The Resurgence the Case of Diphtheria and Measles, the Role of the Vaccines

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Costa Rica
2018
Conflicts of interest
None.
Child mortality rate, 1800

Shown is the share of children (born alive) who die before they are five years old.

Source: Gapminder estimates up until 1949 and UN Population Division from 1950 to today
Child mortality rate, 2015

Shown is the share of children (born alive) who die before they are five years old.

No data 0% 5% 10% 20% 30% >50%

Source: Gapminder estimates up until 1949 and UN Population Division from 1950 to today

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Causes of child mortality in 2013 and annual rate of reduction since 2000

6.3 million children died before the age 5 years in 2013 (44% of which died in the first month of their life). In 2000 9.9 million children died.

- The size of the rectangle shows the share of children killed by each cause.
- The color indicates the annual reduction of that cause since 2000 (child mortality from all causes declined).

Newborns dying in their 1st month

**Preterm birth complications**
Share of children killed by this cause: **15%**
Annual rate of reduction of this cause from 2000 to 2013: **-2.10%**

**Sepsis**
Share: **7%**
Reduction: **-2.6%**

**Other neonatal disorders**
Share: **4%**
Reduction: **-2.4%**

Intrapartum-related events
Share: **11%**
Reduction: **-3.60%**

Children dying after 1st month and before 5 years

**Other disorders**
Share: **15%**
Reduction: **-2.5%**

**Pneumonia**
Share: **13%**
Reduction: **-5%**

**Diarrhoea**
Share: **9%**
Reduction: **-6.5%**

**Injury**
Share: **5%**
Reduction: **-2.8%**

**Malaria**
Share: **7%**
Reduction: **-4.5%**

**Measles**
Share: **2%**
Reduction: **-12.8%**

**Pertussis**
Share: **2%**
Reduction: **-0.2%**

**Tetanus**
Share: **1%**
Reduction: **-5.2%**

**Congenital abnormalities**
Share: **4%**
Reduction: **-0.8%**

**Pneumonia**
Share: **2%**
Reduction: **-5.2%**

Measles
Region of the Americas is declared free of measles

Washington, D.C., 27 September 2016 (PAHO/WHO) - The Region of the Americas is the first in the world to have eliminated measles, a viral disease that can cause severe health problems, including pneumonia, brain swelling and even death. This achievement culminates a 22-year effort involving mass vaccination against measles, mumps and rubella throughout the Americas.

The declaration of measles' elimination was made by the International Expert Committee for Documenting and Verifying Measles, Rubella, and Congenital Rubella Syndrome Elimination in the Americas. The announcement came during the 55th Directing Council of the Pan American Health Organization/World Health Organization (PAHO/WHO), which is currently underway and is being attended by ministers of Health from throughout the Americas.

Measles is the fifth vaccine-preventable disease to be eliminated from the Americas, after the regional eradication of smallpox in 1971, poliomyelitis in 1994, and rubella and congenital rubella syndrome in 2015.
Measles Incidence Rate per Million by Countries, May 2016-April 2017.

### Measles Incidence Rate

- **Rate ≥ 50** (9 countries or 5%)
- **10 ≤ Rate < 50** (38 countries or 20%)
- **5 ≤ Rate < 10** (20 countries or 10%)
- **1 ≤ Rate < 5** (35 countries or 18%)
- **Rate < 1** (79 countries or 41%)
- **No data** (13 countries or 7%)
- **Not available**

### Top 10 Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Cases</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>54345</td>
<td>40</td>
</tr>
<tr>
<td>China</td>
<td>13769</td>
<td>9</td>
</tr>
<tr>
<td>Nigeria</td>
<td>10331</td>
<td>55</td>
</tr>
<tr>
<td>DR Congo</td>
<td>6330</td>
<td>79</td>
</tr>
<tr>
<td>Pakistan</td>
<td>5250</td>
<td>27</td>
</tr>
<tr>
<td>Indonesia</td>
<td>4962</td>
<td>19</td>
</tr>
<tr>
<td>Mongolia</td>
<td>3479</td>
<td>1157</td>
</tr>
<tr>
<td>Romania</td>
<td>3105</td>
<td>160</td>
</tr>
<tr>
<td>Italy</td>
<td>2893</td>
<td>48</td>
</tr>
</tbody>
</table>

