The Measles Outbreak

Resource Pack

2019

Overview

This resource pack was curated by the Global Health Education and Learning Incubator at Harvard University (GHELI) to support an upcoming Forum at Harvard T.H. Chan School of Public Health, "The Measles Outbreak: Why Vaccines Matter." The multidisciplinary materials are suitable for policy makers, educators, and students wanting to understand the current measles outbreak in the U.S. how it fits into broader narrative of the disease's global resurgence. In 2019, four European countries lost their measles elimination status—the United Kingdom, Greece, Czech Republic, and Albania. Many public health experts fear that the U.S. will also lose it elimination status, as measles cases reach record numbers in 2019. The resource pack shares national and global data and resources that contextualize current trends.

The Forum's event, "The Measles Outbreak: Why Vaccines Matter," is described as follow:

> *The U.S. officially eliminated measles nearly 20 years ago. Yet, this year, more than 1,100 cases have been reported, despite being preventable by vaccine. The CDC says the majority of cases are among those who were not vaccinated. This Forum looks at the drivers of the 2019 outbreaks and, more generally, the challenges of vaccine acceptance. Why do some parents delay or decline vaccinating their children? How might their concerns be addressed? What about exemptions? Why does the global picture matter? And what can be done once an outbreak begins? New polling data will frame this discussion, providing a uniquely current picture of vaccine acceptance in the U.S.*

The Forum at Harvard T.H. Chan School of Public Health is a live webcasting series that provides decision-makers with a global platform to discuss policy choices and scientific controversies across the world.

The Global Health Education and Learning Incubator at Harvard University supports interdisciplinary education about world health through the production, curation, and dissemination of educational public goods.

gheli@harvard.edu
617-495-8222

Selected Resources

*indicates resource listed in GHELI's online Repository

MEASLES WORLDWIDE

REPORTS, ARTICLES, & BRIEFS

*** Article. Progress Toward Regional Measles Elimination—Worldwide, 2000-2017**
Dabbagh A et al. Progress Toward Regional Measles Elimination—Worldwide, 2000-2017. Morbidity and Mortality Weekly Report. U.S. Centers for Disease Control and Prevention 2018; 67(47): 1323-1329. DOI: http://dx.doi.org/10.15585/mmwr.mm6747a6.

Brief. Ten Threats to Global Health in 2019
Ten Threats to Global Health in 2019. World Health Organization 2019. https://www.who.int/emergencies/ten-threats-to-global-health-in-2019.

Report. 2018 Assessment Report of the Global Vaccine Action Plan
2018 Assessment Report of the Global Vaccine Action Plan. World Health Organization 2018. https://apps.who.int/iris/handle/10665/276967.

*** Article. Measles and Rubella Elimination: Learning from Polio Eradication and Moving Forward With a Diagonal Approach**
Goodson JL et al. Measles and Rubella Elimination: Learning from Polio Eradication and Moving Forward With a Diagonal Approach. Expert Review of Vaccines 2017; 16(12): 1203-1216. http://www.tandfonline.com/doi/abs/10.1080/14760584.2017.1393337?journalCode=ierv20.

Article. . Long-Term Measles-Induced Immunomodulation Increases Overall Childhood Infectious Disease Mortality
Mina MJ et al. Long-Term Measles-Induced Immunomodulation Increases Overall Childhood Infectious Disease Mortality. Science 2015; 348 (6235): 694-699. DOI: http://dx.doi.org/10.1126/science.aaa3662.

DATA PORTALS, PUBLICATIONS, AND INTERACTIVES

Data Portal. Monthly Measles and Rubella Surveillance Data
Monthly Measles and Rubella Surveillance Data. World Health Organization 2019. https://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/active/measles_monthlydata/en.

ORGANIZATIONS, FACT SHEETS, AND COUNTRY PROFILES

*** Organization. Measles and Rubella Initiative**
Measles and Rubella Initiative. American Red Cross. https://measlesrubellainitiative.org.

*** Country Profiles. Immunization Country Profiles**
Immunization Country Profiles. United Nations Children's Fund 2017. United Nations Children's Fund and World Health Organization 2019. https://data.unicef.org/resources/immunization-country-profiles.

