The Elimination of Measles in the Americas

Desirée Pastor, MD, MPH
Regional Immunization Advisor
Pan American Health Organization
Regional Offices for the Americas, World Health Organization
Outline

1. Update of measles epidemiology in the Americas

2. Most critical challenges for sustaining the gains
Impact of Measles and Rubella Elimination Strategies in the Americas

The Comprehensive Family Immunization Unit (FGL/IM) – Pan American Health Organization, data as of June 8, 2015
Distribution of Confirmed Measles Cases After Interruption of Endemic Transmission

The Americas, 2003-2015

Rate = 1.9 x 1,000,000 population

Number of Confirmed Cases

Rate per 1,000,000 Population

PAHO Measles Eradication Surveillance System and Integrated Surveillance Information System and country reports to The Comprehensive Family Immunization Unit (FGL/IM) – Pan American Health Organization, as of epidemiological week 21, 2015
Geographic Distribution of Confirmed Measles Cases In The Americas

- 2011: N=1,369 cases
- 2014: N=1,896 cases
- 2015* to date: N=515 cases

1 red dot = 1 measles case

Measles Confirmed Cases, 2015
- Brazil=141
- Canada=195
- Chile=5
- Mexico=1
- USA=173
- Total= 515 cases

The Comprehensive Family Immunization Unit (FGL/IM) – Pan American Health Organization, as of epidemiological week 21, 2015 by second administrative level
First Outbreak in Post Elimination Era with More Than 12 Months of Transmission

Confirmed Measles Cases by Epidemiological Week, Selected States Brazil, 2013-2015

The Comprehensive Family Immunization Unit (FGL/IM) – Pan American Health Organization, as of June 8, 2015 epidemiological week 21, 2015 by second administrative level
## Characteristics of Measles Outbreaks in the Americas

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Spread</strong></td>
<td>Rapid spread within US and neighboring countries (Canada, Mexico)</td>
<td>Slow, sustained spread with ‘drop by drop’ transmission in Pernambuco and Ceará</td>
</tr>
<tr>
<td><strong>Genotype</strong></td>
<td>More than one genotype in US and Canada</td>
<td>Single genotype, one outbreak</td>
</tr>
<tr>
<td><strong>Outbreak Control</strong></td>
<td>Rapidly controlled</td>
<td>Ongoing outbreak after 24 months</td>
</tr>
<tr>
<td><strong>Ages of Cases</strong></td>
<td>USA: 53% 5–39y and 28% in &lt;5y</td>
<td>Pernambuco: 48% &lt;1y Ceará: 28% &lt;1y and 34% 15–29y</td>
</tr>
<tr>
<td><strong>Case Vaccine Status</strong></td>
<td>More than 80% unvaccinated</td>
<td>Around 89% unvaccinated</td>
</tr>
<tr>
<td><strong>Barriers to Vaccination</strong></td>
<td>Philosophical or religious exemptions, or too young to vaccinate</td>
<td>Non-eligible for vaccine, limited access to health services, lack of vaccines, limited human resources</td>
</tr>
</tbody>
</table>
Outline

1. Update of measles epidemiology in the Americas

2. Most critical challenges for sustaining the gains
Imported Cases Are Biggest Threat to Maintaining Elimination Efforts

Distribution of confirmed measles cases by import status, The Americas, 2011-2015*

- **Imported**: 11%
- **Import Related**: 59%
- **Unknown**: 30%

N=4,357

*Data as of 21 May 2015

PAHO Measles Eradication Surveillance System and Integrated Surveillance Information System and country reports

Recommendations to Any Person Traveling to Areas with Measles Circulation

PAHO recommends that any traveler over the age of six months be fully vaccinated against measles and rubella, at least 2 weeks before departure.

For the duration of the trip and upon returning, travelers should note any of the following symptoms:

- Fever
- Rash
- Cough, coryza (runny nose), or conjunctivitis (red eyes)
- Joint pain
- Lymphadenopathy (swollen glands)

If travelers suspect they have measles or rubella, they should:

- Remain at their current residence (e.g., hotel or home) except to seek professional health care.
- They should not travel nor go to public places.
- Avoid close contact with other people for seven days following onset of rash.
Ensuring Quality of Surveillance at the Subnational Level

Rate of Suspected Measles/Rubella Cases, Sub national Level, 2013-2014

Expected rate is 2 or more per 100,000 population

The Comprehensive Family Immunization Unit (FGL/IM) – Pan American Health Organization
Overcoming Immunity Gaps by Giving MMR2 and DTP4 Simultaneously

MMR2 and DTP4 Reported Coverage in Selected Countries, 2013

- MMR2: Measles, mumps and rubella, second dose
- DTP4: Diphtheria, tetanus and pertussis, fourth dose

Countries: COL: Colombia  PER: Peru  ARG: Argentina  PAN: Panama  MEX: Mexico  JAM: Jamaica  DMA: Dominican Republic

PAHO-WHO/UNICEF Joint Reporting Form, 2014
Ensuring Second Vaccination Opportunity To Maintain Measles and Rubella Elimination

- Chile: (1–4y) MMR - October
- Colombia: (2–4y) MMR - September
- Dominican Republic: (1–4y) MR - April–May

Types and Reach of Mass Vaccination Campaigns
- Catch-up (<15y): 140 million persons
- Follow-up (1–4y): 60 million children
- Speed-up (adol/adult): 250 million persons

Adol: Adolescents
The Comprehensive Family Immunization Unit (FGL/IM) – Pan American Health Organization, as of June 11, 2015
Challenges to Sustain the Gains

- Increase quality of MR surveillance indicators to rapidly respond to imported MR cases
- Increase data analysis at the local level for strengthening MR surveillance
- Increase MMR1 and MMR2 vaccination coverage
- Support countries to ensure high quality follow-up campaigns
- Declare measles eliminated in the Americas by 2016
Measles zero!
Thank you!

