The Path to a World Free of Polio, Measles, and Rubella, and Remaining Risks for the United States

A collaboration between:

CDC's Current Issues in Immunization NetConference

NVPO's UpShot Webinar Series

Today's Agenda

Introduction and Overview to the National Vaccine Plan and the Importance of Global Immunization
Guthrie Birkhead, MD, MPH, Medical Officer, National Vaccine Program Office,
Office of the Assistant Secretary for Health, U.S. Department of Health and Human Services

Global Progress Towards Polio Eradication
John F. Vertefeuille, PhD, MHS, Chief, Polio Eradication Branch and Incident Manager,
Emergency Polio Response, Centers for Disease Control and Prevention

Global Burden of Measles and Rubella, and Progress Towards their Elimination
CDR Gavin Grant, MD, MPH, Medical Epidemiologist, Accelerated Disease Control and
Vaccine Preventable Diseases Surveillance Branch, Global Immunization Division,
Center for Global Health, Centers for Disease Control and Prevention

Global Transmission Patterns of Measles and Rubella: Tracking the Sources of Importations
Paul A. Rota, PhD, Acting Chief, Viral Vaccine Preventable Diseases Branch,
Division of Viral Diseases, Centers for Disease Control and Prevention

Learning Objectives

1. Describe an emerging immunization issue
2. List a recent immunization recommendation made by the Advisory Committee on Immunization Practices
3. Locate resources relevant to current immunization practice
4. Implement disease detection and prevention health care services (e.g., smoking cessation, weight reduction, diabetes screening, blood pressure screening, immunization services) to prevent health problems and maintain health

Continuing Education Information

- For CE credit go to:

  www2a.cdc.gov/TCEOnline
- CE credit expires: **May 29, 2017**
- Course Code: **WC2661-042517**
- Instructions available in the resource pod

For Questions About …

The Online CE System

- Phone: 1-800-41-TRAIN
- Email: CE@cdc.gov

Immunization

- Phone: 1-800-CDC-INFO
  Monday through Friday from 8 a.m. to 8 p.m. ET
- Email: NIPInfo@cdc.gov

Do You Have A Question?

Please enter your question into the Q&A pod

Disclosure Statements

In compliance with continuing education requirements, all presenters must disclose any financial or other associations with the manufacturers of commercial products, suppliers of commercial services, or commercial supporters as well as any use of unlabeled product(s) or product(s) under investigational use.

CDC, our planners, content experts, and their spouses/partners wish to disclose they have no financial interests or other relationships with the manufacturers of commercial products, suppliers of commercial services, or commercial supporters.

Planners have reviewed content to ensure there is no bias.

Disclosure Statements

Presentations will not include any discussion of the unlabeled use of a product or a product under investigational use.

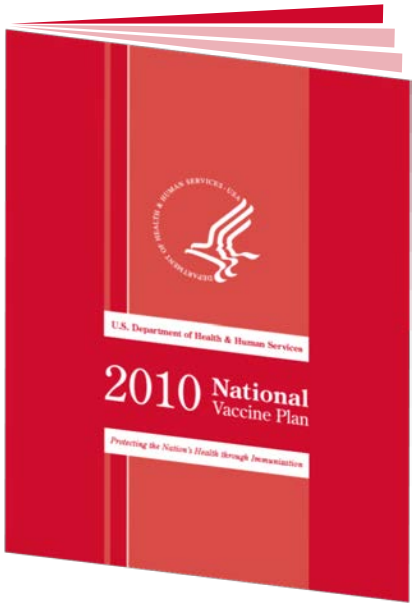
CDC does not accept any commercial support.

Disclosure Statements

The findings and conclusions in this presentation are those of the authors and do not necessarily represent the views of CDC or HHS

NVPO and the National Vaccine Plan

- The National Vaccine Plan (NVP) is the nation's leading roadmap for a 21st century vaccine and immunization enterprise.
- The NVP has five overarching goals:
  - Develop new and improved vaccines
  - Enhance the vaccine safety system
  - Support communications to enhance informed vaccine decision-making
  - Ensure a stable supply of, access to, and better use of recommended vaccines in the United States
  - Increase global prevention of death and disease through safe and effective vaccination



Goal 5: Increase Global Prevention of Death and Disease through Safe and Effective Vaccination

- Infectious diseases are the leading cause of death among children globally and contribute substantially to disease and disability among persons of all ages.
- In the era of global pandemics and mass travel, the public health of U.S. citizens is closely related to diseases occurring in other countries.

Goal 5: Increase Global Prevention of Death and Disease through Safe and Effective Vaccination

- Goal 5 focuses on improving global immunization by supporting international organizations and countries in a number of ways:
  - Improving global surveillance and strengthening health information systems
  - Improving and sustaining immunization programs
  - Introducing and making available new and underutilized vaccines
  - Improving communication
  - Supporting development of regulatory environments and manufacturing capabilities to facilitate access to safe and effective vaccines
  - Build and strengthen multilateral and bilateral partnerships to support global immunization and eradication

Global Progress Towards Polio Eradication

John F. Vertefeuille, PhD, MHS, Chief, Polio Eradication Branch and Incident Manager, Emergency Polio Response, Centers for Disease Control and Prevention

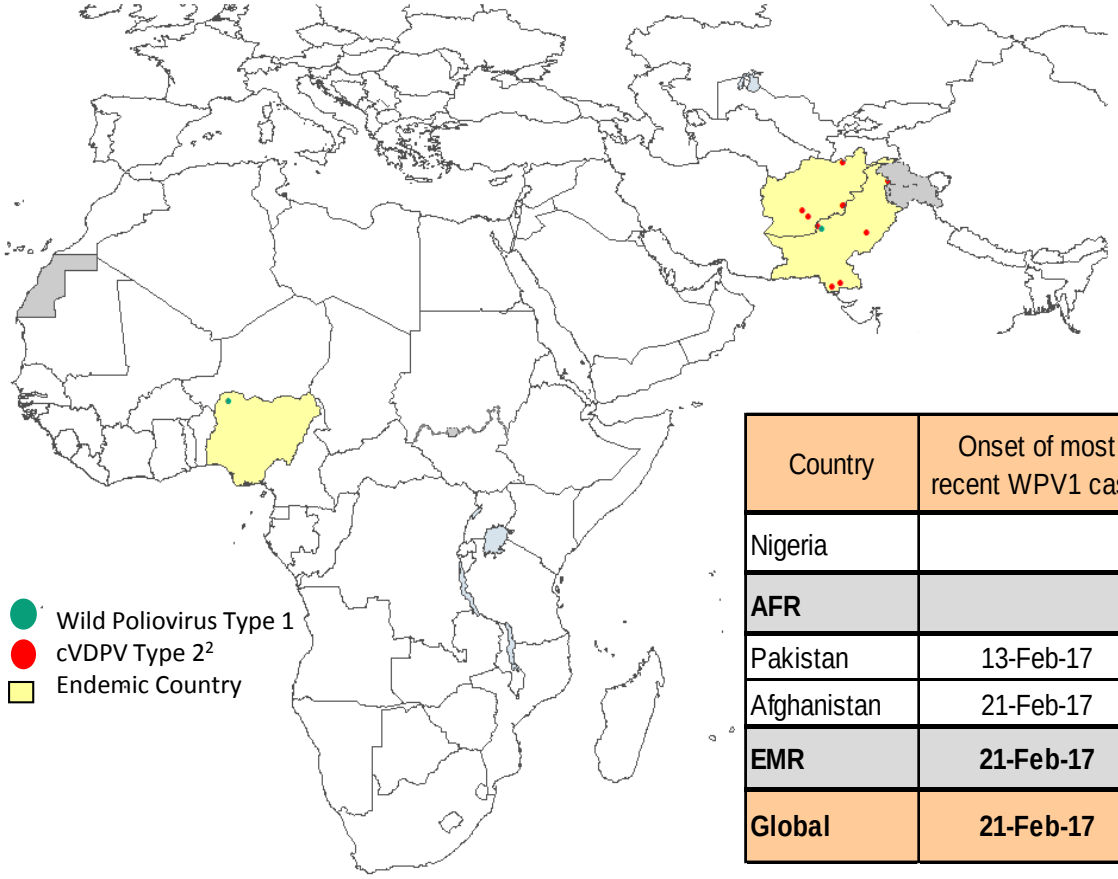
Polio Eradication

John Vertefeuille, PhD
Branch Chief, Global Immunization Division, CDC

Polio Eradication Progress

- Type 2 Wild Polio Virus (WPV2) was certified eradicated in 2015 and Type 3 Wild Polio Virus (WPV3) hasn't been detected since November 2012
- Lowest number of WVP cases (37) in history in 2016
- In 2016, 155 countries removed the polio type 2 from the oral polio vaccine, made possible because of the eradication of WPV2
- Three endemic countries remain: Afghanistan, Pakistan, and Nigeria

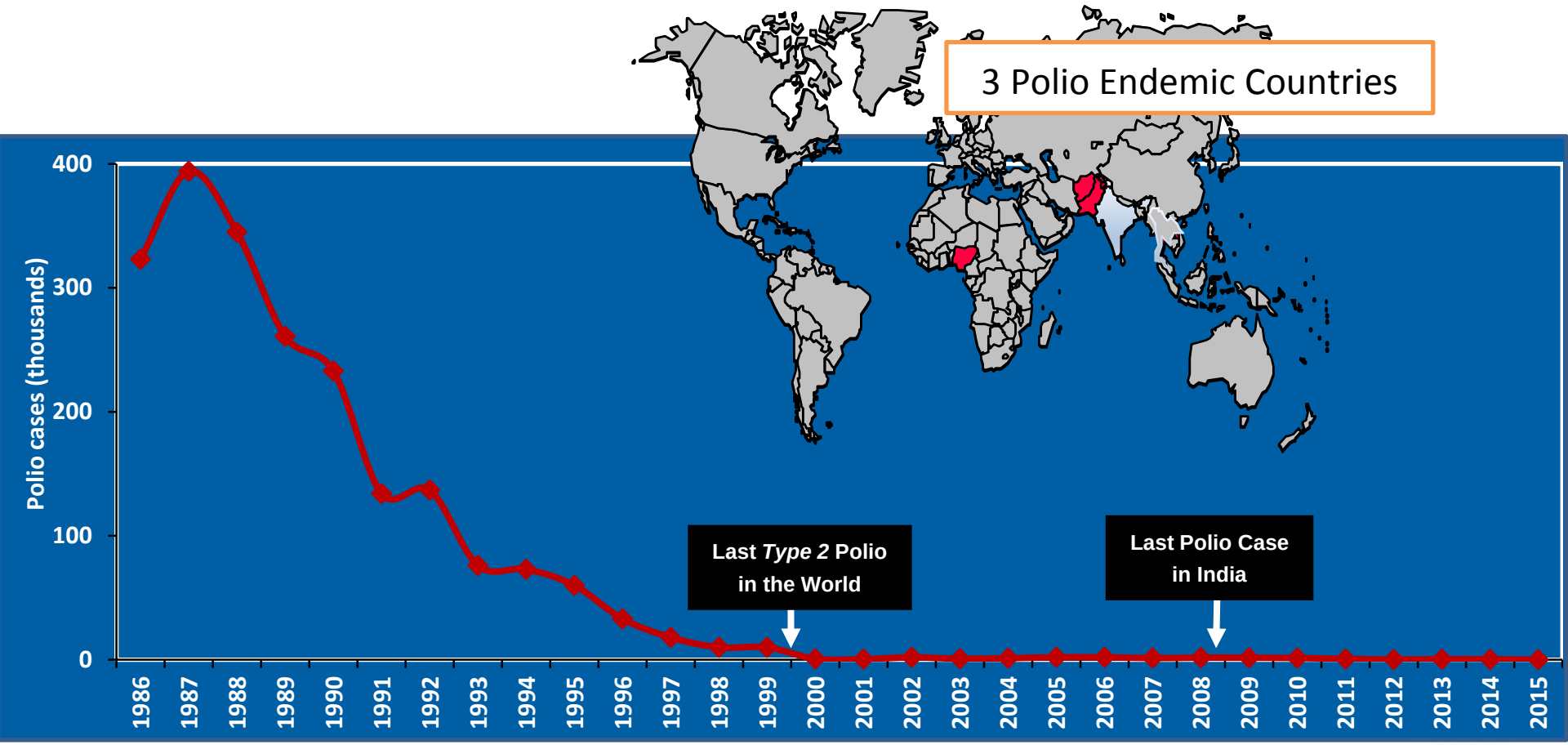
Global Wild Poliovirus & Circulated Vaccine-Derived Polio Virus (cVDPV) Cases, Previous 6 Months



		Number of WPV1 cases		Number of WPV infected districts		cVDPV current 6 months[2]
Country	Onset of most recent WPV1 case	Current[4]	Same period last year[4]	Current[4]	Same period last year[4]	Number of cases
Nigeria		0	0	0	0	1
AFR		**0**	**0**	**0**	**0**	**1**
Pakistan	13-Feb-17	5	23	5	15	1
Afghanistan	21-Feb-17	5	9	4	9	0
EMR	**21-Feb-17**	**10**	**32**	**9**	**24**	**1**
Global	**21-Feb-17**	**10**	**32**	**9**	**24**	**2**

[1]Excludes viruses detected from environmental surveillance
[2]Onset of paralysis 12 October 2016 – 11 April 2017
[4]Current rolling 6 months: 12 October 2016 – 11 April 2017
Same period previous year: 12 October 2015 – 11 April 2016