Fact Sheet. Measles
Measles. World Health Organization 2019. https://www.who.int/en/news-room/fact-sheets/detail/measles.

Country Profiles. National Immunization Coverage Scorecards Estimates for 2017
National Immunization Coverage Scorecards Estimates for 2017. World Health Organization 2018. https://apps.who.int/iris/handle/10665/276969.

gheli@harvard.edu
617-495-8222

MEASLES IN THE U.S.

REPORTS AND ARTICLES

Article. Mandatory Measles Vaccination in New York City — Reflections on a Bold Experiment
Cantor J. Mandatory Measles Vaccination in New York City — Reflections on a Bold Experiment. The New England Journal of Medicine 2019; 381: 101-103. DOI: http://dx.doi.org/10.1056/NEJMp1905941.

Article. Trends and Characteristics of Proposed and Enacted State Legislation on Childhood Vaccination Exemption, 2011–2017
Goldstein ND et al. Trends and Characteristics of Proposed and Enacted State Legislation on Childhood Vaccination Exemption, 2011–2017. American Journal of Public Health 2019; 109(10): 102-107.
DOI: https://doi.org/10.2105/AJPH.2018.304765.

Article. Increase in Measles Cases—United States, January 1-April 26, 2019
Patel M et al. Increase in Measles Cases—United States, January 1-April 26, 2019. Morbidity and Mortality Weekly Report. U.S. Centers for Disease Control and Prevention 2019; 68(17): 402-404. DOI: https://doi.org/10.1111/ajt.15477.

Article. Associations of Statewide Legislative and Administrative Interventions With Vaccination Status Among Kindergartners in California
Pingali SC et al. Associations of Statewide Legislative and Administrative Interventions With Vaccination Status Among Kindergartners in California. JAMA 2019; 322(1): 49-56. DOI: http://doi.org/10.1001/jama.2019.7924.

Article. The True Cost of Measles Outbreaks During the Postelimination Era
Sundaram ME et al. The True Cost of Measles Outbreaks During the Postelimination Era. JAMA 2019; 321(12): 1155-1156.
DOI: http://dx.doi.org/10.1001/jama.2019.1506.

Article. The State of the Antivaccine Movement in the United States: A Focused Examination of Nonmedical Exemptions in States and Counties
Olive JK et al. The State of the Antivaccine Movement in the United States: A Focused Examination of Nonmedical Exemptions in States and Counties. PLOS Medicine 2018; 15(6): e1002578.
DOI: https://doi.org/10.1371/journal.pmed.1002578.

Article. Exploring the Impact of the U.S. Measles Outbreak on Parental Awareness of and Support for Vaccination
Cacciatore MA et al. Exploring the Impact of the U.S. Measles Outbreak on Parental Awareness of and Support for Vaccination. Health Affairs 2016; 35(2) 334-340. DOI: https://doi.org/10.1377/hlthaff.2015.1093.

DATA PORTALS, PUBLICATIONS, AND VISUALIZATIONS

Data Portals. U.S. Measles Cases and Outbreaks
U.S. Measles Cases and Outbreaks. Centers for Disease Control and Prevention 2019.
https://www.cdc.gov/measles/cases-outbreaks.html.

Data Visualizations. A Record Number of Measles Cases Is Hitting the U.S. This Year. Who Is Being Affected?
Keating D et al. A Record Number of Measles Cases Is Hitting the U.S. This Year. Who Is Being Affected? The Washington Post 2019; May 31. https://www.washingtonpost.com/graphics/2019/health/measles-who-is-being-affected.

Data Tables. Nationally Notifiable Infectious Diseases and Conditions, United States: Weekly Tables
Nationally Notifiable Infectious Diseases and Conditions, United States: Weekly Tables. Centers for Disease Control and Prevention. https://wonder.cdc.gov/nndss/nndss_weekly_tables_menu.asp.