Email: immunization@paho.org
Web: www.paho.org/immunization
Global Strategy to Eliminate Measles

Peter Strebel, MBChB, MPH
Accelerated Disease Control Leader
Expanded Programme on Immunization
World Health Organization
Outline

- What are the strategies?
- Why has progress slowed?
- How can progress be accelerated?
5 Key Strategies:

1. Achieve high population immunity through vaccination
2. Conduct effective surveillance and monitoring
3. Develop outbreak preparedness and response
4. Communicate to engage public’s confidence and build demand
5. Perform research and development to improve program efficiency
Failure to Vaccinate Causes Measles Outbreaks

USA\(^4\)
Jan 4–Apr 2, 2015
159 cases,
82% not vaccinated or vaccine status unknown

E. Mediterranean\(^2\)
Apr 2014–Mar 2015
7,592 cases
83% <2 doses

W. Pacific Region\(^2\)
Apr 2014–Mar 2015
16,369 cases
98% <2 doses

Nigeria\(^3\)
Jan–Apr, 2015
1,350 cases
78% not vaccinated

Reported Measles Incidence Rate\(^1\)
April 2014 through March 2015

- (70 countries or 36%) <1
- (34 countries or 18%) ≥1 - <5
- (34 countries or 18%) ≥5 - <10
- (41 countries or 21%) ≥10 - <50
- (15 countries or 8%) ≥50
- (16 countries or 8%) No data reported to WHO HQ
- Not applicable

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1. Rate per 1,000,000 population
2. WHO/HQ monthly measles surveillance data as of May 4, 2015
3. WHO/African Region measles surveillance data as of May 14, 2015
4. MMWR April 2015;64;373-376
21 Million Infants Missed MCV1 in 2013

- Over 60% of these children are in 6 countries
  - India
  - Nigeria
  - Ethiopia
  - Indonesia
  - Pakistan
  - Democratic Republic of Congo (DRC)

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of Children (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>6.37</td>
</tr>
<tr>
<td>Nigeria</td>
<td>2.66</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>1.68</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1.11</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.74</td>
</tr>
<tr>
<td>Democratic Republic of Congo (DRC)</td>
<td>0.68</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.38</td>
</tr>
<tr>
<td>USA</td>
<td>0.38</td>
</tr>
<tr>
<td>Iraq</td>
<td>0.36</td>
</tr>
<tr>
<td>Afghanistan</td>
<td>0.37</td>
</tr>
</tbody>
</table>

Number of children (millions)
Global Routine Immunization Strategies and Practices – A Call to Invest in 8 Core Areas

1. Community involvement
2. Strategies to reach
3. Beyond infancy vaccination
4. Monitoring systems
5. National team
6. Planning cycle
7. Adequate supply
8. Vaccinator capacity

### Monitoring Progress through Regional Verification of Measles Elimination, 2014–2015

<table>
<thead>
<tr>
<th>WHO Region</th>
<th>Regional Verification Commissions Established</th>
<th>Elimination Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No. of countries</td>
</tr>
<tr>
<td>Americas(^1)</td>
<td>Yes</td>
<td>34</td>
</tr>
<tr>
<td>Europe(^2)</td>
<td>Yes</td>
<td>22</td>
</tr>
<tr>
<td>Western Pacific(^3)</td>
<td>Yes</td>
<td>6</td>
</tr>
<tr>
<td>Eastern Mediterranean</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>South-East Asia</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Africa</td>
<td>No</td>
<td>-</td>
</tr>
</tbody>
</table>

2. Third meeting of the European Regional Verification Commission for Measles and Rubella Elimination (RVC) November 2014
Innovations – Intradermal Patch Vaccination

- 10 ten-dose vials
- 100 microneedle patches
- 100 needles and syringes
- Cold-chain storage
- Biohazardous sharps disposal

GA Tech and CDC
# Strategies

1. Achieve and maintain high levels of population immunity
2. Communicate and engage to build public confidence
3. Monitor disease using effective surveillance
4. Maintain outbreak preparedness and response
5. Research and develop improved vaccination & diagnostic tools

# Working Groups

- Resource Mobilization
- Routine Immunization
- Strategic Communications
- Programme Implementation
- Vaccine Supply Coordination
- Research and Innovation

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2013 Annual Report of the Measles and Rubella Initiative  
Critical Shortfall of Funding

$1.4 billion needed for measles and rubella control, 2015-2020

- GAVI
- Measles & Rubella Initiative
- Shortfall in Funding
Implementing Our Plan

- 5 clear strategies to eliminate measles and rubella
- Cause of recent outbreaks is failure to fully implement the strategies
- To accelerate progress we need
  - Investment in immunization programs
  - Verification commissions to monitor progress
  - Game-changing solutions
  - Effective program management
  - Resource mobilization
Regaining Momentum in the Fight Against Measles

- Measles is preventable through vaccination
- Combined vaccines make it possible to eliminate rubella and measles
  - The Region of the Americas eliminated rubella in April 2015
- The Global Measles and Rubella Laboratory Network provides valuable surveillance and disease tracking
- Progress has slowed and gains in some regions have been lost
- “The best defense against measles is a strong offense.”
  – Walt Orenstein

Orenstein, WA and Seib K. NEJM, 2014
Thank You
Achieving a world without measles by connecting the dots