U.S. Immunization Program
Successful Reduction in Racial and Ethnic Disparities in Vaccination Coverage Among Young Children

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Director, Immunization Services Division
National Center for Immunization and Respiratory Diseases, CDC
Historical Background
Measles

- **Pre-vaccine era: Each year**
  - 3–4 million estimated and ~530,000 reported cases
  - 48,000 hospitalizations
  - 450–500 deaths

- **First measles vaccine licensed in 1963**
  - By 1968, measles incidence decreased >95% compared to pre-vaccine levels
  - Between 1981 and 1986, reported cases ranged from ~1,500 to 6,000 annually
Historical Background

- From 1989 to 1991
  - 55,000 cases, 11,000 hospitalizations and 123 deaths
- Focus: Urban areas with low vaccination coverage
  - Largest outbreaks in Chicago, Los Angeles, Houston, Dallas, Milwaukee, New York
- Among children 16–59 months old who developed measles, only 15% had ever received MCV
- Higher risk among American Indian, Black, and Hispanic children

MCV, Measles containing vaccine
MMWR 1992;40(2):36–9
What Went Wrong?

- **Root causes**
  - Low vaccination coverage
  - Missed opportunities for immunization
  - Gaps in access to care

- **Epidemic identified significant weaknesses within the national immunization infrastructure**

- **1991: NVAC released a report with 13 key recommendations for improving immunization with focus on**
  - Availability
  - Management
  - Measurement

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MCV, measles containing vaccine
NVAC, National Vaccine Advisory Committee
Public Policy and Public Health Response

- **Childhood Immunization Initiative**
  - Led to current national immunization program (1993)

- **Vaccines for Children (VFC) program (1994)**
  - Section 1928 of the Social Security Act (42 U.S.C. 1396s)
  - Purchase vaccines for eligible children
  - National Immunization Survey (NIS) for vaccination coverage measurement (implemented 1994)
  - Development of Immunization Information Systems
  - Systematic quality improvement methods for immunization through assessment, feedback, incentives, and exchange

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U.S.C., United States Code
Improving Availability of Vaccines
The Vaccines for Children (VFC) Program

- Provides federally purchased vaccines recommended by ACIP at no cost
- Eligible children
  - 18 years or younger and at least 1 of the following
    - Medicaid eligible
    - Uninsured
    - Underinsured (if vaccinated at an Federally qualified health center or rural health clinic)
    - Of American Indian/Alaska Native descent
- In 2011, 54.3% of children 19–35 months of age were eligible for VFC vaccine

MMWR 2012;61(35):689–96
Improving Measurement
The National Immunization Survey (NIS)

- **Annual survey implemented in 1994**
  - National- and state- level estimates available

- **Random digit dial telephone survey**
  - National sample of parents of children 19–35 months old
  - Since 2011, uses dual-frame sample including cellphone and landline numbers
  - Provider records checked to verify immunizations received

- **Analyses limited to children with provider- reported immunization histories**

- **Can evaluate disparities in immunization coverage**
  - Example: MMR, Poliovirus, and DTaP

MMR, Measles, mumps, rubella vaccine
DTaP, Diphtheria and tetanus toxoids and acellular pertussis vaccine

- Increased from 88% to 92% for Hispanic children
- Increased from 87% to 91% for Black children
- Remained at or above 91% for White children

MMR, Measles, mumps, and rubella vaccine

Difference between White and Hispanic children

Average annual decrease = -0.26%
95% CI: [-0.38%, -0.14%]

Difference between White and Black children

Average annual decrease = -0.23%
95% CI: [-0.36%, -0.10%]

Unpublished CDC data
MMR, Measles, mumps, and rubella vaccine
Measles Cases, United States, 1962–2011

http://www.cdc.gov/vaccines/pubs/pinkbook/meas.html
https://cdc.confex.com/cdc/nic2012/webprogram/Session12996.html
VFC, Vaccines for Children

From 2007–2011, no significant coverage differences among these 3 groups.