Data Publication. Vast Majority of Americans Say Benefits of Childhood Vaccines Outweigh Risks
Vast Majority of Americans Say Benefits of Childhood Vaccines Outweigh Risks. Pew Research Center 2017.
https://www.pewresearch.org/science/2017/02/02/vast-majority-of-americans-say-benefits-of-childhood-vaccines-outweigh-risks.

gheli@harvard.edu
617-495-8222

NEWS AND MULTIMEDIA

News. Lives at Risk From Surge in Measles Across Europe, Experts Warn
Davis N. Lives at Risk From Surge in Measles Across Europe, Experts Warn. The Guardian 2019; Aug 29. https://www.theguardian.com/society/2019/aug/29/lives-at-risk-from-surge-in-measles-across-europe-experts-warn.

News. 8 Things Everybody Should Know About Measles
Belluz J. 8 Things Everybody Should Know About Measles. Vox 2019; Apr 29. https://www.vox.com/2019/1/29/18201982/measles-outbreak-virus-vaccine-symptoms.

News Portal. Measles Outbreak
Measles Outbreak. The New York Times 2019. https://www.nytimes.com/news-event/measles-outbreak.

News. The US Eliminated Measles in 2000
Cohen E. The US Eliminated Measles in 2000. The Current Outbreak Could Change That. CNN 2019; Sept 3. https://www.cnn.com/2019/08/28/health/us-measles-elimination-status-in-jeopardy/index.html.

Video. Why Measles is Back in the U.S
Why Measles is Back in the U.S. Vox 2019; Apr 18. https://youtu.be/Z2swde6Z97w.

TEACHING MATERIAL

Timeline. How Bad is the Measles Comeback? Here's 70 Years of Data
Akpan N, Dennis, V. How Bad is the Measles Comeback? Here's 70 Years of Data. PBS NewsHour 2019; Jun 18. https://www.pbs.org/newshour/science/how-bad-is-the-measles-comeback-heres-70-years-of-data.

*** Teaching Case. Eliminating Measles in Southern Africa**
Levine R. Eliminating Measles in Southern Africa. Center for Global Development 2007. http://www.cgdev.org/page/case-17-eliminating-measles-southern-africa.

*** Teaching Case. The Measles Initiative**
Dhillon R, Rhatigan J. The Measles Initiative. Harvard Medical School, Brigham and Women's Hospital 2011. http://www.globalhealthdelivery.org/case-collection/case-studies/global/measles-initiative.

*** Online Learning. The Measles Outbreak: Why Vaccines Matter**
The Measles Outbreak: Why Vaccines Matter. The Forum. Harvard T.H. Chan School of Public Health 2019; Sep 12. https://theforum.sph.harvard.edu/events/the-measles-outbreak.

gheli@harvard.edu
617-495-8222

Annotated Bibliography

MEASLES WORLDWIDE

REPORTS, ARTICLES, & BRIEFS

Progress Toward Regional Measles Elimination—Worldwide, 2000-2017
Article. Dabbagh A et al. Progress Toward Regional Measles Elimination—Worldwide, 2000-2017. Morbidity and Mortality Weekly Report. U.S. Centers for Disease Control and Prevention 2018; 67(47): 1323-1329.
DOI: http://dx.doi.org/10.15585/mmwr.mm6747a6.
GHELI repository link: https://repository.gheli.harvard.edu/repository/11920
This article by the U.S. Centers for Disease Control and Prevention (CDC) examines global progress towards reducing child mortality by increasing measles vaccination coverage. It provides an update to a previous report by describing the developments in immunization activities, disease incidence, disease and mortality estimates, and regional verifications of measles elimination from 2000 to 2017. In 2010, the World Health Assembly created three aims for addressing measles: increased coverage of the first dose of vaccine, reduced annual incidence, and reduced global measles mortality. Countries in all six World Health Organization regions intend to eliminate measles by 2020. This report uses evidence from 2015 milestones to suggest that improved implementation strategies are needed to reach these goals in a timely manner.

Ten Threats to Global Health in 2019
Brief. Ten Threats to Global Health in 2019. World Health Organization 2019. https://www.who.int/emergencies/ten-threats-to-global-health-in-2019.
This brief from the World Health Organization (WHO) summarizes the top ten threats to global health in 2019. Among the threats identified is vaccine hesitancy—"the reluctance or refusal to vaccinate despite the availability of vaccines." The brief notes that this reluctance threatens global progress made it addressing preventable diseases. Vaccines currently prevent 2-3 million deaths a year. In particular, the WHO points to measles as one example of a disease experiencing global resurgence.