Global Update:
Distribution of Wild Poliovirus

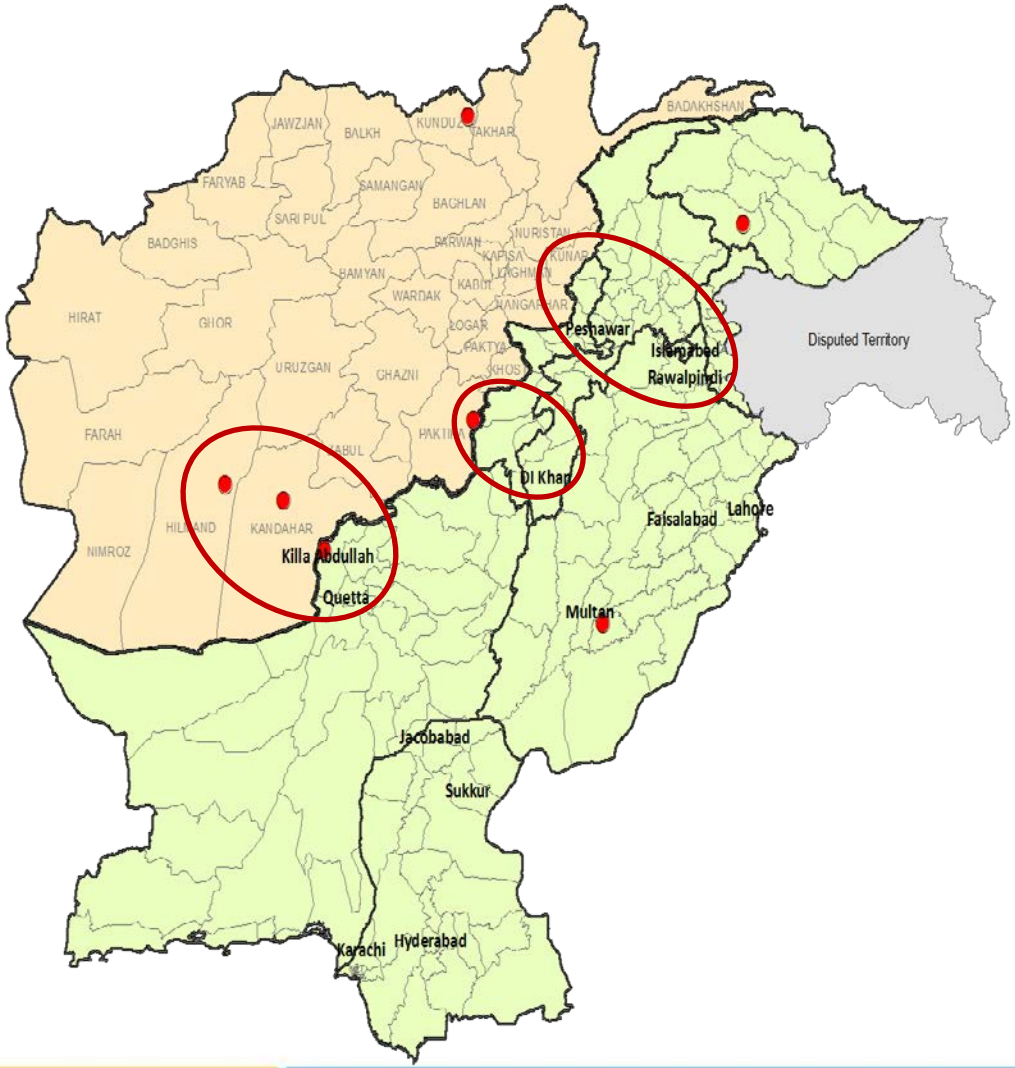


Pakistan and Afghanistan

Lowest number of cases ever seen

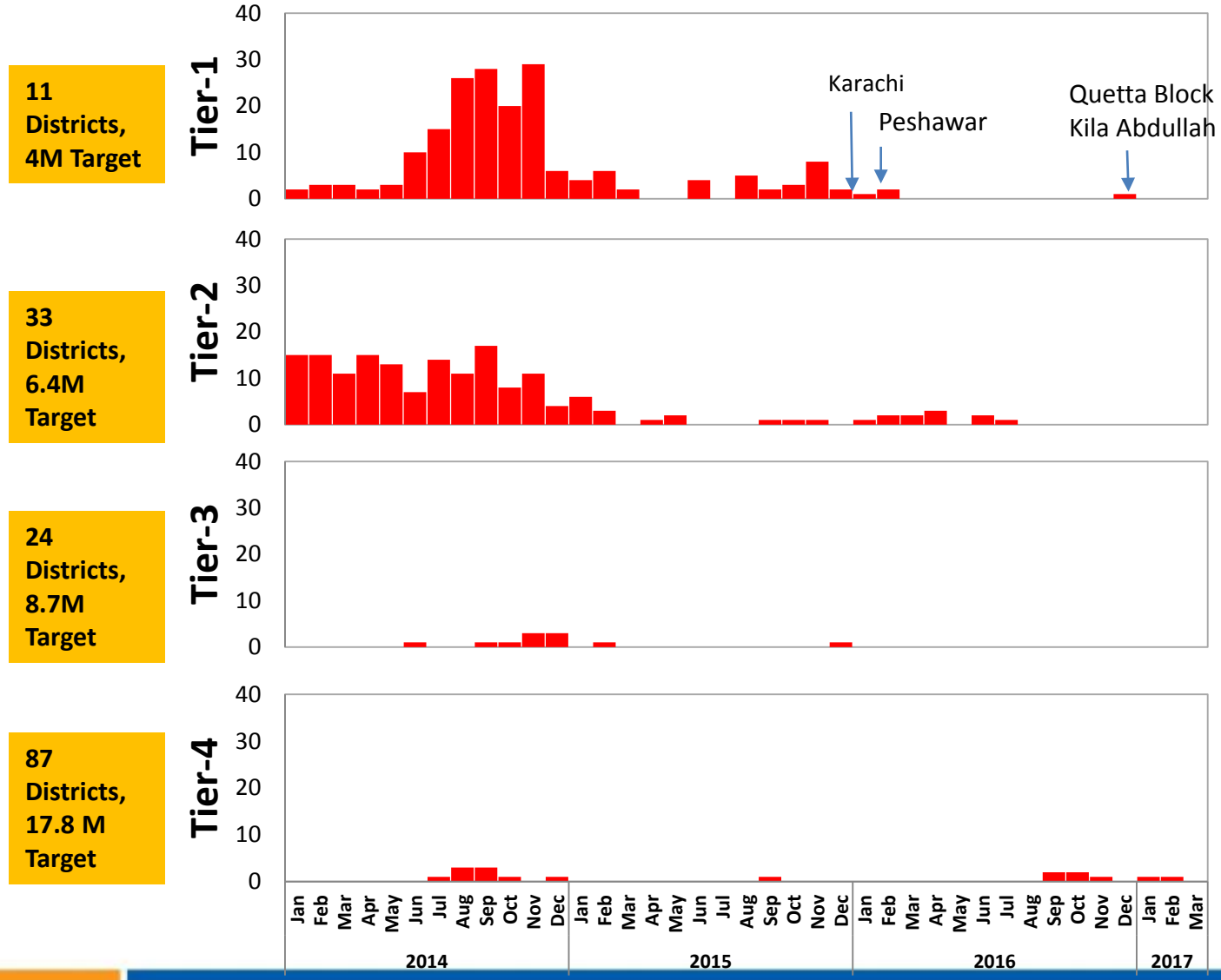
Afghanistan and Pakistan WPV1 Cases, Last 4 Months (Nov. 2016 – Mar. 2017)

Common Corridors of Transmission Create One Epidemiologic Block



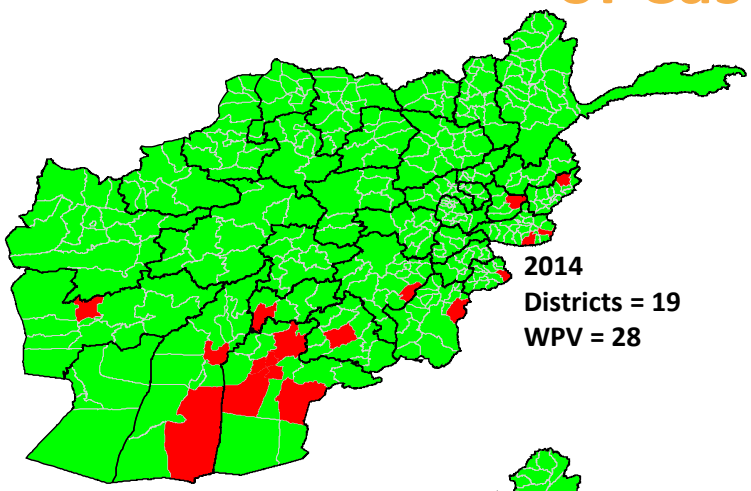
PROVINCE	CASES
PAKISTAN	3
BALOCHISTAN	1
G-BALTISTAN	1
PUNJAB	1
AFGHANISTAN	4
HILMAND	1
KANDAHAR	1
PAKTIKA	1
KUNDUZ	1

Pakistan: Decreasing Transmission in Core Reservoirs, Outbreaks in Tier-4 Districts

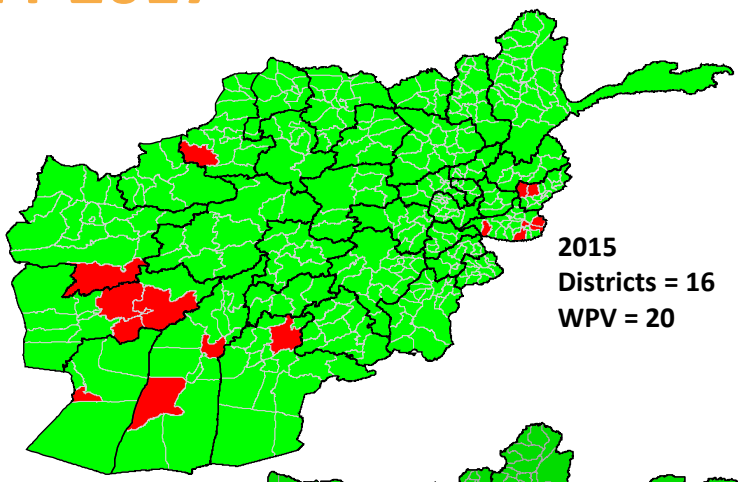


* Data as of Mar 10 April 2017

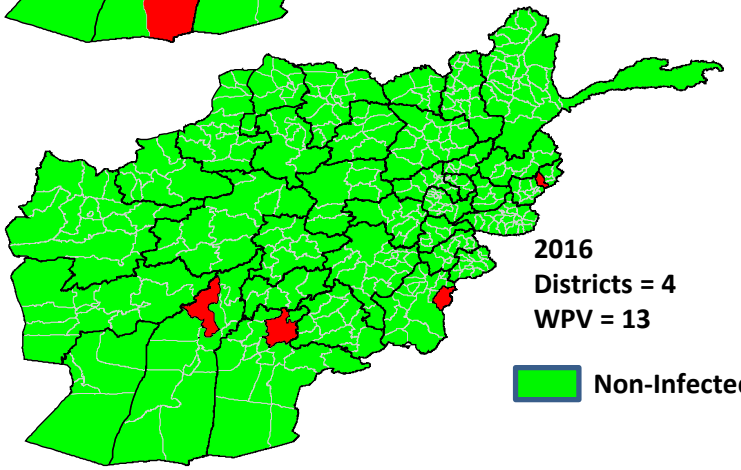
Afghanistan: Reduced Geographic Spread of Cases 2014-2017