### Measles cases from countries with known discrepancies between case-based and aggregate surveillance, as reported by country

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Cases</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR Congo</td>
<td>2016</td>
<td>22162</td>
<td>SITUATION EPIDEMIOLOGIQUE DE LA ROUGEOLE EN RDC, Week of 30/05/2017</td>
</tr>
<tr>
<td></td>
<td>2017</td>
<td>20146</td>
<td></td>
</tr>
<tr>
<td>Somalia</td>
<td>2016</td>
<td>5657</td>
<td>Somali EPI/POL Weekly Update Week 22</td>
</tr>
<tr>
<td></td>
<td>2017</td>
<td>9813</td>
<td></td>
</tr>
</tbody>
</table>

Based on data received 2017-06 and covering the period between 2016-05 and 2017-04. Incidence: Number of cases / population * 100,000. * World population prospects, 2015 revision. ** Countries with the highest number of cases for the period. Data source: IVB Database. Map production: IVB/EPI World Health Organization, WHO, 2017. All rights reserved.
# Global and regional immunization profile

## Region of the Americas

### Population data in thousands

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>1'001'309</td>
<td>992'157</td>
<td>982'903</td>
<td>973'565</td>
<td>964'141</td>
</tr>
<tr>
<td>Live births</td>
<td>15'109</td>
<td>15'125</td>
<td>15'140</td>
<td>15'160</td>
<td>15'188</td>
</tr>
<tr>
<td>Surviving infants</td>
<td>14'912</td>
<td>14'921</td>
<td>14'929</td>
<td>14'943</td>
<td>14'963</td>
</tr>
<tr>
<td>Pop. less than 5 years</td>
<td>74'725</td>
<td>74'755</td>
<td>74'921</td>
<td>75'107</td>
<td>75'357</td>
</tr>
<tr>
<td>Pop. less than 15 years</td>
<td>226'910</td>
<td>227'376</td>
<td>227'954</td>
<td>228'718</td>
<td>229'526</td>
</tr>
<tr>
<td>Female 15-49 years</td>
<td>253'763</td>
<td>252'188</td>
<td>250'555</td>
<td>248'921</td>
<td>247'225</td>
</tr>
</tbody>
</table>

### Number of reported cases

<table>
<thead>
<tr>
<th>Disease</th>
<th>2017</th>
<th>2016</th>
<th>2015</th>
<th>2014</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diphtheria</td>
<td>872</td>
<td>45</td>
<td>49</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Measles</td>
<td>775</td>
<td>12</td>
<td>611</td>
<td>1'966</td>
<td>491</td>
</tr>
<tr>
<td>Mumps</td>
<td>46'730</td>
<td>21'142</td>
<td>19'115</td>
<td>18'377</td>
<td>16'747</td>
</tr>
<tr>
<td>Pertussis</td>
<td>10'232</td>
<td>10'160</td>
<td>32'116</td>
<td>46'865</td>
<td>54'873</td>
</tr>
<tr>
<td>Polio</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rubella</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Rubella (CRS)</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Tetanus (neonatal)</td>
<td>13</td>
<td>11</td>
<td>22</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Tetanus (total)</td>
<td>512</td>
<td>499</td>
<td>568</td>
<td>517</td>
<td>485</td>
</tr>
<tr>
<td>Yellow fever</td>
<td>823</td>
<td>113</td>
<td>37</td>
<td>23</td>
<td>26</td>
</tr>
</tbody>
</table>

[http://www.who.int/immunization/monitoring_surveillance/data/gs_amrprofile.pdf?ua=1](http://www.who.int/immunization/monitoring_surveillance/data/gs_amrprofile.pdf?ua=1)
# Global and regional immunization profile