2018 Assessment Report of the Global Vaccine Action Plan
Report. 2018 Assessment Report of the Global Vaccine Action Plan. World Health Organization 2018.
https://apps.who.int/iris/handle/10665/276967.
GHELI repository link: https://repository.gheli.harvard.edu/repository/13046
This report from the World Health Organization (WHO) assesses progress on the Global Vaccine Action Plan (GVAP), the ambitious global goal to reach 90% vaccine coverage by 2020. Though 2017 marked the highest number of children immunized, 2018 underscores how quickly global progress can unravel. The assessment points to increasing measles and diphtheria outbreaks, as well as ongoing circulation of vaccine-derived poliovirus, and emphasizes that elimination targets for measles, rubella, and maternal and neonatal tetanus are unlikely to be met by the end of the decade. Complex global changes within and across borders—such as urbanization, migration, population growth, conflict, and natural disasters—will remain roadblocks to national immunization progress in years to come. The report indicates that integration of immunization efforts, particularly through universal health coverage, can amplify the impact of the Sustainable Development Goals, protect global health security, and combat antimicrobial resistance.

Measles and Rubella Elimination: Learning from Polio Eradication and Moving Forward With a Diagonal Approach
Article. Goodson JL et al. Measles and Rubella Elimination: Learning from Polio Eradication and Moving Forward With a Diagonal Approach. Expert Review of Vaccines 2017; 16(12): 1203-1216.
http://www.tandfonline.com/doi/abs/10.1080/14760584.2017.1393337?journalCode=ierv20.
GHELI repository link: http://repository.gheli.harvard.edu/repository/11918
This article from *Expert Review of Vaccines* explores how polio eradication strategies can be translated to measles and rubella elimination. Since the Global Polio Eradication Initiative (GPEI) was implemented in 2012, the number of polio cases globally has significantly decreased, with eradication on the horizon. The article suggests that lessons learned

from GPEI's efforts could be applied to measles and rubella global vaccination and equity. A diagonal approach is suggested, where measles transmission data can be used to explore other vaccine-preventable diseases and achieve reductions in child mortality. Not Open Access

Long-Term Measles-Induced Immunomodulation Increases Overall Childhood Infectious Disease Mortality
Article. Mina MJ et al. Long-Term Measles-Induced Immunomodulation Increases Overall Childhood Infectious Disease Mortality. Science 2015; 348 (6235): 694-699. DOI: http://dx.doi.org/10.1126/science.aaa3662.
This article published in *Science* examines the multiple benefits of measles vaccination, analyzing data since mass vaccination began in high-income countries when measles was common. Measles, if not prevented or left untreated, can disable immune memory for 2 to 3 years. Studying pre- and post-vaccine eras, the authors find that vaccination not only protects children from measles, but also prevents other infections from taking advantage of measles-induced immune damage.

DATA PORTALS, PUBLICATIONS, AND INTERACTIVES

WHO: Monthly Measles and Rubella Surveillance Data
Data Portal. Monthly Measles and Rubella Surveillance Data. World Health Organization 2019. https://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/active/measles_monthlydata/en.
This data portal from the World Health Organization (WHO) shares global measles and rubella data on a monthly basis. The monthly updates present case distribution and incidence rates by WHO region and are intended to assist with early detection of outbreaks.

ORGANIZATIONS, FACT SHEETS, AND COUNTRY PROFILES

Measles and Rubella Initiative
Organization. Measles and Rubella Initiative. American Red Cross. https://measlesrubellainitiative.org.
GHELI repository link: http://repository.gheli.harvard.edu/repository/11919
As a part of the Global Vaccine Action Plan, the Measles and Rubella Initiative (M&RI) is an organization that is working to eliminate measles and rubella in at least five of the six regions identified by the World Health Organization (WHO) by 2020. M&RI supports countries' efforts to expand vaccination coverage for measles, rubella, and other diseases, investigate and respond to outbreaks, strengthen immunization delivery, and more. The organization provides a wide range of resources surrounding measles and rubella progress, including multimedia materials, an interactive map, publications, and reports and tools. The Measles & Rubella Initiative (M&RI) is a joint effort by the American Red Cross, the United Nations Foundation, the U.S. Centers for Disease Control and Prevention, UNICEF, and the World Health Organization.