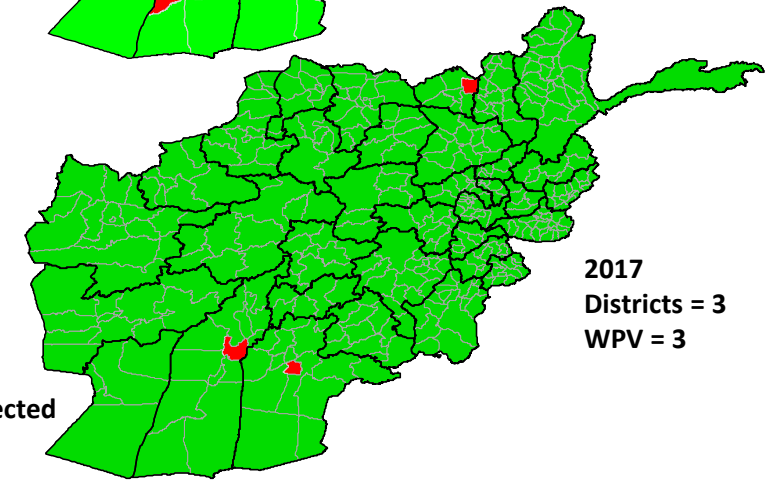
2014
Districts = 19
WPV = 28



2015
Districts = 16
WPV = 20

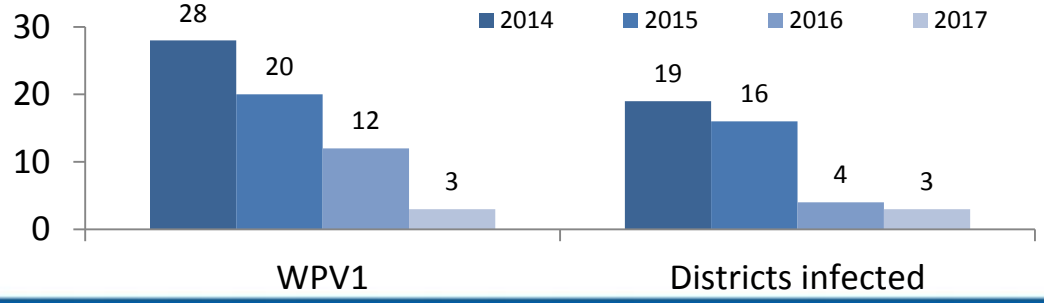


2016
Districts = 4
WPV = 13



2017
Districts = 3
WPV = 3

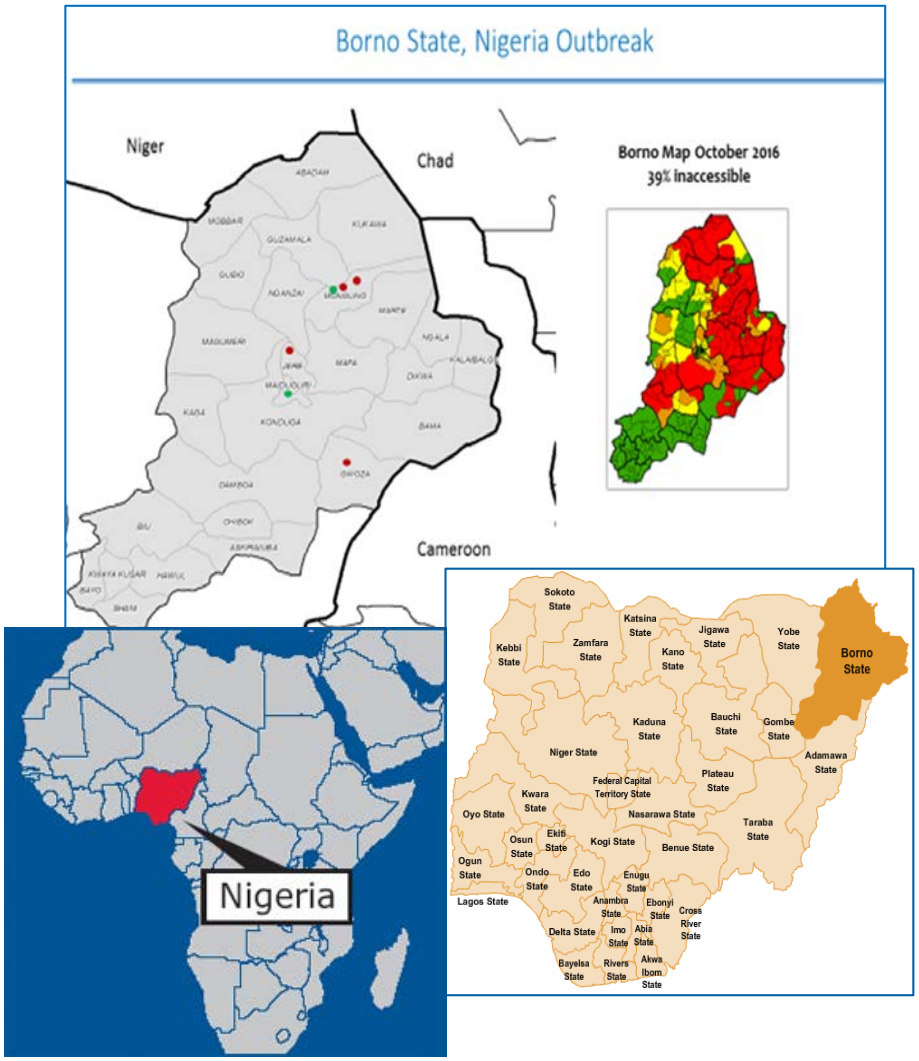
Non-Infected Infected



Nigeria & Lake Chad

EVERY LAST CHILD

Nigeria and Lake Chad Outbreak



- **May 2016**
  cVDPV2 found in Borno
- **July 2016**
  Positive WPV1 Case in Borno
- 5 country response with
  170 million children >5 vaccinated
- **August 2016**
  Last case detected

Challenges in Polio Eradication

- Being everywhere all at the same time
- Access populations in hard-to-reach conflict areas and emergency settings
- Weak immunization systems and inaccurate reporting of vaccination coverage
- Surveillance gaps in accessible geographic areas
- Mobile populations that cross international boarders
- Access to populations in hard to reach and conflict areas

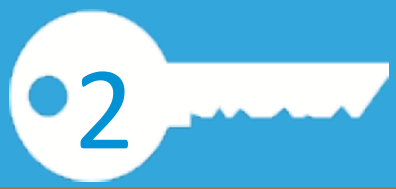
The Remaining Road Towards Eradication

- Accessing insecure and hard-to-reach areas
- Accountability
- Communications
- Social mobilization/community engagement of women
- Global partnership
- Political commitment
- Global disease surveillance networks; Global lab network

Key Components of Transition Planning

Mainstreaming essential polio functions

- Surveillance and laboratory
- Immunization programs
- Outbreak response
- Vaccine stockpile
- Biocontainment & biosafety



Sharing knowledge and lessons learned to improve child health

- Access to insecure and hard-to-reach areas
- Political commitment and accountability
- Social mobilization and community engagement
- Global disease surveillance networks

Transitioning polio infrastructure and capacities to other public health priorities

- Millions of vaccinators
- Tens of thousands of local social mobilizers
- Thousands of skilled technical staff
- Hundreds of highly skilled technical managers and leaders

Source: *'Legacy Planning Process for the Global Polio Eradication Initiative" (Nov. 2013)*

Thank you!

Global Burden of Measles and Rubella, and Progress Towards their Elimination

CDR Gavin Grant, MD, MPH, Medical Epidemiologist, Accelerated Disease Control and Vaccine Preventable Diseases Surveillance Branch, Global Immunization Division, Center for Global Health, Centers for Disease Control and Prevention

Global Burden of Measles and Rubella, and Progress Towards their Elimination

April 25, 2017

Gavin Grant, MD, MPH
Global Immunization Division, CDC

Presentation Outline

- Global measles and rubella strategic plan
- Progress towards achieving elimination
- Next steps

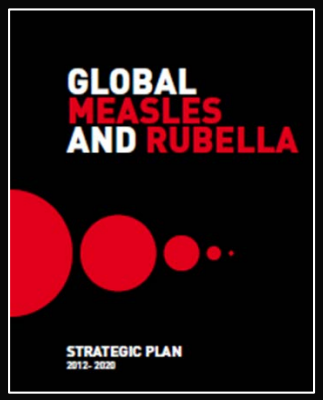
GLOBAL MEASLES AND RUBELLA

STRATEGIC PLAN

2012-2020

Vision:

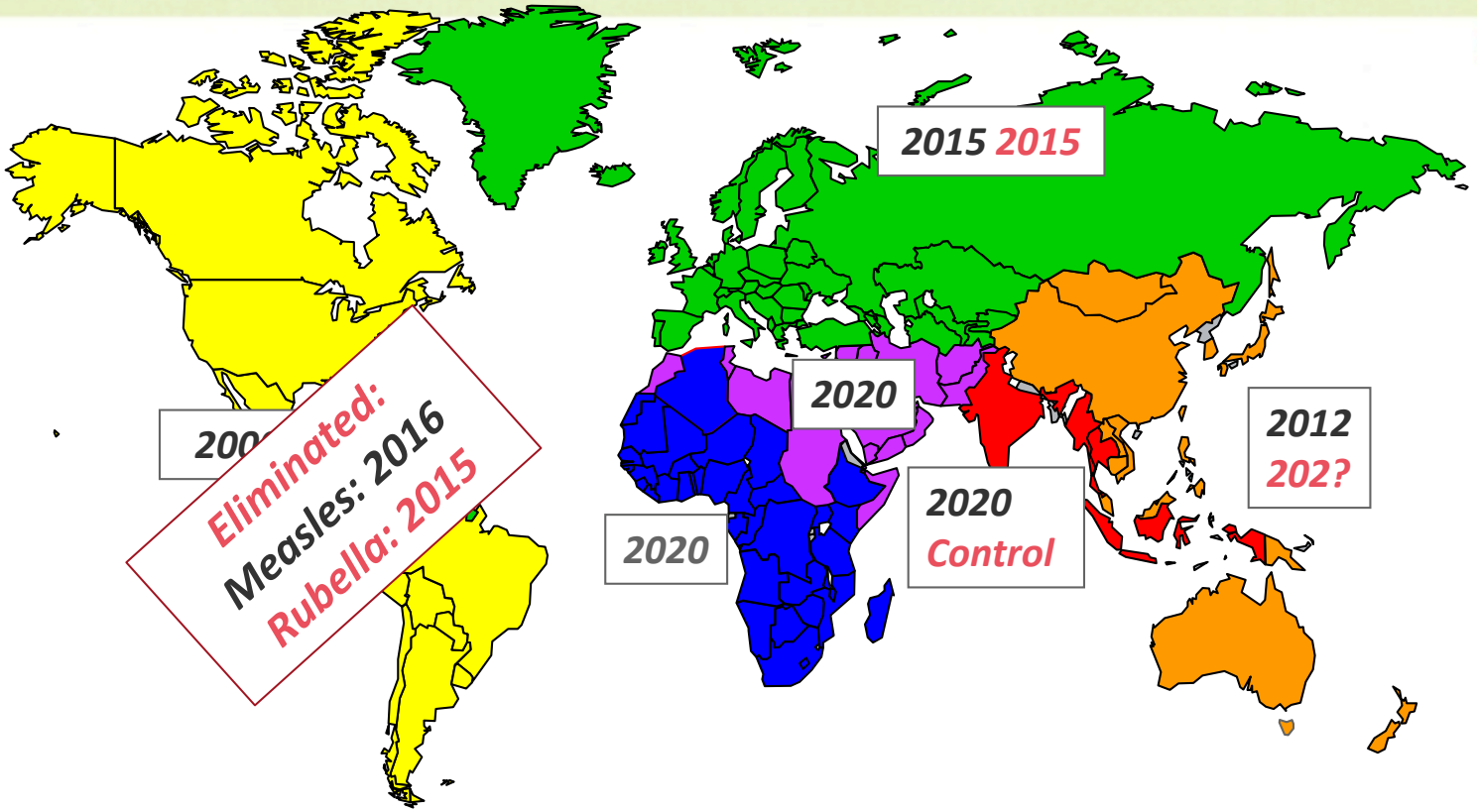
Achieve and maintain a world without measles, rubella, and congenital rubella syndrome



Strategies

1. High population immunity through vaccination with two doses of measles and rubella containing vaccines
2. Effective surveillance, monitoring, and evaluation
3. Outbreak preparedness and response & case management
4. Communication to build public confidence and demand for immunization
5. Research and development to support cost-effective operations and improve vaccination and diagnostic tools

Measles and Rubella Elimination Goals by WHO Region, 2016

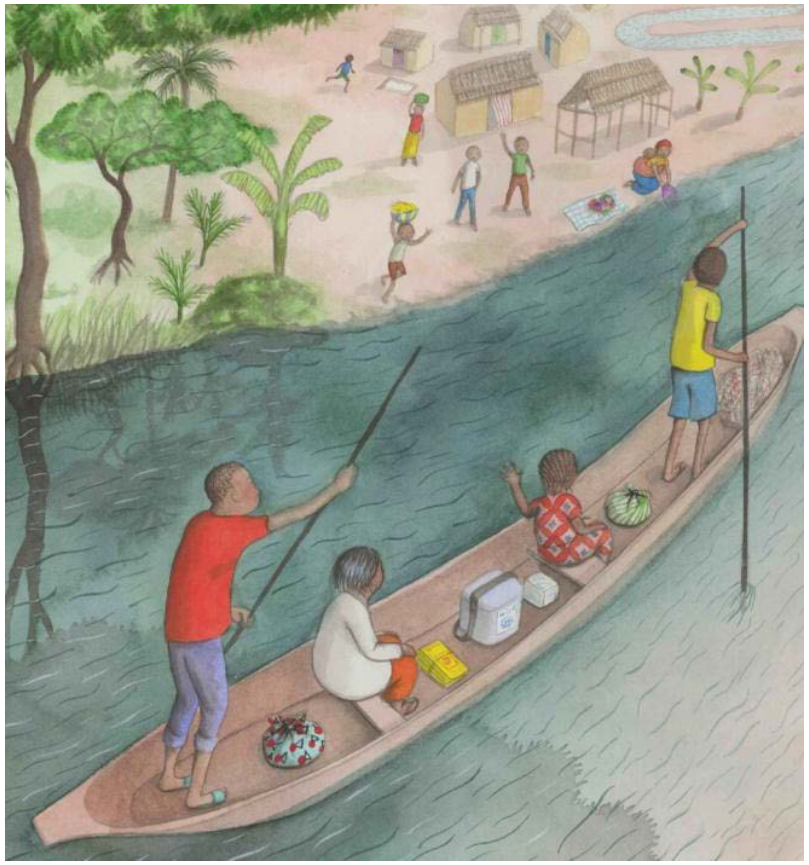


All Regions have Measles Elimination Goals

Americas, European, and Western Pacific Regions have Rubella Elimination Goals

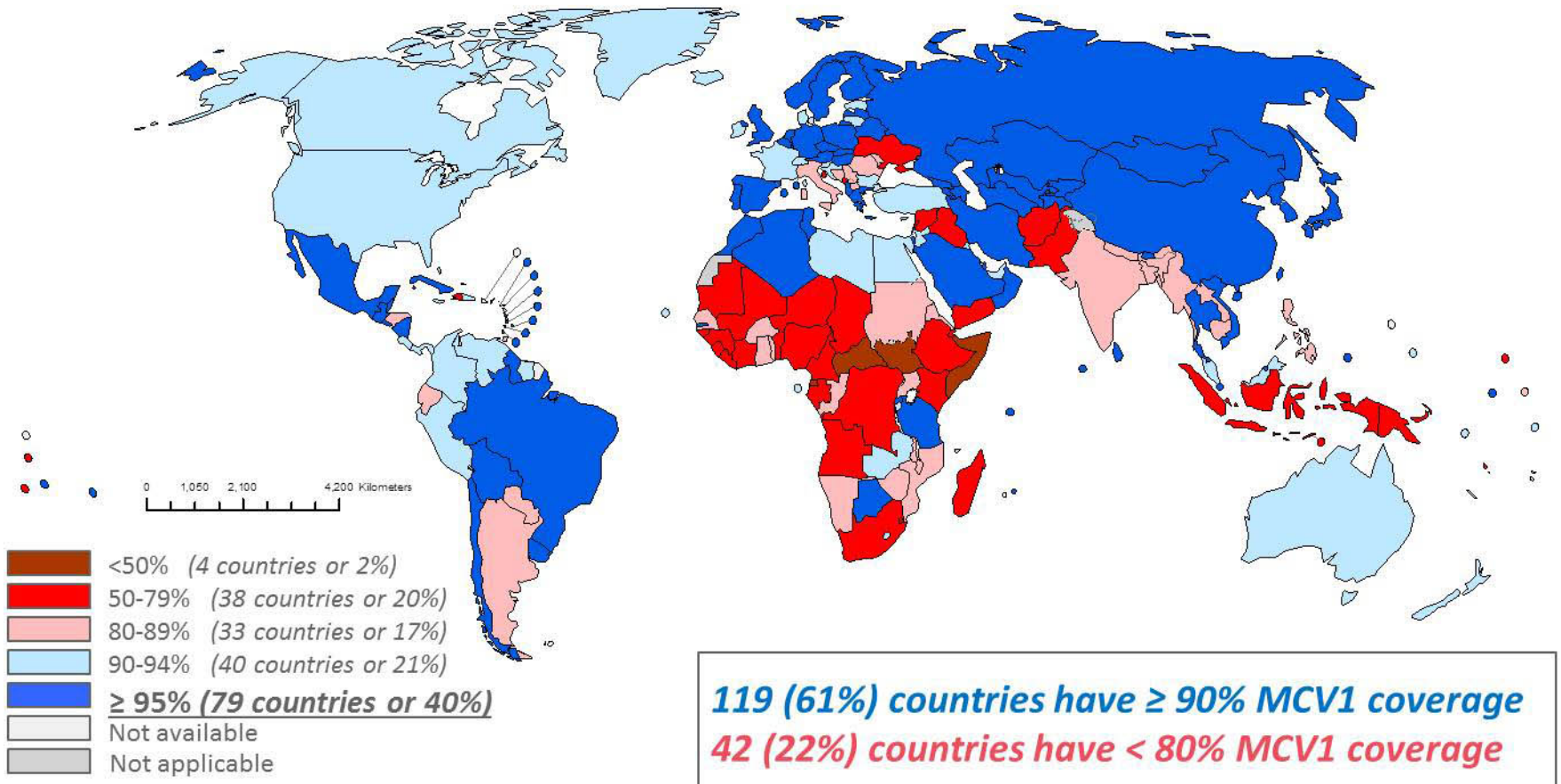
MEASLES & RUBELLA INITIATIVE

Progress to Achieve Elimination: Measles



1. Coverage
   - Target: 90% routine
   - Target: 95% campaign
2. Incidence
   - Target: < 5/million
3. Mortality
   - Target: 95% reduction (baseline 2000)