Increased from 87% to 93% for Hispanic children
Increased from 84% to 93% for Black children
Increased from 89% to 93% for White children

Increased from 75% to 84% for Hispanic children
Increased from 74% to 81% for Black children
Increased from 80% to 85% for White children

DTaP coverage from 1995 to 2011

Survey year


NIS, National Immunization Survey; http://www.cdc.gov/nchs/nis.htm
Summary

- Since 1995, vaccination coverage has increased for MMR, polio, and DTaP
  - Disparities in coverage between White and Hispanic children have been eliminated
  - Disparities between White and Black children remain for DTaP vaccine
- Policy and program activities have helped achieve and maintain high vaccination coverage
  - Need to monitor impact of health care reform
  - Continue to monitor disparities to avoid “immunity gaps” in the face of potential disease importation
Societal Benefits of the U.S. National Immunization Program

- For 2009, the routine childhood immunization program for one birth cohort (4 million births)
  - Prevented ~20 million cases of vaccine-preventable diseases and 42,000 deaths
  - Saved ~$13.5 billion in direct costs and had total societal economic benefits of ~$68.8 billion
Progress Toward Eliminating Hepatitis A Disease in the United States

Trudy V. Murphy, MD
Team Lead, Vaccine Research and Policy
Division of Viral Hepatitis
National Center for HIV/AIDS, Viral Hepatitis, STD and TB Prevention, CDC
Acute Hepatitis A Virus Infection

- **Mild disease among children**
  - 70% children <6 years asymptomatic

- **Morbidity and mortality increase with age**
  - ≥70% adolescents and adults are symptomatic (including jaundice)
  - Illness lasts for up to 2 months
    - Average 27 (0–180) days of work lost
  - Case-fatality
    - 2.1% for persons ≥40 year old
    - Increased with chronic liver disease, immunosuppression

- **No specific treatment (supportive care)**

References:
- MMWR 1996;45(RR–15)
- WHO Weekly Epidemiological Record 2012;87:261–76
Acute Hepatitis A in Highly Endemic Areas

- **Characteristics**
  - Crowded living conditions
  - Limited access to clean water and sanitation

- **Epidemiology**
  - Approximately 90% of children are infected by age 10 years
  - Life-long Immunity
  - Acute hepatitis A disease is rare

Jacobsen, KH. Vaccine 2010;28:6653–7
MMWR 1996;45 (RR–15)
Acute Hepatitis A in Areas in Transition to Low Endemicity

- **Epidemiology**
  - Fewer infections among children; facilitate transmission
  - More infections among adolescents and adults (≥70% cases)
  - Greater morbidity and mortality
  - Community-wide outbreaks and cyclic increases in disease

- **Disparities by geographic area and race/ethnicity**

- **Hepatitis A epidemiology in the United States during the 20th century**

Jacobsen, KH. Vaccine 2010;28:6653–7
Murphy, TV. Hepatitis A. In Vaccines, 6th edition. Plotkin SA, Orenstein WA, Offit PA editors, 2013
Pre-Vaccine Rates of Reported Acute Hepatitis A, United States, 1966–1994

- **1966–1993**
  - Cyclic increases
  - Annually: ≥22,000 cases

- **1994**
  - 26,796 cases reported

- **Across all years**
  - ~1 in 10 cases reported

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CDC National Morbidity Reporting System and National Notifiable Diseases Surveillance System (NNDSS)
MMWR 2009;58 (SS–3); Viral Hepatitis Surveillance, United States, 2010 at
Rates of Reported Hepatitis A Cases by County, United States, 1987–1997

*Cases/100,000 population  National average rate ~10/100,000

NNDSS, National Notifiable Diseases Surveillance System
MMWR 1999;48 (RR–12)
## Rates of Reported Acute Hepatitis A by Race/Ethnicity, United States, 1994

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Rate/100,000 Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian/Alaska Native</td>
<td>104.5</td>
</tr>
<tr>
<td>Hispanic</td>
<td>21.2</td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td>6.4</td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td>5.5</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>4.3</td>
</tr>
<tr>
<td><strong>National average</strong></td>
<td><strong>10.3</strong></td>
</tr>
</tbody>
</table>
Hepatitis A Vaccines in 1995 and 1996 Efficacy of 2–Dose Schedules

<table>
<thead>
<tr>
<th>Vaccine*</th>
<th>Site and Age Group</th>
<th>Number in Trial</th>
<th>Vaccine Efficacy (95 %CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAQTA®, MSD</td>
<td>New York 2–16 years</td>
<td>1,037</td>
<td>100% (85–100%)§</td>
</tr>
<tr>
<td>HAVRIX®, SKB</td>
<td>Thailand 1–16 years</td>
<td>38,157</td>
<td>94% (74–98%)</td>
</tr>
</tbody>
</table>