Immunization Country Profiles
Country Profiles. Immunization Country Profiles. United Nations Children's Fund 2017. United Nations Children's Fund and World Health Organization 2019. https://data.unicef.org/resources/immunization-country-profiles.
GHELI repository link: http://repository.gheli.harvard.edu/repository/12159
These country profiles from the United Nations Children's Fund (UNICEF) and the World Health Organization (WHO) outline the state of immunization coverage for polio, hepatitis, measles, and several other infectious diseases. Each report contains detailed historical and current data on the vaccination programs for these diseases based on joint estimates by UNICEF and the World Health Organization in partnership with country-level government partners.

Measles
Fact Sheet. Measles. World Health Organization 2019. https://www.who.int/en/news-room/fact-sheets/detail/measles.
This fact sheet from the World Health Organization (WHO) summarizes key information about measles symptoms, transmission, global incidence, and vaccination rates. Measles is a highly contagious, but vaccine-preventable, viral disease. Global measles deaths have decreased 80 percent from 2000 to 2017.

National Immunization Coverage Scorecards Estimates for 2017
Country Profiles. National Immunization Coverage Scorecards Estimates for 2017. World Health Organization 2018. https://apps.who.int/iris/handle/10665/276969.
These country profiles from the World Health Organization (WHO) provide a quick visual "snapshot" of country progress towards the 90% national coverage goal for vaccines in the national immunization program. Divided by WHO geographic region, the graphics share a visual representation of vaccination trends over time, making visible both the strengths and gaps across different vaccines.

MEASLES IN THE U.S.

REPORTS AND ARTICLES

Mandatory Measles Vaccination in New York City — Reflections on a Bold Experiment
Article. Cantor J. Mandatory Measles Vaccination in New York City — Reflections on a Bold Experiment. The New England Journal of Medicine 2019; 381: 101-103. DOI: http://dx.doi.org/10.1056/NEJMp1905941.
GHELI repository link: https://repository.gheli.harvard.edu/repository/13047
This article in the *New England Journal of Medicine* reflects on mandatory measles vaccination in New York City, which was put into place after ensuing outbreaks in 2019. A $1,000 fine was the consequence for nonvaccination, and reactions were mixed from a rights-perspective. The piece outlines the differences between "mandatory vaccination" and "forcible vaccination" and their relationship to constitutional law. The author proposes alternatives for shifting norms around vaccination, such as eliminating nonmedical exemptions, that may feel less "heavy-handed" to citizens.

Trends and Characteristics of Proposed and Enacted State Legislation on Childhood Vaccination Exemption, 2011–2017
Article. Goldstein ND et al. Trends and Characteristics of Proposed and Enacted State Legislation on Childhood Vaccination Exemption, 2011–2017. American Journal of Public Health 2019; 109(10): 102-107.
DOI: https://doi.org/10.2105/AJPH.2018.304765.
GHELI repository link: https://repository.gheli.harvard.edu/repository/13048
This article in the *American Journal of Public Health* examines the content of proposed bills in state legislatures from 2011 to 2017 that would affect immunization exemption laws. 92 bills expanded access to exemptions, while 83 bills limited the ability to exempt. Of the 13 bills actually signed into law, 12 limited the ability to exempt—a promising sign for public health. Proposed bills that were likely to increase access to exemptions usually came from Republican legislators and Northeastern and Southern states.

Increase in Measles Cases—United States, January 1-April 26, 2019

Article. Patel M et al. Increase in Measles Cases—United States, January 1-April 26, 2019. Morbidity and Mortality Weekly Report. U.S. Centers for Disease Control and Prevention 2019; 68(17): 402-404.
DOI: https://doi.org/10.1111/ajt.15477.
This article in *Morbidity and Mortality Weekly Report* summarizes the increase in U.S. measles cases in the first four months of 2019. As of April 26, 2019, 704 cases had been reported—the largest number of cases reported in the U.S. in a single year since 1994, and since measles was declared eliminated in 2000. Of the total 704 cases, 94 percent were related to outbreaks.