Estimated National First Measles Containing Vaccine (MCV1) Coverage, 2015



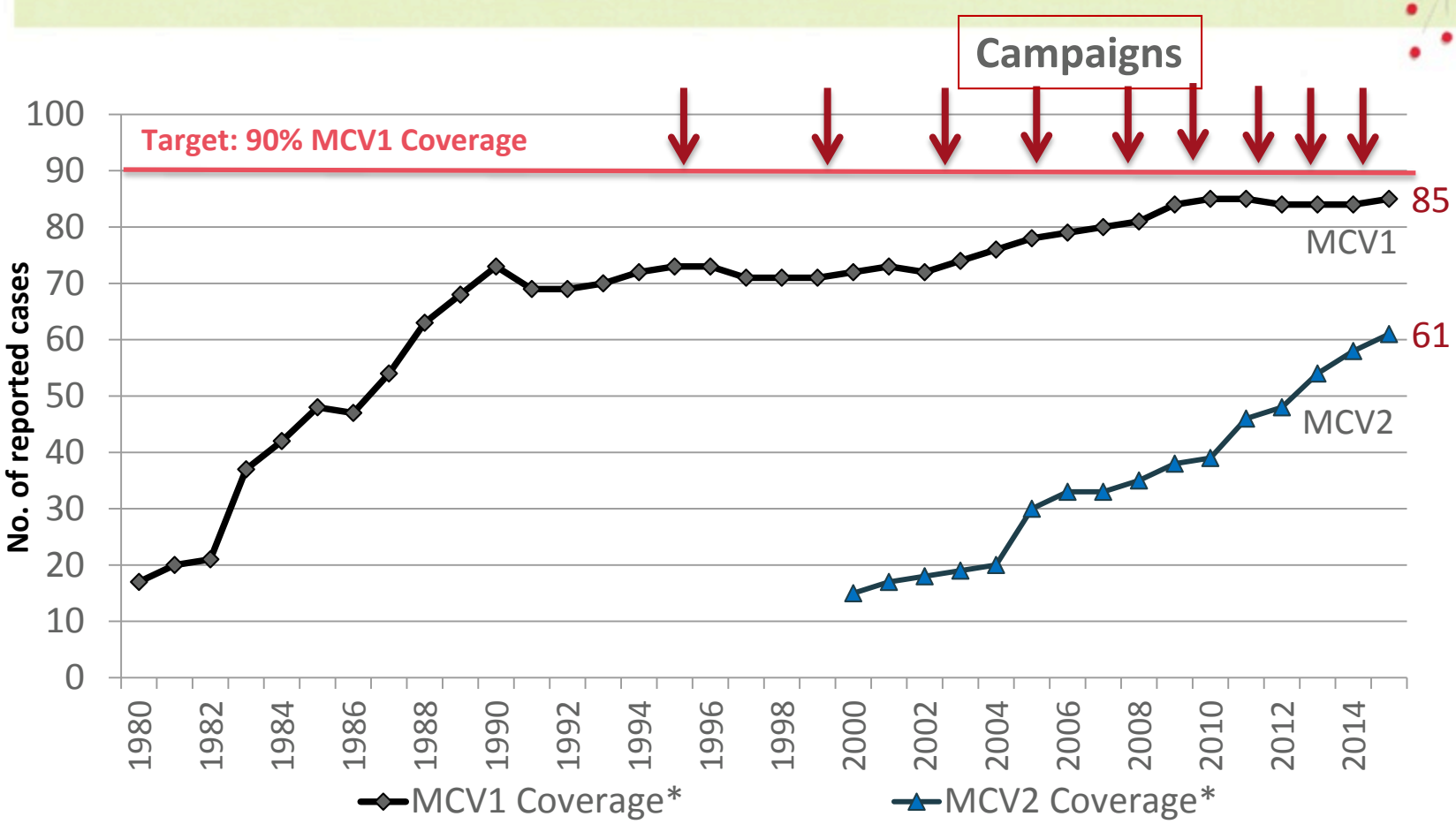
119 (61%) countries have ≥ 90% MCV1 coverage

42 (22%) countries have < 80% MCV1 coverage

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement. © WHO 2016. All rights reserved

Source: *WHO/UNICEF Coverage Estimates 2015 Revision. Map Production: Immunization Vaccines and Biologicals, (IVB). World Health Organization, 194 WHO Member States. Date of slide: 16 July 2016*

Global Measles Containing Vaccine Coverage 1980-2015

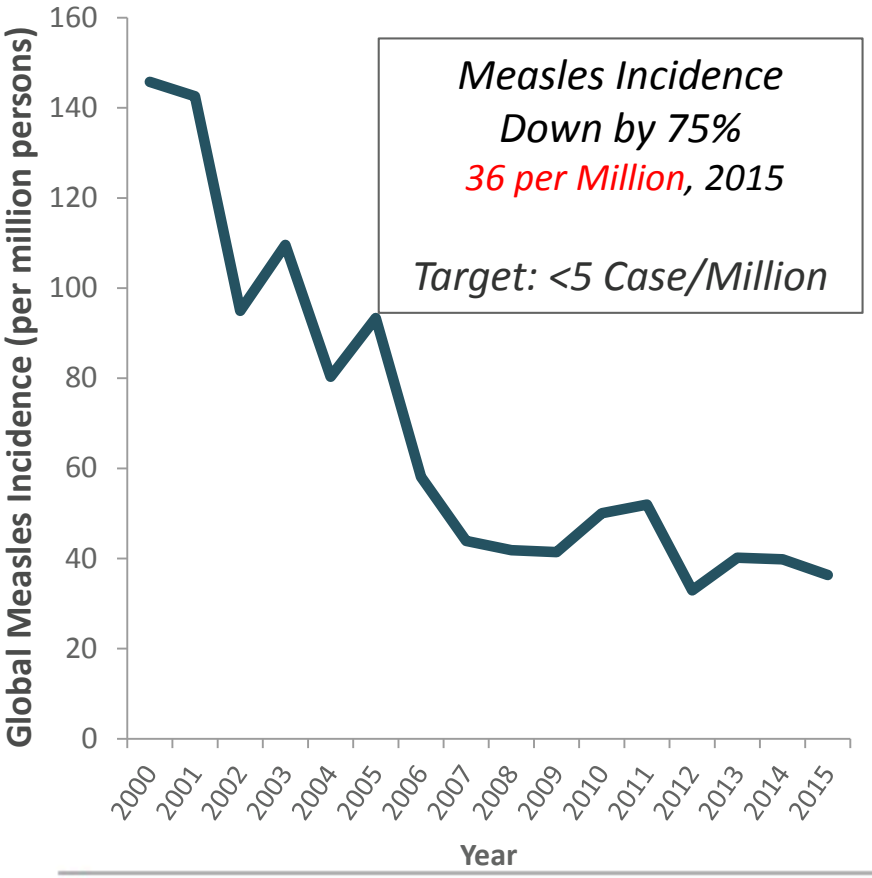


* Coverage as estimated by WHO and UNICEF.
**MCV2 estimates is only available from 2000 when global data collection started, however some countries have introduced the vaccine earlier.

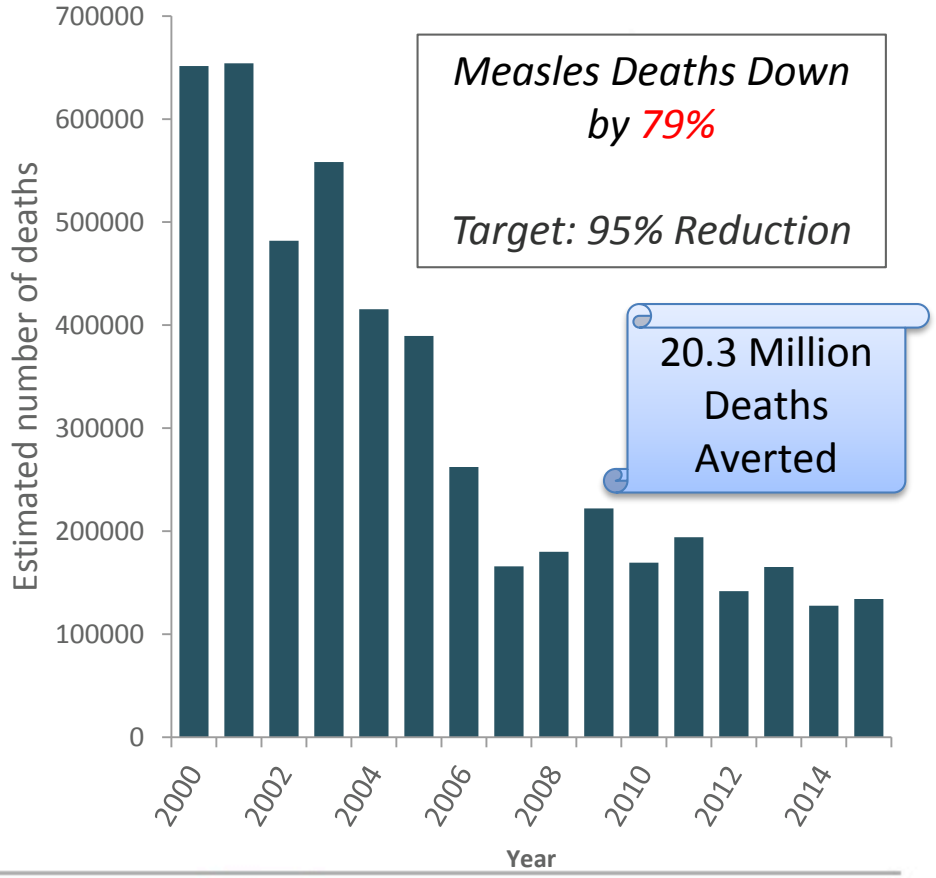
Source: *JRF 194 WHO Member States. Updated on 18 July 2016*