## Region of the Americas

Data received as of 2018-Sep-18

Next overall update spring 2019

Next WHO UNICEF estimates July 2019

## Percentage of target population vaccinated, by antigen

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BCG</td>
<td>92</td>
<td>93</td>
<td>96</td>
<td>96</td>
<td>94</td>
</tr>
<tr>
<td>DTP1</td>
<td>96</td>
<td>96</td>
<td>96</td>
<td>95</td>
<td>95</td>
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<tr>
<td>DTP3</td>
<td>91</td>
<td>91</td>
<td>91</td>
<td>90</td>
<td>91</td>
</tr>
<tr>
<td>HepB_BD</td>
<td>69</td>
<td>65</td>
<td>69</td>
<td>67</td>
<td>66</td>
</tr>
<tr>
<td>HepB3</td>
<td>90</td>
<td>90</td>
<td>89</td>
<td>88</td>
<td>89</td>
</tr>
<tr>
<td>Hib3</td>
<td>91</td>
<td>91</td>
<td>91</td>
<td>90</td>
<td>91</td>
</tr>
<tr>
<td>IPV1</td>
<td>93</td>
<td>84</td>
<td>62</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MCV1</td>
<td>92</td>
<td>92</td>
<td>92</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>MCV2</td>
<td>74</td>
<td>80</td>
<td>53</td>
<td>54</td>
<td>45</td>
</tr>
<tr>
<td>PCV3</td>
<td>82</td>
<td>82</td>
<td>85</td>
<td>83</td>
<td>79</td>
</tr>
<tr>
<td>Pol3</td>
<td>90</td>
<td>87</td>
<td>91</td>
<td>90</td>
<td>89</td>
</tr>
<tr>
<td>RCV1</td>
<td>92</td>
<td>92</td>
<td>92</td>
<td>92</td>
<td>92</td>
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<tr>
<td>TT2plus</td>
<td>60</td>
<td>71</td>
<td>48</td>
<td>54</td>
<td>69</td>
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<tr>
<td>YFV</td>
<td>60</td>
<td>53</td>
<td>56</td>
<td>57</td>
<td>56</td>
</tr>
</tbody>
</table>

*Based on WHO-UNICEF estimates
TT2plus is based on reported coverage*
Epidemiological Update
Measles
21 September 2018

Situation Summary

In 2018, as of 21 September, a total of 6,629 confirmed cases of measles, including 72 deaths, have been reported in 11 countries of the Region of the Americas: Antigua and Barbuda (1 case), Argentina (11 cases), Brazil (1,735 cases, including 10 deaths), Canada (22 cases), Colombia (85 cases), Ecuador (19 cases), Guatemala (1 case), Mexico (5 cases), Peru (21 cases), the United States of America (124 cases), and the Bolivarian Republic of Venezuela (4,605 cases, including 62 deaths).

Since the 20 August 2018 Epidemiological Update on measles¹, a total of 1,625 additional confirmed measles cases were reported, including 4 deaths in 8 countries of the Region (3 cases in Argentina, 498 cases and 4 new deaths in Brazil, 3 cases in Canada, 25 cases in Colombia, 2 cases in Ecuador, 17 cases in Peru, 17 cases in the United States, and 1,060 cases in Venezuela).
Measles cases by countries in selected years*, The Americas.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases</th>
<th>Country(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>1,369</td>
<td>Canada=12, Ecuador=1, United States=80, Total (2016)=93</td>
</tr>
<tr>
<td>2014</td>
<td>1,966</td>
<td>Argentina=3, Canada=43, United States=108, Total (2017)=154</td>
</tr>
<tr>
<td>2015</td>
<td>613</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>2017*</td>
<td>154</td>
<td></td>
</tr>
</tbody>
</table>

Source: surveillance country reports to PAHO (MESS and ISIS)
* Data as of 9 June 2017

Confirmed measles cases

- **Imported**: 9%
- **Import related**: 60%
- **Unknown**: 31%

**Source**: ISIS, MESS and country reports.
*Data as of epidemiological week 24, 2017.
Annual reported measles cases and MCV1 and MCV2** coverage*, 1980-2015.