Associations of Statewide Legislative and Administrative Interventions With Vaccination Status Among Kindergartners in California
Article. Pingali SC et al. Associations of Statewide Legislative and Administrative Interventions With Vaccination Status Among Kindergartners in California. JAMA 2019; 322(1): 49-56. DOI: http://doi.org/10.1001/jama.2019.7924.
This article in *JAMA* examines vaccination status of kindergartners in California between 3 interventions (2 laws and 1 educational campaign) to increase vaccination uptake in the state. The laws tightened and later eliminated person belief exemptions for vaccines, while the campaign provided educational materials to school staff. The rate of kindergartners *without* up-to-date vaccination was halved between 2013 to 2017.

gheli@harvard.edu
617-495-8222

The True Cost of Measles Outbreaks During the Postelimination Era
Article. Sundaram ME et al. The True Cost of Measles Outbreaks During the Postelimination Era. JAMA 2019; 321(12): 1155-1156. DOI: http://dx.doi.org/10.1001/jama.2019.1506.
GHELI repository link: https://repository.gheli.harvard.edu/repository/13049
This article in *JAMA* outline the costs of measles outbreaks in the U.S. beyond simple case counts, analyzing long-term immune issues from infection, monetary effects of outbreak response, and strain on health care infrastructure. The authors share that measles infection—which suppresses immune response for 2 to 3 years after infection—can make individual susceptible other infections in the future. From a financial perspective, measles response is costly, and can be high as $142,000 for a single case based on the size of the outbreak, number quarantined, and amount of postexposure prophylaxis used. And finally, measles outbreaks, which are preventable, divert critical human resources from other regular health systems programs and functions.

The State of the Antivaccine Movement in the United States: A Focused Examination of Nonmedical Exemptions in States and Counties
Article. Olive JK et al. The State of the Antivaccine Movement in the United States: A Focused Examination of Nonmedical Exemptions in States and Counties. PLOS Medicine 2018; 15(6): e1002578.
DOI: https://doi.org/10.1371/journal.pmed.1002578.
This article in *PLOS Medicine* studies the social movement of vaccine opposition in the U.S., where the number of "philosophical-belief" nonmedical vaccine exemptions have risen since 2009 in the 18 states permitting this policy. Several metropolitan areas in the U.S. are developing very high numbers of such exemptions. The authors found that states with higher nonmedical vaccine exemption rates do have lower measles, mumps, and rubella (MMR) vaccine coverage of kindergartners in the state. In contrast, state closures of nonmedical exemptions have increased MMR coverage.

Exploring the Impact of the U.S. Measles Outbreak on Parental Awareness of and Support for Vaccination
Article. Cacciatore MA et al. Exploring the Impact of the U.S. Measles Outbreak on Parental Awareness of and Support for Vaccination. Health Affairs 2016; 35(2) 334-340. DOI: https://doi.org/10.1377/hlthaff.2015.1093.
This article in *Health Affairs* explores parental awareness and support of vaccinations before and after the 2014-15 U.S. measles outbreak. The study found that although many parents were familiar with the outbreak, some were not—and this familiarity shaped their support and concerns about requiring childhood vaccination. *This article is open access.*

DATA PORTALS, PUBLICATIONS, AND INTERACTIVES

CDC: U.S. Measles Cases and Outbreaks
Data Portal. U.S. Measles Cases and Outbreaks. Centers for Disease Control and Prevention 2019.
https://www.cdc.gov/measles/cases-outbreaks.html.
GHELI repository link: https://repository.gheli.harvard.edu/repository/13044
This data portal from the Centers for Disease Control and Prevention provides the latest data on the number of confirmed measles cases in the United States. The number of cases is updated on a weekly basis by the organization. As of August 29th, 2019, there have been 1,234 confirmed measles cases in 31 states since January 1st. According to the portal, more than 75% of these confirmed cases are linked to the outbreak in New York, where there are a number of people who are not immunized against the illness. The portal also provides data on measles cases in past years, as well as information on the illness itself.