Global Measles Incidence and Deaths 1980-2015

Global Incidence



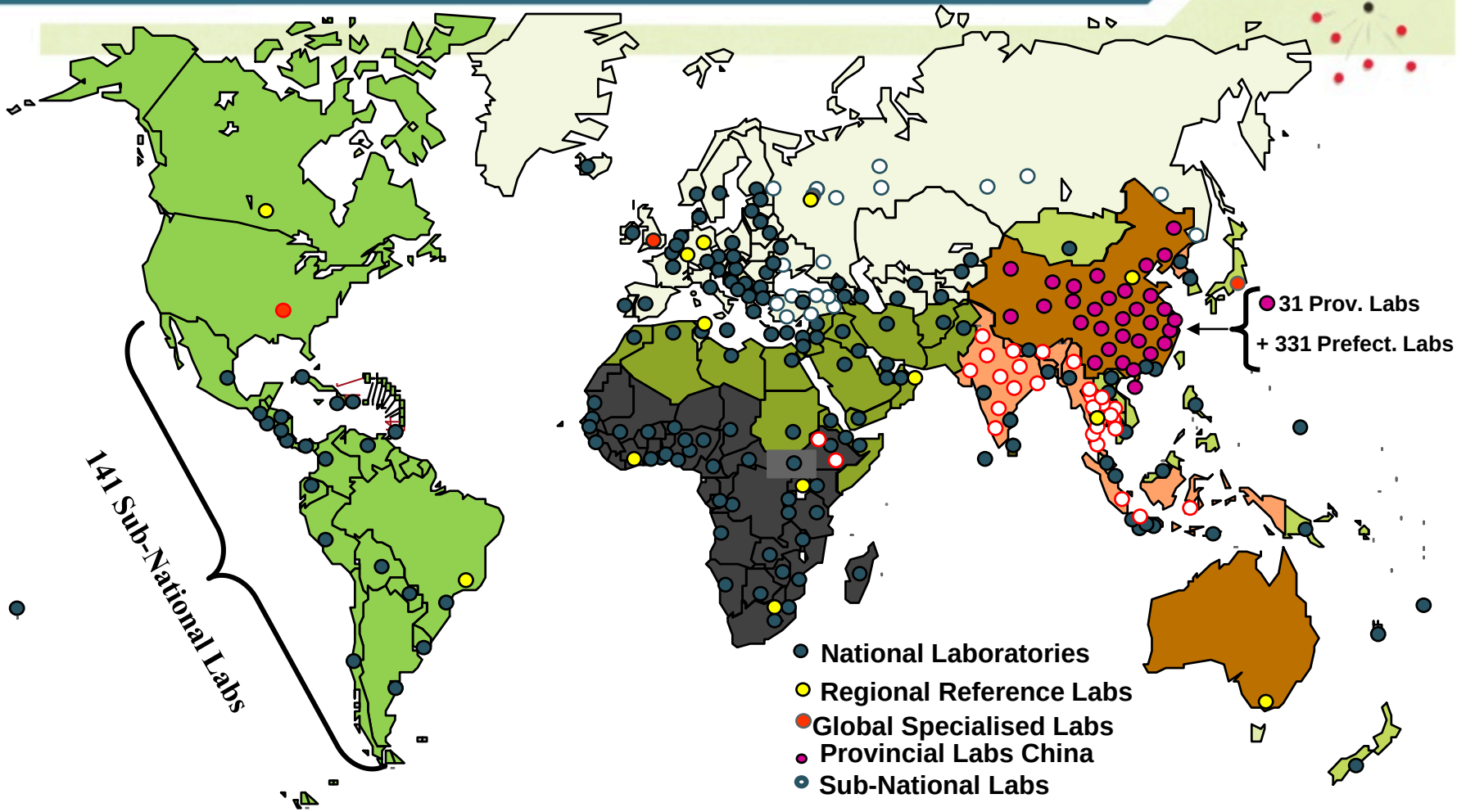
Estimated Global Measles Deaths



MEASLES & RUBELLA INITIATIVE

WHO

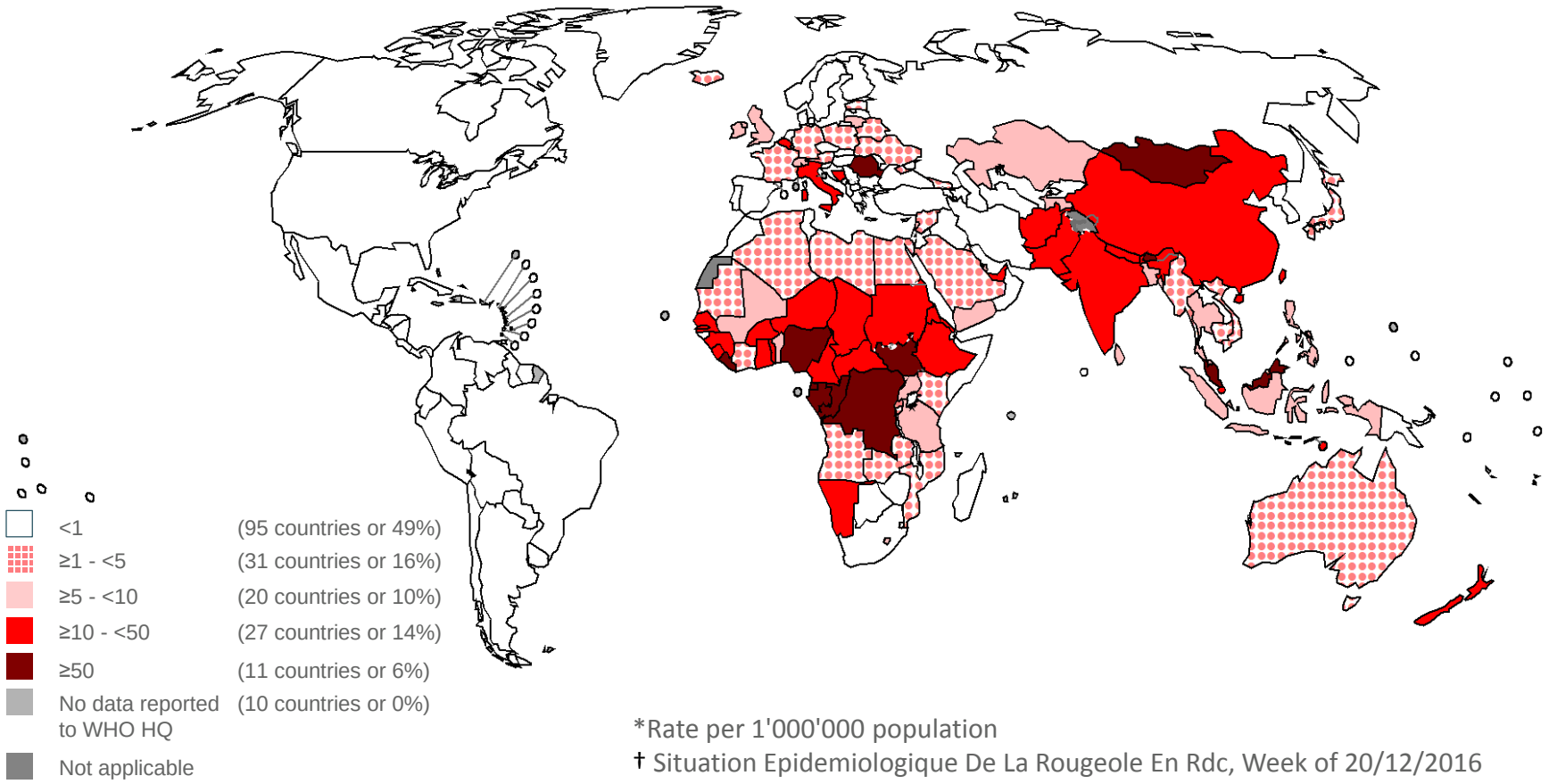
WHO Global Measles & Rubella Laboratory Network (GRMLN): 2017



MEASLES & RUBELLA INITIATIVE

Source: *Mick Mulders, WHO LabNet, Presented 20 April 2017*

Reported Measles Incidence Rate* Jan-Dec 2016

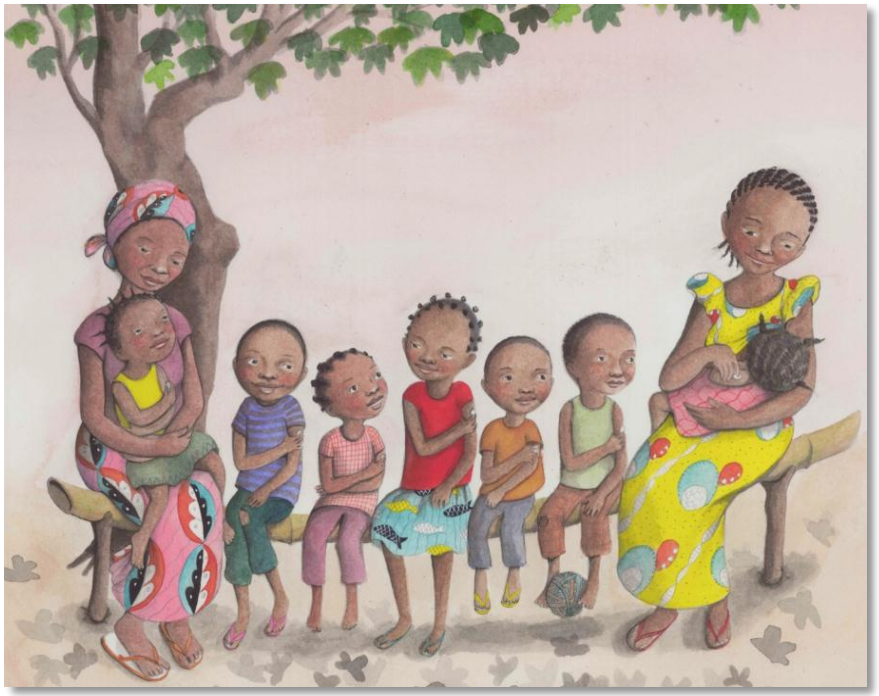


*Rate per 1'000'000 population

† Situation Epidemiologique De La Rougeole En Rdc, Week of 20/12/2016

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement. ©WHO 2017. All rights reserved.

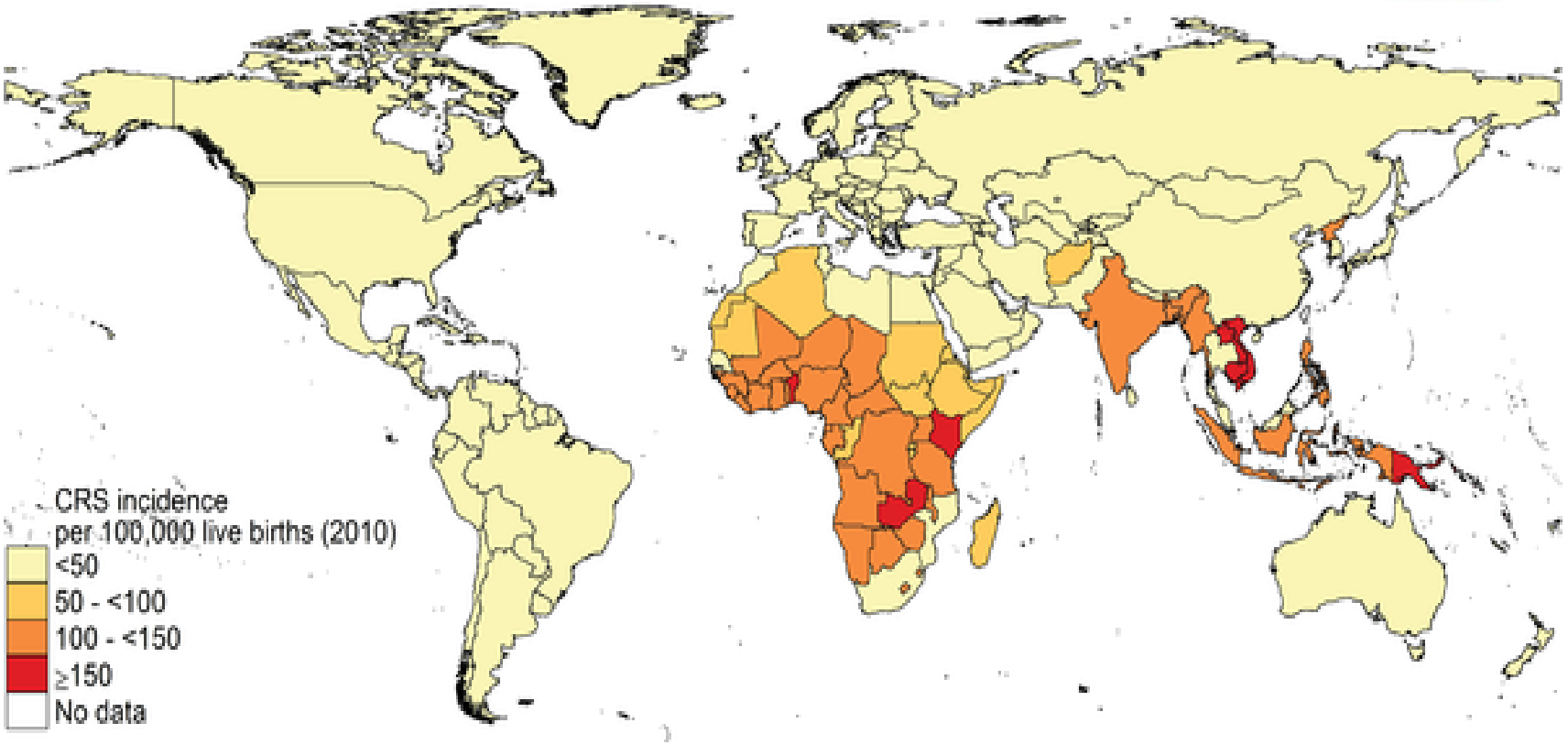
Progress to Achieve Elimination: Rubella



1. Burden of Congenital Rubella Syndrome (CRS)
2. Global Rubella Coverage
3. Vaccine Introduction

Rubella Vaccination Prevents CRS: National CRS Estimates

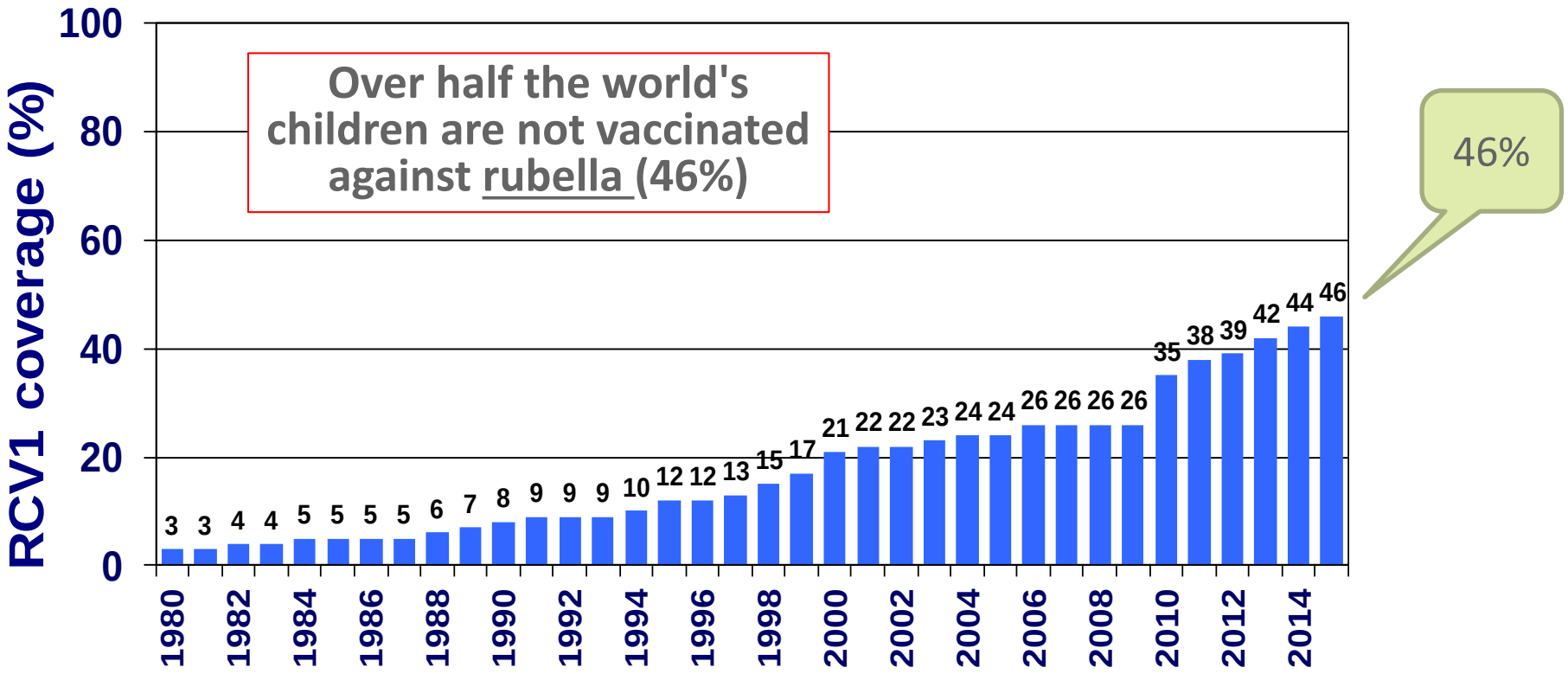
Incidence per 100,000 Live Births, 2010



MEASLES & RUBELLA INITIATIVE

Source: *Vynnycky E, Adams EJ, Cutts FT, Reef SE, Navar AM, et al. (2016) Using Seroprevalence and Immunisation Coverage Data to Estimate the Global Burden of Congenital Rubella Syndrome, 1996-2010: A Systematic Review. PLoS ONE 11(3): e0149160. doi:10.1371/journal.pone.0149160. http://journals.plos.org/plosone/article?id=info:doi/10.1371/journal.pone.0149160*