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

* 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.

MMR1 coverage by countries in children 1 year of age, Latin America and the Caribbean, 2014-2015.

Coverage Range
- ≥95%
- 90%-94%
- 80%-89%
- <80%
- Data not available

Source: Country reports through the PAHO/WHO/UNICEF Joint Reporting Form (JRF), 2014 and 2015.
Global Milestone: 95% Reduction in Measles Deaths.

Measles deaths down by 79%*

Estimated deaths by Region, 2015 (Total 134,180)

20.3 million deaths prevented since 2000 by measles vaccination
WHO Recommendation*

- **two doses** of measles vaccine
- Minimum interval of one month between doses
- MCV1 at 9 or 12 months
- When MCV1 ≥ 80% for 3 years then add MCV2 at:
  - 15-18 months (if country has ongoing measles transmission)
  - school entry (option if near elimination)
- Very high coverage (>90%) is needed with both doses
  - Mortality reduction: ≥90% national, ≥80% in every district
  - Elimination: ≥95% in every district


<table>
<thead>
<tr>
<th>Introduced MMR2 at 18 months</th>
<th>Lower the age (18 months) since 2014</th>
<th>No lower the age (4-7yrs)</th>
<th>No MMR2 yet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominica</td>
<td>Anguilla*</td>
<td>Argentina</td>
<td>Bolivia</td>
</tr>
<tr>
<td>Grenada</td>
<td>Belize*</td>
<td>Bahamas</td>
<td>Haiti</td>
</tr>
<tr>
<td>Antigua &amp; Barbuda</td>
<td>Bermuda</td>
<td>Dom. Republic</td>
<td></td>
</tr>
<tr>
<td>Barbados</td>
<td>Chile</td>
<td>Honduras</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>Canada</td>
<td>Nicaragua</td>
<td></td>
</tr>
<tr>
<td>Ecuador</td>
<td>Colombia</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Guyana</strong>*</td>
<td>Costa Rica</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jamaica</td>
<td>Cuba*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Montserrat</td>
<td>Cayman Islands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panama</td>
<td>Mexico*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peru</td>
<td>Paraguay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>St. Kitts &amp; Nevis</td>
<td>El Salvador</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Saint Lucia</strong>*</td>
<td>Trinidad and Tobago</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suriname</td>
<td>St. Vincent &amp; Grenadines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turks and Caicos</td>
<td>United States</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virgin Islands</td>
<td>Uruguay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guatemala</td>
<td>Venezuela</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results of follow-up campaigns against measles and rubella, The Americas, 2016*. 

13,175,180 children were vaccinated against measles and rubella in 2016

- **Mexico (1-4yr)**
  - 94%—MMR

- **Honduras (1-4yr)**
  - 96%—MMR

- **Nicaragua (1-4yr)**
  - 105%—MMR

- **Haiti (1-4yr)**
  - 99%—MR

- **Peru (2-5yr)**
  - 78%—MR

Source: Country reports to PAHO
*Data as of May 17, 2017
Regional rate of measles and rubella suspected cases, Latin America and the Caribbean, 2005-2017*.

2011: Monitoring the regional rate for 2 suspected cases x 100,000 pop

Eliminated countries are not maintaining sensitive surveillance

Source: ISIS, MESS and country reports. *Data as of epidemiological week 25, 2017
Measles outbreaks: what does it represent for the elimination strategy in the region of the Americas? A call for the action

Avila-Agüero ML et al

Diphtheria in the Americas - Summary of the situation

Between epidemiological week (EW) 1 and EW 37 of 2018, three countries in the Region of the Americas (Colombia, Haiti, and the Bolivarian Republic of Venezuela) have reported confirmed cases of diphtheria. While in Colombia no new cases have been detected (since July 2018), in Haiti and Venezuela the outbreaks are ongoing.
Diphtheria Worldwide 1980-2015

Figure 1- Reported cases of diphtheria worldwide- 1980 -2015

Clarke K, REVIEW OF THE EPIDEMIOLOGY OF DIPHTHERIA – 2000-2016 WHO Joint Reporting Form CDC. 2017
Reported cases of diphtheria per year worldwide by 5 year average

Reported diphtheria cases declined from almost **10,000 cases** per year during 2000-2004 to **5288** per year during 2005-2009. However, since 2009 annual reported cases have levelled off.