*Pediatric formulation
§Determined 6–18 months after dose 1

MSD, Merck, Sharpe, and Dohme
SKB, SmithKline Beecham

- Targeted vaccination, 1996–1999
  - 1996
    - Children at age 2 years in communities with high rates of disease
    - Children through teen years in outbreaks
  - 1999
    - Recommended in 11 states with rates 2x the national average
    - Considered in 6 states with rates above the national average

MMWR 1996:45 (RR-15)
MMWR 1999:48 (RR-12)
MMWR 2006:55 (RR-7)
Universal childhood vaccination, 2006

- Recommended for use in all states at age 12 months
- Continue vaccination programs for ages 2–18 years
- Consider catch-up vaccination in outbreaks and areas with increasing disease rates
Hepatitis A Vaccine Coverage by Area of Targeted Vaccination

2007 NIS, ≥1 dose
Ages 24–35 months

2009 NIS, ≥2 doses
Ages 13–17 years

2011 NIS, ≥2 doses
Ages 19–35 months

MMWR 2009;58:689–94
Dorell, CG. Pediatrics 2012;129:213–21
MMWR 2012; 61(35):689
Rates of Reported Acute Hepatitis A Cases

1987–1997

2007

*Per 100,000 population

Rate*
- 0–4
- 5–9
- 10–19
- ≥20

NNDSS, National Notifiable Diseases Surveillance System
Rates of Reported Hepatitis A Cases by Race/Ethnicity, United States, 1990–2010

Decline in rates: 1994–2010

- American Indian/Alaska Native: >99%
- Hispanic: 97%
- Black, non-Hispanic: 95%
- White, non-Hispanic: 95%
- Asian/Pacific Islander: 77%
Rates of Reported Acute Hepatitis A Cases United States, 1966–2010

1994 (pre-vaccine) to 2010: 95% decrease in rate

Vaccination recommended 1996: rate 11.7 (31,032 cases)

2010: rate 0.5 (1,670 cases)

NNDSS, National Notifiable Diseases Surveillance System
Armstrong, GL. Pediatrics 2007;119:e22–9
A source for hepatitis A was identified in a minority of 1,670 cases reported in 2010

- Risk information available for 1,031 (62%) cases; risk identified in only 25%
- International travel
  - 14.1% of cases with travel information
  - Preventable through pre-travel vaccination
- Contaminated food/water
  - 10.4% of cases linked to outbreaks
  - Substantial public health response (e.g. vaccination) required for post-exposure management of exposed persons

NNDSS, National Notifiable Diseases Surveillance, 2010
Van Effelterre, T. Human Vaccines Immunotherapeutics 2012;8:1–10
Nelson, N. Unpublished data, 2013
Other Challenges and Opportunities

- Document continuing vaccine-induced protection
  - Expected for ≥25 years after 2-dose vaccination

- Prevalence of hepatitis A protection
  - National Health and Nutrition Examination Survey (NHANES)
    - Antibody to hepatitis A virus (anti-HAV)
    - Representative sample of non-institutionalized, U.S. residents ages 6 to ≥60 years

*P ≤0.005

NHANES, National Health and Nutrition Examination Survey
Summary

- **Accomplishment: Progress toward eliminating hepatitis A disease since 1994**
  - 95% decrease in rates of reported cases
  - Near elimination of disparities by geography and race/ethnicity

- **Challenges and Opportunities: Maintain barrier to transmission and ensure protection for future generations**
  - Increase hepatitis A vaccination among children and other groups at risk, e.g. international travelers
  - Consider accelerating vaccine protection for adolescents
  - Monitor for persistence of vaccine-induced protection
Use of Vaccines to Reduce Health Disparities Among American Indian and Alaska Native Children

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Director, Arctic Investigations Program
Division of Preparedness and Emerging Infections
National Center for Emerging and Zoonotic Infectious Disease, CDC
Anchorage, Alaska
The American Indian/Alaska Native (AI/AN) Population

- **Descendants of indigenous peoples of North America**
  - 5.2 million people; 1.7% of the U.S. population

- **566 federally-recognized tribes**
  - Tribes range in size from 200 to 332,000 persons
  - 35 states have at least one tribe

- **Health care**
  - Indian Health Service (IHS), DHHS
    - Federal, Tribal, and urban facilities
    - 2 million persons (38%) served by IHS
    - Health care and preventive services offered with no charge to patients
  - Other health insurance (Medicare, Medicaid, private carrier)