Rubella Vaccine 1st Dose Coverage, 1980-2015

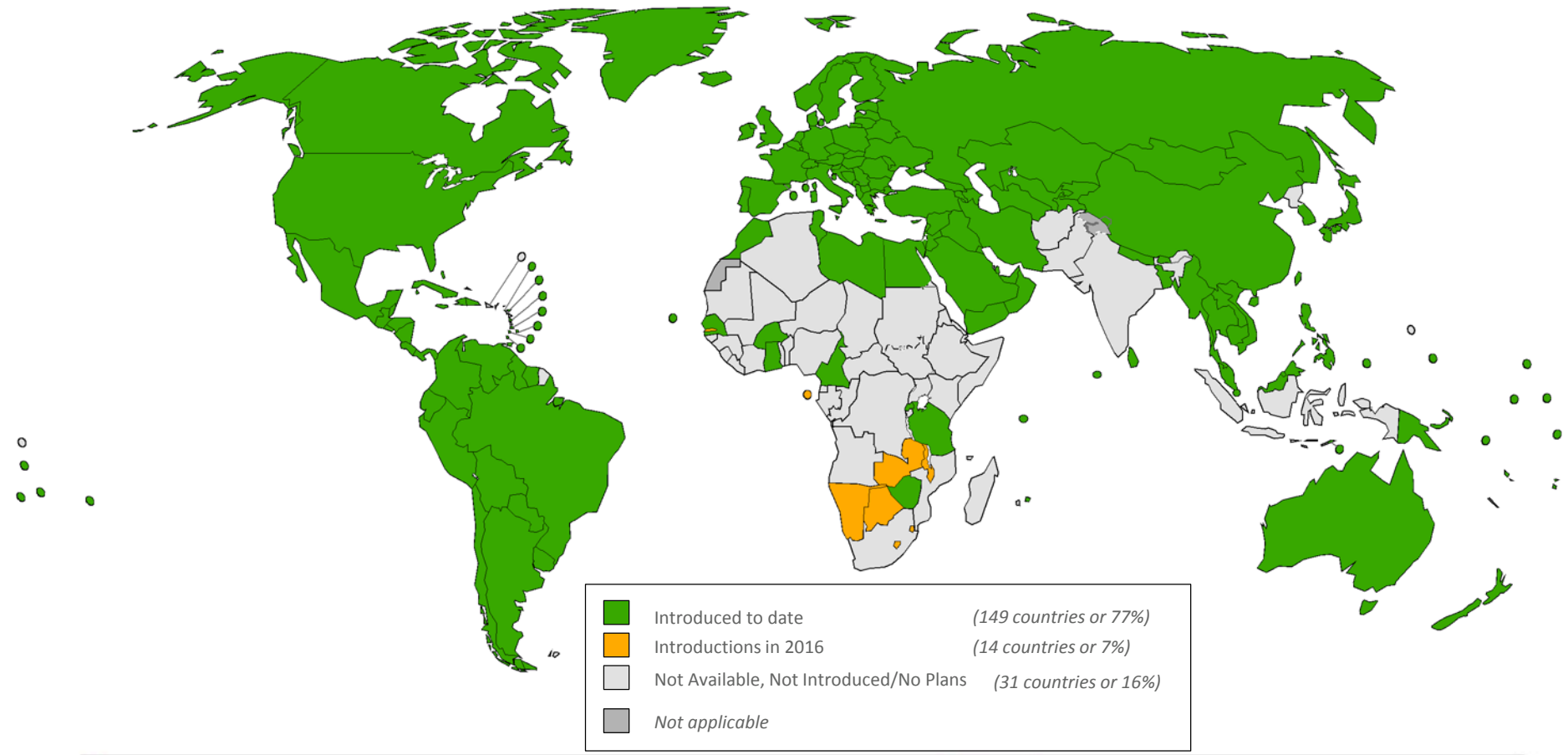


*coverage estimates for the 1rst dose of rubella containing vaccine are based on WHO and UNICEF estimates of coverage of measles containing vaccine.

MEASLES & RUBELLA INITIATIVE

Source: *WHO/UNICEF coverage estimates 2015 revision. July 2016. Immunization Vaccines and Biologicals, (IVB), World Health Organization. 194 WHO Member States. Date of slide: 16 July 2016.*

Countries with Rubella Vaccine in the National Immunization Program
Introductions in 2016



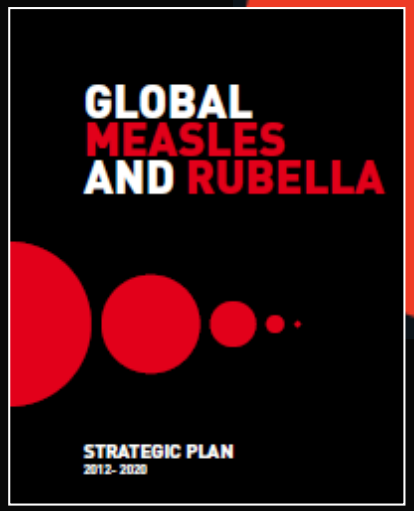
The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement. ©WHO 2016. All rights reserved.

Source: *WHO/IVB Database, as of 12 April 2016. Map production Immunization Vaccines and Biologicals (IVB), World Health Organization*

Challenges to Measles-Rubella Elimination

- Need for increased visibility and political commitment to regional elimination goals
- Susceptibility gaps including among older children and adolescents
- Surveillance quality in most AND least developed countries
- Vaccine hesitancy
- Risk of importations in countries that have eliminated

MIDTERM REVIEW OF THE GLOBAL MEASLES AND RUBELLA STRATEGIC PLAN 2012-2020



Presented to Strategic Advisory Group of Experts, Geneva, 19 October 2016

Major Mid-Term Review Findings and Conclusions

- Tremendous progress made since 2001, however, neither measles nor rubella elimination on track to achieve ambitious goals
- Basic strategies articulated are sound
- Full implementation has been limited by inadequate country ownership and global political will, reflected in inadequate resources
- It is premature to set a timeframe for measles eradication at this point
  - A determination should be made, not later than 2020, whether a formal global goal for measles eradication should be set with timeframes for achievement

Major Mid-Term Review Findings and Conclusions

- Disease incidence is the most important indicator of progress
- There is an urgent need to strengthen the collection and use of surveillance data to better guide program strategy and implementation
- Strengthening of immunization systems is critical to achieving regional elimination goals
  - Two doses of measles or measles-rubella vaccine delivered through ongoing services is the standard for national programs
  - Regular preventative campaigns should be conducted if coverage is insufficient for high population immunity

MEASLES & RUBELLA INITIATIVE

Summary

- Global transmission of measles and rubella put countries, such as the United States, at high risk of importation
- Effective vaccination strategies exist, resulting in major achievements, but milestones are ***not*** being met
  - Increased country ownership and global political will is needed to achieve elimination
- Global efforts to assist countries to introduce rubella containing vaccine are needed
- The mid-term program review has highlighted efforts that are needed to continue progress towards a world without measles, rubella, and congenital rubella syndrome

Thank you from the Measles & Rubella Initiative Partners

American Red Cross

CDC

unicef

United Nations Foundation

World Health Organization

GAVI Alliance

Canadian International Development Agency

Bill & Melinda Gates foundation

International Federation of Red Cross and Red Crescent Societies

IFFIm

MERCK

BD

The Church of Jesus Christ of Latter-day Saints

Anne Ray Charitable Trust

Norwegian Ministry of Foreign Affairs

Immunization basics

Lions Clubs International Foundation

JICA Japan International Cooperation Agency

vodafone

international pediatric association
association internationale de pédiatrie
asociación Internacional de pediatría

ecdc European Centre for Disease Prevention and Control

SABIN VACCINE INSTITUTE

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Global Transmission Patterns of Measles and Rubella: Tracking the Sources of Importations

Paul A. Rota, PhD, Acting Chief, Viral Vaccine Preventable Diseases Branch, Division of Viral Diseases, Centers for Disease Control and Prevention

Global Transmission Patterns of Measles and Rubella: Tracking the Sources of Importations

Paul A. Rota, PhD

Acting Chief

Viral Vaccine Preventable Disease Branch (proposed), Division of Viral Diseases,

National Center for Immunization and Respiratory Diseases

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

Laboratory Surveillance for Measles and Rubella

Competent and sustainable laboratory support for global measles and rubella surveillance is provided by the WHO Global Measles and Rubella Laboratory Network (GMRLN)

Roles of the GMRLN

- Confirm cases of suspected measles or rubella
- Determine genetic relationships of circulating viral strains
- Measure population immunity

Molecular Epidemiology of Measles and Rubella

- Allows tracking of transmission pathways and helps to identify the source of importations
- Can confirm or deny suspected epidemiologic links between cases
- Only means to distinguish between infection with wild type virus and vaccine reactions
- Critical for monitoring the maintenance and elimination of endemic transmission of measles and rubella in the United States

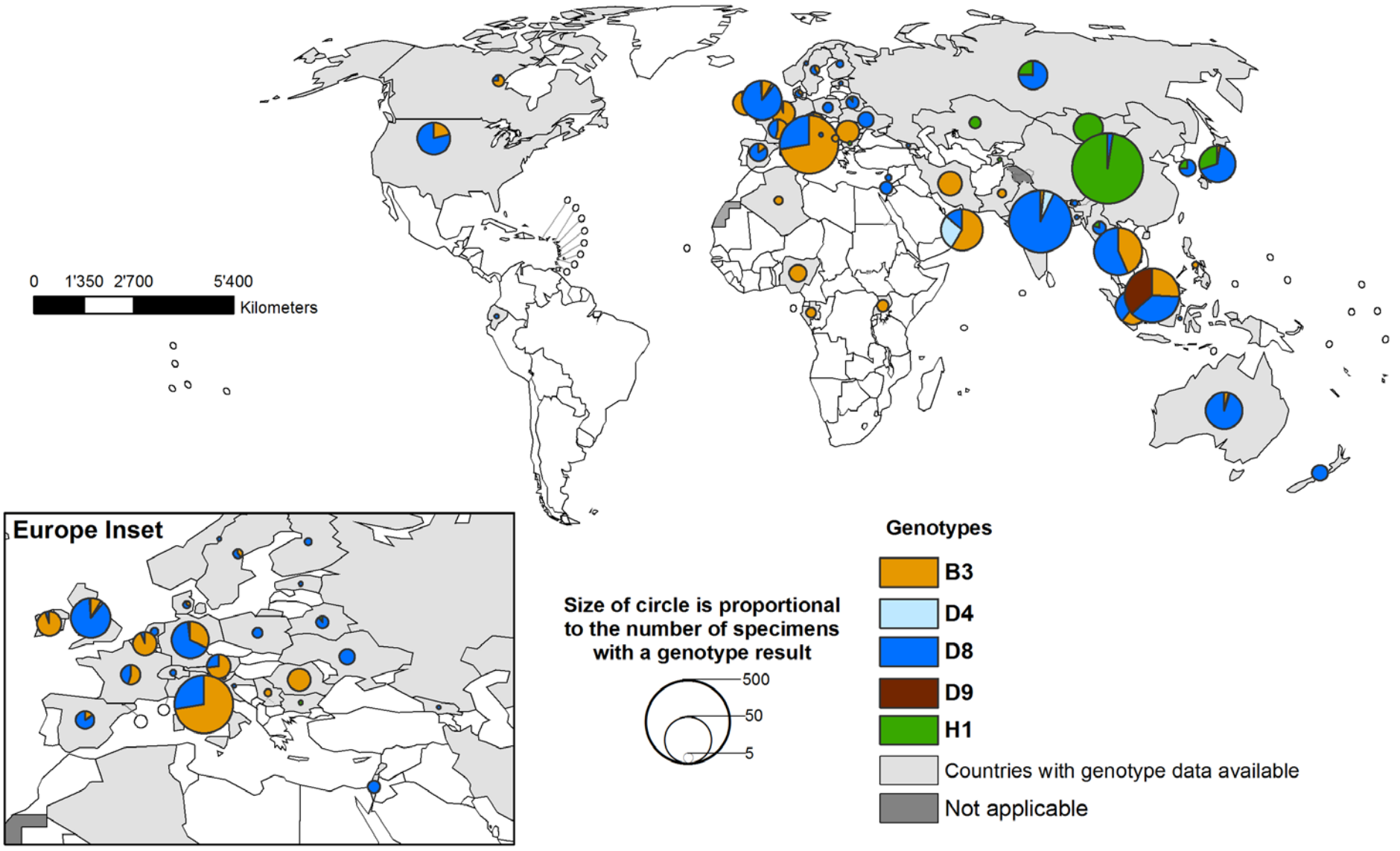
Global Sequence Databases: MeaNS and RubeNS