A Record Number of Measles Cases Is Hitting the U.S. This Year. Who Is Being Affected?
Data Visualizations. Keating D et al. A Record Number of Measles Cases Is Hitting the U.S. This Year. Who Is Being Affected? The Washington Post 2019; May 31. https://www.washingtonpost.com/graphics/2019/health/measles-who-is-being-affected.
These data visualizations from *The Washington Post* provides numerous data visualizations depicting the ongoing 2019measles outbreak in the United States. The first of the graphic models is a map of the U.S. showing counties that have been impacted by the outbreak, as well as the prevalence of cases in that area. Also provided is a breakdown of the 2019 cases by age and vaccination status. The issue of vaccination is heavily intertwined with the measles outbreak,

as 503 people who have contracted cases as of May 3rd are not immunized against the illness. The visualizations also depict which states in the U.S allow parents to avoid vaccinating their children for philosophical or religious reasons. There are currently 17 states in which parents can choose not to immunize based on personal objections.

Nationally Notifiable Infectious Diseases and Conditions, United States: Weekly Tables
Data Tables. Nationally Notifiable Infectious Diseases and Conditions, United States: Weekly Tables. Centers for Disease Control and Prevention. https://wonder.cdc.gov/nndss/nndss_weekly_tables_menu.asp.
These data tables from the Centers for Disease Control and Prevention present weekly data on all nationally notifiable diseases and conditions in the U.S., including measles. The measles tables disaggregates case data by indigenous and imported cases, U.S. region, and state.

Vast Majority of Americans Say Benefits of Childhood Vaccines Outweigh Risks
Data Publication. Vast Majority of Americans Say Benefits of Childhood Vaccines Outweigh Risks. Pew Research Center 2017. https://www.pewresearch.org/science/2017/02/02/vast-majority-of-americans-say-benefits-of-childhood-vaccines-outweigh-risks.
GHELI repository link: https://repository.gheli.harvard.edu/repository/13050
This data publication from the Pew Research Center shares findings from a U.S. survey exploring views on "vaccine hesitancy." The survey shows that an overwhelming majority of Americans (82%) support requiring all schoolchildren to be vaccinated for measles, mumps, and rubella (MMR)—and that the benefits outweigh any potential risks. Specific populations like parents of children under 4, adults under age 30, and people with low knowledge about science see higher risk from the MMR vaccine.

NEWS AND MULTIMEDIA

Lives at Risk From Surge in Measles Across Europe, Experts Warn
News. Davis N. Lives at Risk From Surge in Measles Across Europe, Experts Warn. The Guardian 2019; Aug 29. https://www.theguardian.com/society/2019/aug/29/lives-at-risk-from-surge-in-measles-across-europe-experts-warn.
This news article from *The Guardian* describes the dramatic surge in measles in Europe during the first half of 2019—a surge that has already exceeded the number of cases from all last year. The U.K., Albania, Czech Republic, and Greece have had their measles elimination status removed. Many connect the inadequate vaccination rates—which endanger herd immunity—to persistent anti-vaxxer sentiments.

8 Things Everybody Should Know About Measles
News. Belluz J. 8 Things Everybody Should Know About Measles. Vox 2019; Apr 29. https://www.vox.com/2019/1/29/18201982/measles-outbreak-virus-vaccine-symptoms.
This article in *Vox* describes the global rise in measles outbreaks, presenting information about the U.S. context, symptoms, vaccine safety, speed of transmission, and vaccine refusal. This resource is a great "primer" for anyone

NYT News Portal: Measles Outbreak
News Portal. Measles Outbreak. The New York Times 2019. https://www.nytimes.com/news-event/measles-outbreak.
This news portal from *The New York Times* curates the newspaper's measles outbreak and vaccination coverage in one location.

The US Eliminated Measles in 2000. The Current Outbreak Could Change That
News. Cohen E. The US Eliminated Measles in 2000. The Current Outbreak Could Change That. CNN 2019; Sept 3. https://www.cnn.com/2019/08/28/health/us-measles-elimination-status-in-jeopardy/index.html.
This article from CNN discusses how the current 2019 measles outbreak in the U.S. threatens the country's elimination status. The World Health Organization (WHO) previously declared that the U.S. had eliminated measles in 2000. WHO removes a country's elimination status when the disease has been spring continuously for one year. The article discusses how Facebook and Twitter are at the center of growing anti-vaccination sentiment in the U.S., while conflict were at the root for other countries in the Americas that have recently lost elimination status.