Clarke K, REVIEW OF THE EPIDEMIOLOGY OF DIPHTHERIA – 2000-2016 WHO Joint Reporting Form CDC. 2017
Figure 3: Cases of diphtheria by region by 5 year averages, 2000-2015
Figure 5: Percentage (number) of countries with each diphtheria vaccination schedule - 2016

Clarke K, REVIEW OF THE EPIDEMIOLOGY OF DIPHTHERIA – 2000-2016 WHO Joint Reporting Form CDC. 2017
Sensitivity analysis of age distribution in higher case count versus sporadic incidence countries

In high case count countries, approximately 60% of cases are in those under 15, while in sporadic incidence countries the proportions were reversed.

66% of cases were in those 15 and older.

Clarke K, REVIEW OF THE EPIDEMIOLOGY OF DIPHTHERIA – 2000-2016 WHO Joint Reporting Form CDC. 2017
Vaccination status of cases in high case count countries *versus* sporadic incidence countries

Main challenge in countries with high case counts is achieving adequate coverage with the primary series. In countries with sporadic incidence, the predominance of older cases taken together with the relatively even distribution of vaccination status indicate that waning immunity might be a bigger issue.

Clarke K, REVIEW OF THE EPIDEMIOLOGY OF DIPHTHERIA – 2000-2016 WHO Joint Reporting Form CDC. 2017
These data indicate that the lack of vaccination with the primary series tends to be the principal risk factor for infection, yet also support evidence that immunity does wane and booster doses may be relevant.

Clarke K, REVIEW OF THE EPIDEMIOLOGY OF DIPHTHERIA – 2000-2016 WHO Joint Reporting Form CDC. 2017
Editorial

The current syndemic in Venezuela: Measles, malaria and more co-infections coupled with a breakdown of social and healthcare infrastructure. Quo vadis?

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Alberto Paniz-Mondolfi

Committee on Travel Medicine, Pan American Association of Infectious Diseases (API), Panama City, Panama
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Infectious Diseases Research Branch, Venezuelan Science Incubator and the Zoonosis and Emerging Pathogens Regional Collaborative Network, Cabudare, 3023, Lara, Venezuela
Laboratorio de Señalización Celular y Bioquímica de Pardositos, Instituto de Estudios Avanzados (IDEA), Caracas, Caracas, Venezuela
Conclusions

- **Risk**: to import and reestablish the endemic transmission of measles and rubella viruses, undoing the elimination achievements.

- **Challenge**: to maintain the adequate balance in the fulfillment of three key strategies:
  1. Guarantee high (=> 95%) and homogeneous coverage with two doses of MMR vaccine in every district or municipality.
  2. Guarantee high-quality epidemiological surveillance systems, with the capacity to promptly detect any suspected measles, rubella or CRS case.
  3. Implement a rapid response to imported measles, rubella and CRS cases, following standard mechanisms to prevent the reestablishment of endemic transmission.
Progress in decreasing diphtheria incidence worldwide has stalled over the past 10 years.

A wide variety of diphtheria vaccination schedules are used globally.

Most diphtheria cases occur in unvaccinated individuals, particularly in countries with higher case counts.

Countries with higher vaccination coverage had an increased percentage of cases over age 15 years compared to countries with lower vaccination coverage.
YOU REPRESENT A PARENT'S RIGHT TO CHOOSE, RESIST GOVERNMENT MANDATES AND LIVE FREE!

HOW DOES THAT MAKE YOU FEEL, SON?

SICK.

Mike Keefe, Cagle Cartoons