- Global genetic sequence databases for measles and rubella
- Maintained at Public Health England
- Governance from GMRLN laboratories in all WHO regions
- Rapid sequence analysis, genotyping, and sequence comparison

Genetic Characterization of Measles and Rubella

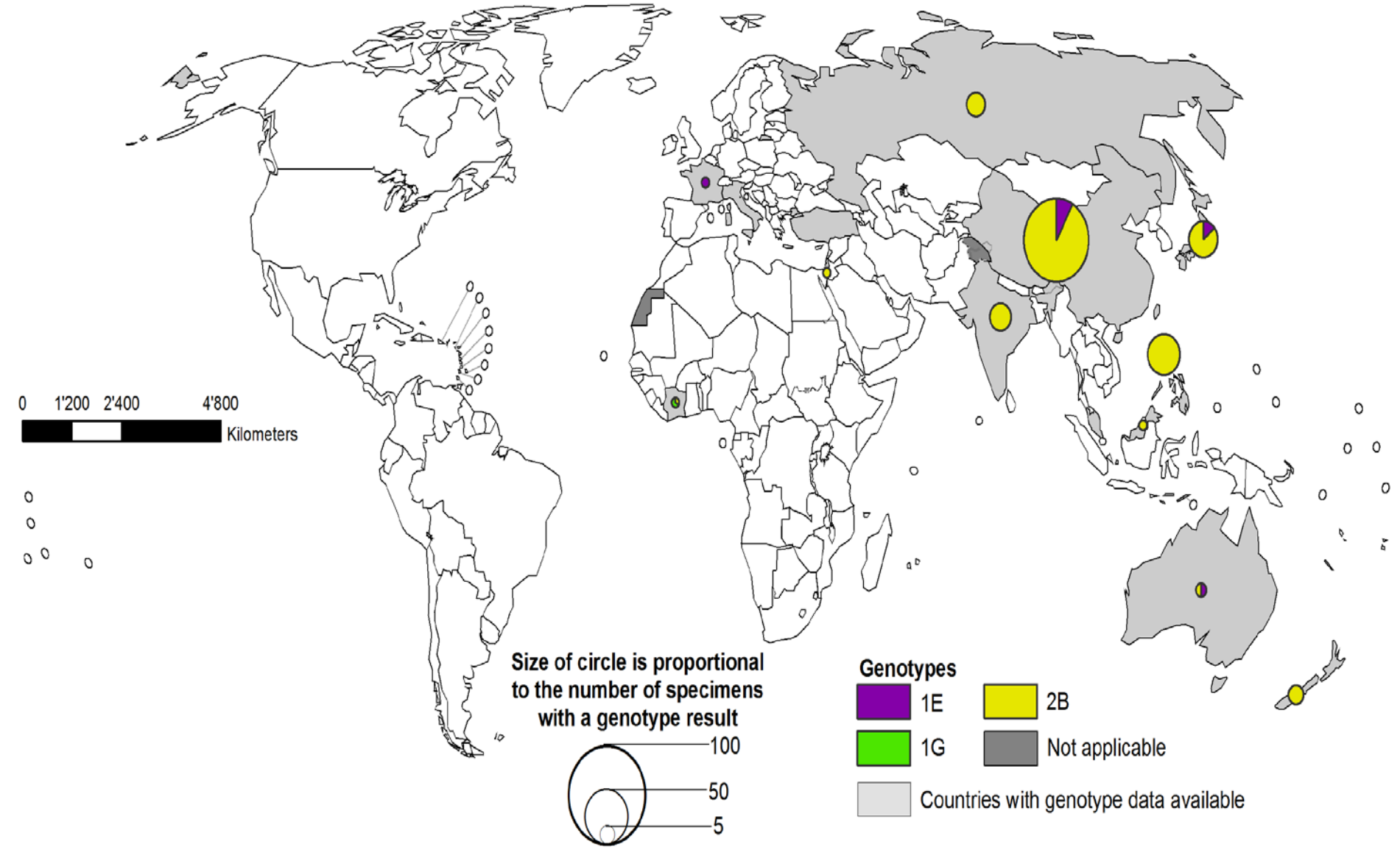
- **WHO has established standard protocols for genotyping measles and rubella**
- **Measles**
  - 24 Genotypes, 6 active (B3, D4, D8, D9, G3, H1)
  - Based of sequence of 450 nucleotides of the N gene
  - Over 30,000 sequences in the WHO database, **MeaNS**
- **Rubella**
  - Clade 1 - 10 genotypes: a-J
  - Clade 2 - 3 genotypes: A-C
  - Based on 739 nucleotides in the E1 coding region
  - 1768 sequences in the WHO Database, **RubeNS (**1E=321 sequences, 2B=795 sequences)

Global Distribution of Measles Genotypes: 2016



Source: *MeaNS*

Global Distribution of Rubella Genotypes: 2016



Source: *RubeNS*

Measles in the United States: 2013-2016

Year	Total Cases	Import	Imported-Virus	Linked to Importation or Imported-Virus	Unknown
2013	187	51	5	127	4
2014	667	63	61	535	8
2015	191	28	52	104	7
2016*	80	16	27	34	3

From 2013-2016, 112 (71%) of 158 imports occurred among U.S. residents

Data provided by VVPDB/MMRPH Team
***Provisional data**

Measles in the United States: 2013-2016

Year	Total Cases	Import	Imported-Virus	Linked to Importation or Imported-Virus	Unknown
2013	187	51	5	127	4
2014	667	63	61	535	8
2015	191	28	52	104	7
2016*	80	16	27	34	3

From 2013-2016, 112 (71%) of 158 imports occurred among U.S. residents

Data provided by VVPDB/MMRPH Team
***Provisional data**

Genetic Characterization of Measles Viruses for Molecular Epidemiology

Example of tracking transmission pathways by genetic analysis

Importation of genotype B3

Importation of genotype D9

Global transmission of measles viruses from the Philippines, 2014

Source: *CDC and WHO GMRLN*

Measles Outbreak in Ohio: 2014

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

A Measles Outbreak in an Underimmunized Amish Community in Ohio

Paul A. Gastañaduy, M.D., M.P.H., Jeremy Budd, B.S., Nicholas Fisher, B.S., Susan B. Redd, B.A., Jackie Fletcher, R.N., Julie Miller, R.N., M.S.N., Dwight J. McFadden III, M.D., M.P.H., Jennifer Rota, M.P.H., Paul A. Rota, Ph.D., Carole Hickman, Ph.D., Brian Fowler, M.P.H., Lilith Tatham, D.V.M., M.P.H., Gregory S. Wallace, M.D., M.P.H., Sietske de Fijter, M.S., Amy Parker Fiebelkorn, M.S.N., M.P.H., and Mary DiOrio, M.D., M.P.H.

Source: *N Engl J Med 2016;375:1343-54.DOI: 10.1056/NEJMoa1602295*

Measles Outbreak in Ohio: 2014

- March through July, 2014, 383 cases associated with the outbreak
- Nine counties in Ohio
- 89% of the cases were unvaccinated
- Transmission of measles took place primarily within households
- The virus strain was genotype D9, sequences (n=37) were identical to viruses detected in Hong Kong in 2014

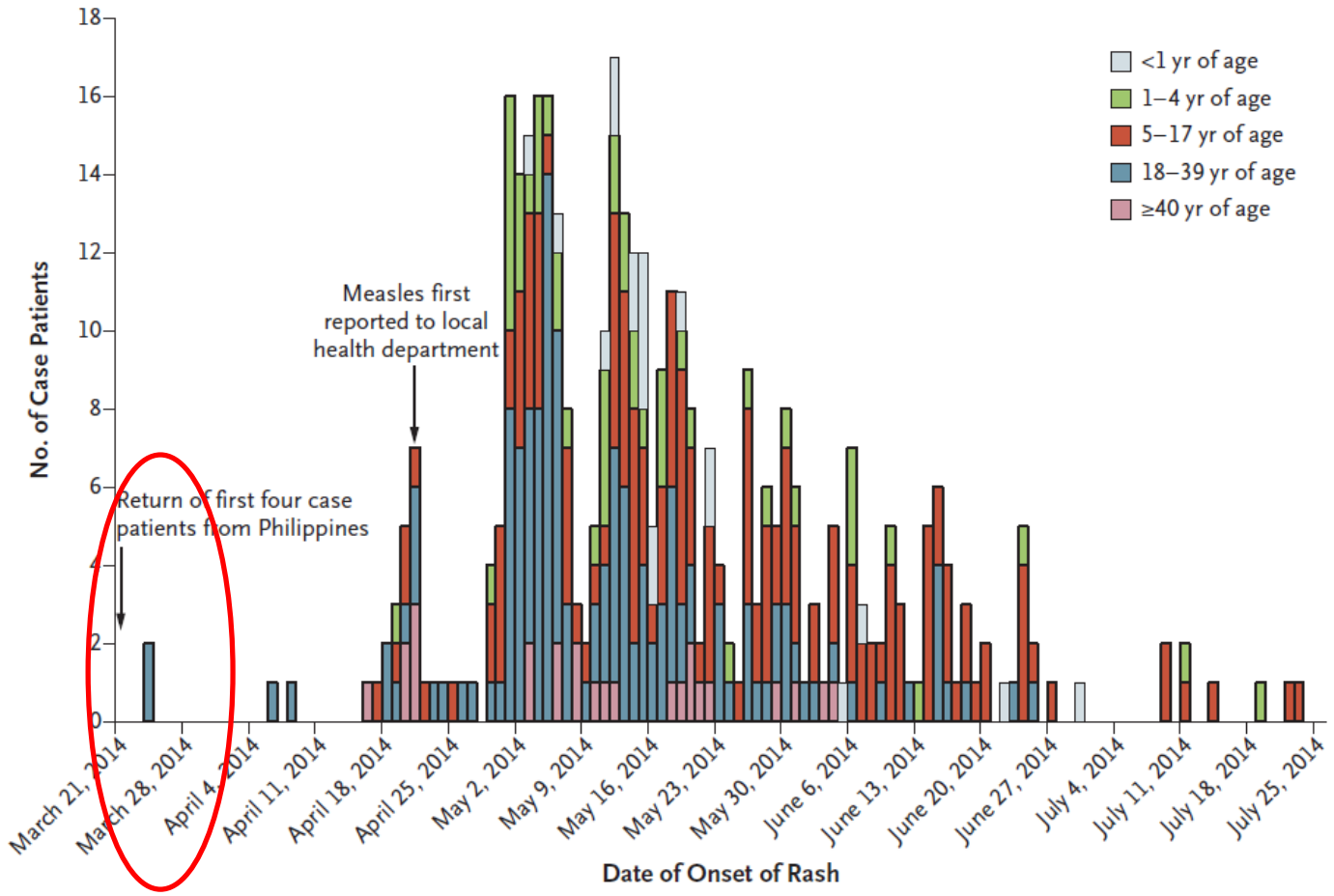


Figure 1. Epidemiologic Curve of 383 Case Patients with Confirmed Outbreak-Associated Measles in Ohio, March 24, 2014, through July 23, 2014.

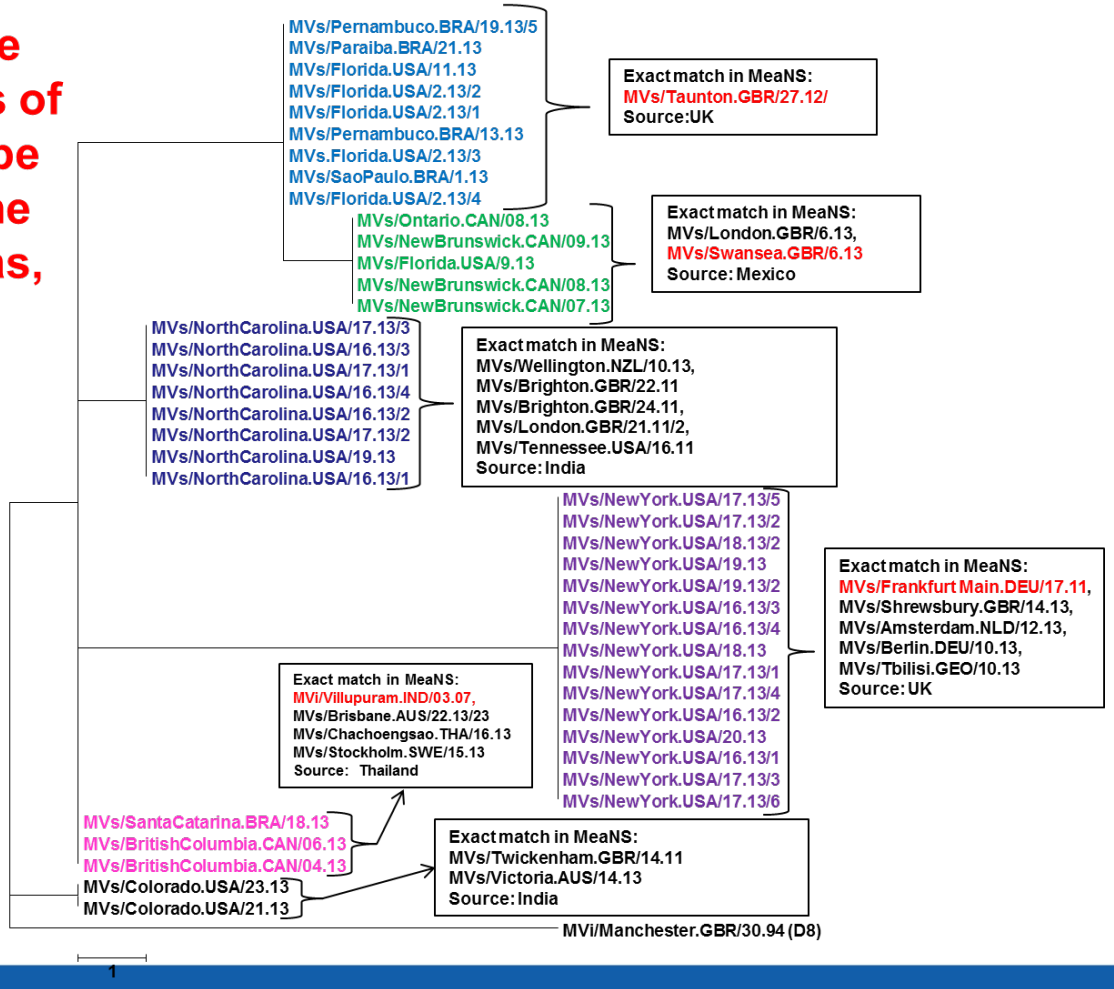
Shown are the total numbers of case patients with measles according to age group and date of onset of rash. For three case patients with measles, the date of onset of rash could not be determined; therefore, the date of onset of illness plus 2 days (the median number of days between onset of illness and onset of rash for all other cases) is shown. In one case patient who had laboratory-confirmed measles, a rash did not develop; therefore, the date of onset of illness is shown. The first four case patients who returned from the Philippines on March 21, 2014, include the two patients from whom the measles outbreak originated.