gheli@harvard.edu
617-495-8222

Why Measles is Back in the U.S.
Video. Why Measles is Back in the U.S. Vox 2019; Apr 18. https://youtu.be/Z2swde6Z97w.
This short video from *Vox* summarizes the main reasons why measles has made a resurgence in the U.S. Almost all U.S. states allow parents to opt out of vaccines, and persistent anti-vaccination misinformation has led to a decrease in children immunized. This drop-in vaccination has compromised herd immunity, which makes small communities particularly vulnerable to new outbreaks. The video describes the different policy environments across the U.S. that have potentially enabled new measles cases, and proposed legislation to tackle the issue.

TEACHING MATERIAL

How Bad is the Measles Comeback? Here's 70 Years of Data
Timeline. Akpan N, Dennis, V. How Bad is the Measles Comeback? Here's 70 Years of Data. PBS NewsHour 2019; Jun 18. https://www.pbs.org/newshour/science/how-bad-is-the-measles-comeback-heres-70-years-of-data.
GHELI repository link: https://repository.gheli.harvard.edu/repository/13045
This timeline from PBS NewsHour presents key moments and outbreaks in U.S. measles history since 1492—a response to the current resurgence in the vaccine-preventable disease. In the first few months of 2019, the epidemic has already surpassed a 25-year record. The timeline specifically highlights how a policy switch in 1989—giving two people two doses of the vaccine—helped eliminate the disease in the U.S. by 2000.

Millions Saved: Eliminating Measles in Southern Africa
Teaching Case. Levine R. Eliminating Measles in Southern Africa. Center for Global Development 2007. http://www.cgdev.org/page/case-17-eliminating-measles-southern-africa.
GHELI repository link: http://repository.gheli.harvard.edu/repository/10844
This case describes the successful cross-country measles vaccination program throughout seven African countries. Four years after the campaign had begun, there were only 117 cases reported instead of 60,000 that had been reported in 1996 and death by measles for children had nearly been eliminated in the region. This is Case 17 in the Center for Global Development's online case series, "Millions Saved."

The Measles Initiative
Teaching Case. Dhillon R, Rhatigan J. The Measles Initiative. Harvard Medical School, Brigham and Women's Hospital 2011. http://www.globalhealthdelivery.org/case-collection/case-studies/global/measles-initiative.
GHELI repository link: http://repository.gheli.harvard.edu/repository/10729
This case examines the Measles Initiative (MI), a consortium of organizations expanding delivery of measles vaccines. After providing background information on the biology of the measles virus and the epidemiology of measles, it recounts the formation of the MI, its partnership structure, its goals, its program design, international nature, and its financing. The case focuses on how multilateral global health initiatives coordinated with national governments to improve health care delivery. By 2009, the MI had made significant gains in reducing measles mortality, but was facing decreased funding and was questioning its strategy going forward. The objectives of the case study are to help students understand how multi-lateral, international disease-control initiatives are designed, coordinated, and financed, and to examine how these initiatives interact with national health systems to achieve their objectives.

The Measles Outbreak: Why Vaccines Matter
Online Learning. The Measles Outbreak: Why Vaccines Matter. The Forum. Harvard T.H. Chan School of Public Health 2019; Sep 12. https://theforum.sph.harvard.edu/events/the-measles-outbreak.
GHELI repository link: https://repository.gheli.harvard.edu/repository/13051
This webcast seminar from The Forum at the T.H. Chan School of Public Health explored the drivers of the 2019 measles outbreaks and the challenges of vaccine acceptance. This Forum examined why parents delay or decline vaccinating their children and how to potentially address their concerns—as well how the U.S. outbreaks fit into the global picture. This Forum was presented jointly with PRI's The World and WGBH.

Also see:

- Resource Pack: The Measles Outbreak, Global Health Education and Learning Incubator at Harvard University

The Forum at Harvard T.H. Chan School of Public Health is a live webcasting series that provides decision-makers with a global platform to discuss policy choices and scientific controversies across the world. Through collaboration with major media outlets, The Forum facilitates discussion with expert panelists, and aims to bridge the gap between science and policy decision-making for the pressing health issues that affect populations worldwide.

gheli@harvard.edu
617-495-8222