Lineages of Measles Viruses Detected in the US during 2014. Strains from the US are listed in the left column. Strains with exact matches in N-450 are listed on the right column. Named lineages (from MeaNS) are shown in red. NEM refers to no exact match.

Measles Representative Strain	Gen.	Number of Strains	MeaNS Exact Match
MVs/New York.USA/15.14/2	B3	+ 4 identical strains	NEM
MVs/Missouri.USA/22.14	B3	+ 1 identical strains	NEM
MVs/Michigan.USA/48.14/1	B3	+ 4 identical strains	NEM
MVs/Alaska.USA/37.14/ (CDC_COE-2014-173)	B3		NEM
MVs/California.USA/4.14/ (CDC_COE-2014-3)	B3		NEM
MVs/California.USA/6.14/1 (CDC_COE-2014-9)	B3		NEM
MVs/California.USA/8.14/3 (CDC_COE-2014-18)	B3	+ 2 identical strains	NEM
MVs/NewYork.USA/8.14/6 (CDC_COE-2014-24)	B3		NEM
MVs/California.USA/5.14/ (CDC_COE-2014-7)	B3	+ 81 identical strains	MVi/Harare.ZWE/38.09/
MVs/Kosrae.FSM/21.14/2	B3	+ 69 identical strains	MVi/Harare.ZWE/38.09/
MVs/Kosrae.FSM/21.14/4	B3		NEM
MVs/Pohnpei.FSM/28.14/2	B3		NEM
MVs/Chuuk.FSM/34.14	B3		NEM
MVs/Indiana.USA/30.14/	H1	+ 1 identical strains	MVs/Liaoning.CHN/23.14/2, MVi/Tianjin.CHN/22.14/4, MVi/Shanghai.CHN/20.14/, MVs/Anhui.CHN/19.14/8
MVs/California.USA/1.14/ (CDC_COE-2014-23)	H1		MVs/Hong Kong.CHN/49.12
MVs/Texas.USA/36.14/ (CDC_COE-2014-171)	H1		MVs/Hong Kong.CHN/42.11/
MVs/Ohio.USA/28.14	D9		NEM
MVs/Ohio.USA/16.14/1	D9	+ 37 identical strains	MVs/Hong Kong.CHN/08.14/2
MVs/Washington.USA/12.14/ (CDC_COE-2014-69)	D8	+ 2 identical strains	MVs/Taunton.GBR/27.12/
MVs/California.USA/4.14/2 (CDC_COE-2014-11)	D8		NEM
MVs/California.USA/8.14/ (CDC_COE-2014-14)	D8		NEM
MVs/Hawaii.USA/43.14/3	D8	+ 2 identical strains	MVs/Queensland.AUS/45.14/, MVs/London.GBR/30.14/ MVs/NewSouth Wales.AUS/27.14/ MVs/WesternAustralia.AUS/23.14/
MVi/Massachusetts.USA/14.14	D8		MVs/London.GBR/22.12/3, MVs/Victoria.AUS/6.11/ MVs/Ludwigsburg.DEU/13.10/
MVs/Virginia.USA/19.14	D8		MVs/Maastricht.NLD/14.14, MVi/Pune.IND/38.13 MVs/WesternAustralia.AUS/51.13
MVs/Massachusetts.USA/19.14	D8	+ 2 identical strains	MVs/Heidelberg.DEU/45.13/
MVs/California.USA/20.14/ (CDC_COE-2014-118)	D8		MVi/HuluLangat.MYS/26.11
MVs/California.USA/8.14/2 (CDC_COE-2014-17)	D8		MVs/FrankfurtMair.DEU/17.11/
MVs/California.USA/12.14/8 (CDC_COE-2014-90)	D8	+ 4 identical strains	MVs/Western Australia.AUS/12.14/, MVs/London.GBR/9.14/2 MVi/Singapore.SGP/13.14/

Tracking Lineages of Measles Virus (Named Strains)

Multiple Lineages of Genotype D8 in the Americas, 2013



Measles Outbreaks in the United States: 2016

Outbreaks USA:2016

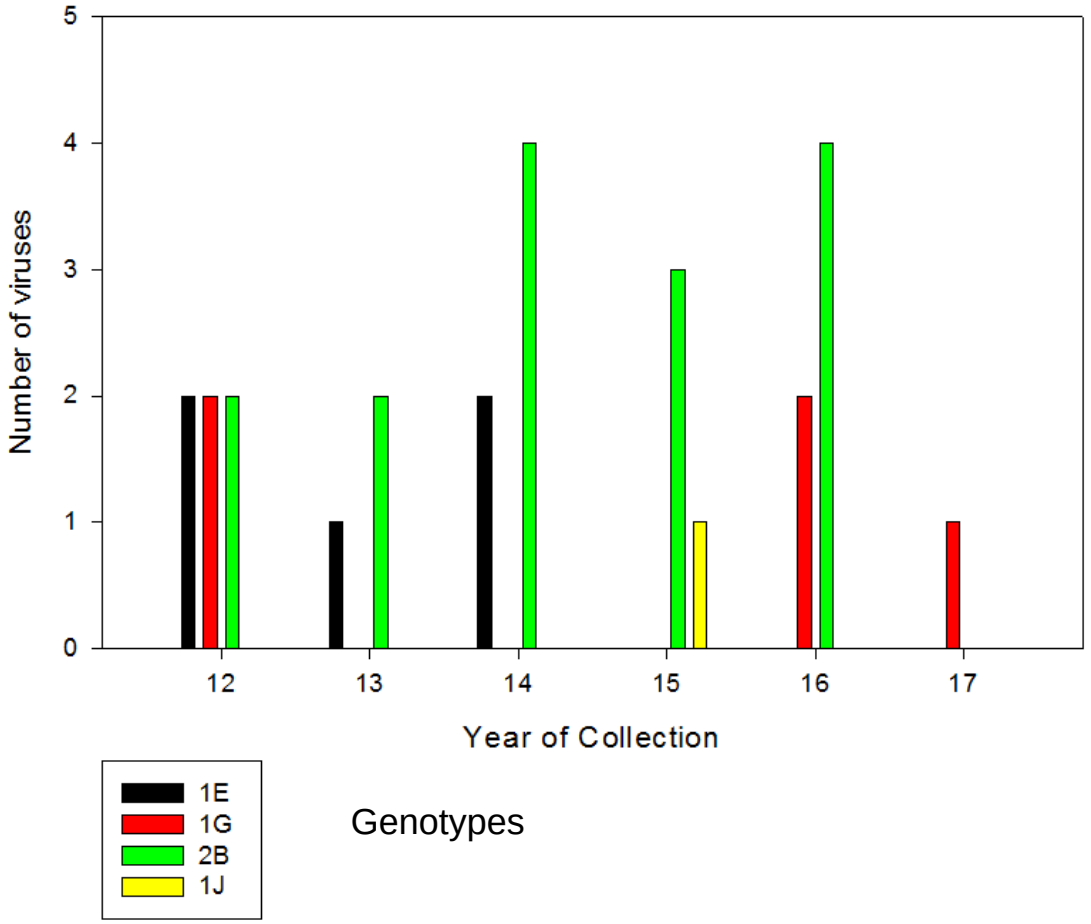
1st onset	latest rash	State(s)	# cases	Source	Genotype
12/2/2016		CA	11+	Investigation underway	D8
5/18/2016	6/26/2016	AZ	29	Unknown	D8
5/14/2016	6/19/2016	IL 2 / FL 3	5	Import, Indonesia	D8
4/9/2016	4/20/2016	TN	7	Unknown	B3

Measles Outbreaks in the United States: 2016

Genotypes from Outbreaks USA:2016

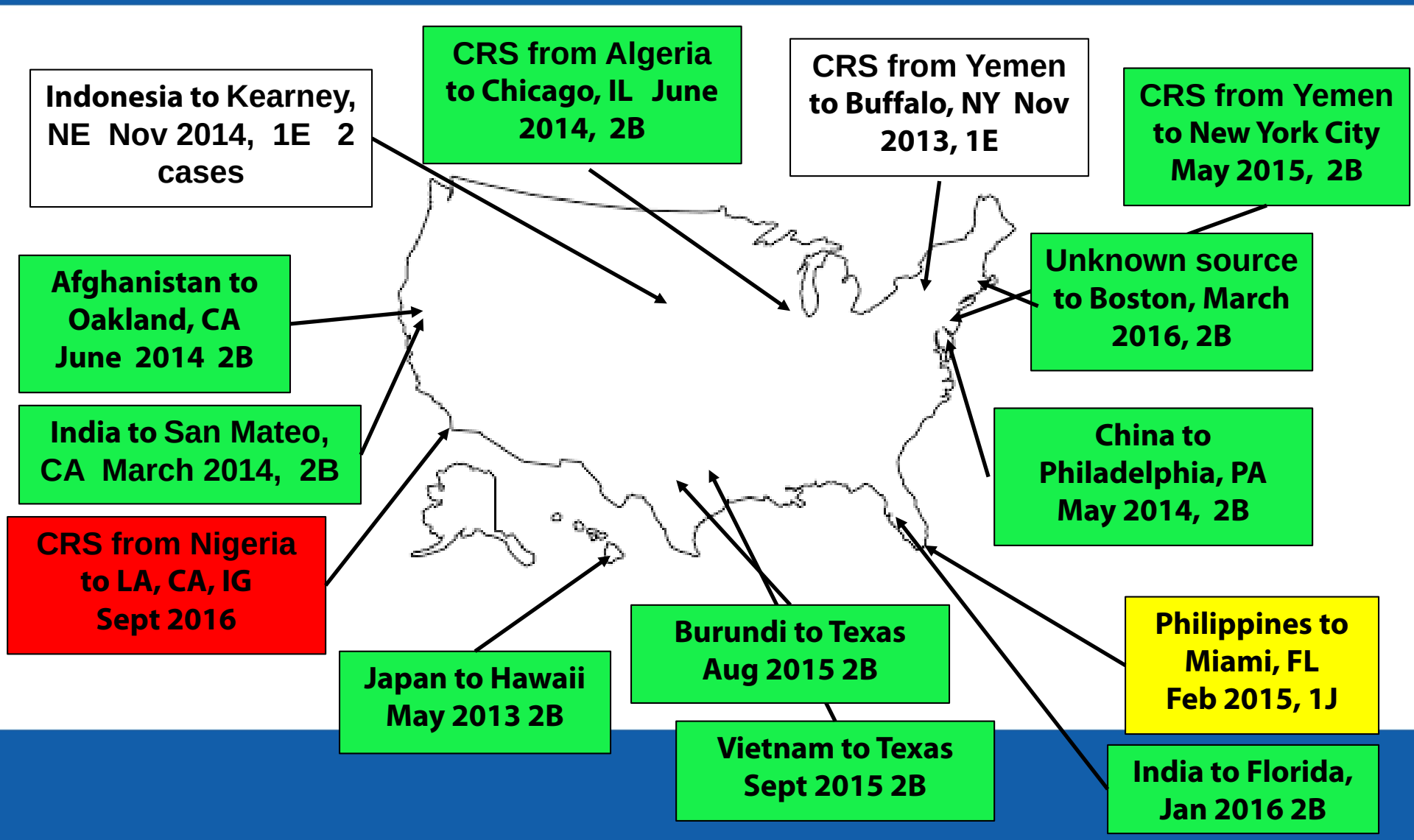
State(s)	Source	Genotype	MeaNS Match
CA	Investigation underway	D8	No exact match, 4 nt difference from closest match
AZ	Unknown	D8	Exact match to New Zealand, Australia, India
IL 2 / FL	Import, Indonesia	D8	Exact match Malaysia, Thailand
TN	Unknown	B3	1 nt different from Romania, Serbia, Ireland, Italy Austria

Rubella Genotypes from Imported Rubella* Cases: 2012-2017



*Includes both acute and congenital rubella syndrome (CRS) cases

Source of Importations of Rubella and CRS Cases into the United States, 2013-2016



Summary

- Measles and rubella have been eliminated in the United States, but the viruses are continually introduced from countries that still have endemic circulation
  - High coverage with MMR vaccine must be maintained
  - Surveillance to rapidly identify imported cases is critical

- The diversity of genotypes reflects the various sources of the importations

- The genotypic data help to monitor the maintenance of elimination of measles and rubella in the United States, these data confirm that there is no endemic genotype of measles or rubella

Continuing Education Information

- For CE credit go to:

  www2a.cdc.gov/TCEOnline

- CE credit expires: **May 29, 2017**
- Course Code: **WC2661-042517**
- Instructions available in the resource pod

Q&A

Thank You!