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2010 U.S. Census
DHHS, U.S. Department of Health and Human Services
IHS, Indian Health Service
Diverse People, Cultures, Languages, and Lifestyles

Photos courtesy of the Indian Health Service/U.S. Department of Health and Human Services and the Alaska Native Tribal Health Consortium
Infectious Disease Disparities among AI/AN

- **History of disparities**
  - 1950: Proportion of all deaths due to infections in Alaska
    - White Alaskans 3%
    - Alaska Natives 47%
  - Influenza pandemic 2009
    - 4-fold increased mortality for AI/AN compared to non-AI/AN
  - Vaccine-preventable childhood diseases
    - Viral infections: 1960’s: Measles, mumps; 1970’s: Hepatitis A, hepatitis B
    - Bacterial respiratory infections: *H. influenzae, S. pneumoniae*

- **Environmental and household factors**
  - Crowding, poverty, environmental smoke exposure, lack of running water

AI/AN, American Indian, Alaska Native
MMWR 2009;58(48):1341–4
Hepatitis B

- Double-stranded DNA virus
- Passed from person to person
  - Mother-to-baby
  - Child-to-child
  - Sexual contact, contaminated blood or needles
- Acute hepatitis
  - Jaundice, fatigue, nausea
- Chronic infection
  - Risk is highest with infections occurring in infancy and childhood
  - Complications: Cirrhosis, liver failure, hepatocellular cancer
- Vaccine introduced in 1982
  - 3-dose series
Hepatitis B among Alaska Native (AN) Persons

- **Southwest Alaska, 1970s**
  - Hyperendemic levels of chronic infection: 6.4%

- **Hepatitis B Vaccine Demonstration Project, 1981**
  - Effectiveness
  - Duration of protection

- **Statewide screening of AN persons, 1984–87**
  - 3% with chronic infection

- **AN hospitals were the first to**
  - Test pregnant women for hepatitis B: 1980
  - Offer immune globulin to newborns of infected moms: 1980
  - Begin universal newborn immunization: 1984

AN, Alaska Native

Hepatitis B Immunization Coverage and Impact in Alaska

- **National Immunization Survey, 1996**
  - Hepatitis B vaccination in children, 19–35 months old
    - AN: 94% with ≥3 doses
    - Overall U.S. population: 82% with ≥3 doses
  - AN uptake remains high in subsequent surveys

- **Acute symptomatic hepatitis B infection in AN children**
  - 19 cases per 100,000 in 1981
  - 0 cases since 1992

- **Hepatocellular cancer in AN children**
  - 17 cases from 1969 to 1998
  - 0 cases since 1999

AN, Alaska Native

Hepatocellular Cancer in Alaska Native Children <20 Years Old, 1969–2008

Mount McKinley, Alaska
Haemophilus influenzae

- **Gram-negative bacteria**
- **Clinical illnesses**
  - Meningitis, bacteremia, septic arthritis, pneumonia
  - Pre-vaccine era: 1 in 200 children contracted invasive infection
- **Polysaccharide capsule with 6 serotypes (a–f)**
- **Vaccines for *H. influenzae* type b (Hib)**
  - Protein-polysaccharide conjugate, 1991
    - Primary series in first year of life
    - Booster in 12–15 month-old children
  - Currently, 2 conjugate vaccines available in the United States
    - Efficacy >90%
    - Differ in timing to protection (after 1 dose versus after ≥2 doses)
Hib Disease in AI/AN Children

- **Infant Hib rates were among highest in the world**
  - Up to 700/100,000/ year before conjugate vaccine
    - Up 10 times higher than other U.S. infants
  - Leading cause of bacterial meningitis

- **Laboratory-based surveillance established in the 1980s**
  - Alaska, Navajo, White Mountain Apache

- **Earlier age of illness onset for invasive infections**
  - Median age for meningitis infections
    - AN 8 months; non-AN 11.5 months
  - Proportion of infections in infants <6 month old
    - AN 23%; other U.S. 12%

- **PRP-OMP vaccine is preferred for AI/AN children**
  - Provides protective antibodies after 1 dose
  - Addresses the earlier age of onset

**PRP-OMP**, Polyribosylribotol phosphate-outer membrane protein
Ward, JI et al. JID 1986; 153(1):17–26
Murphy, TV et al. JID 1992;165(Suppl1):s7–10
Invasive Hib Disease, Children Aged <5 Years Alaska, 1980–2012

PRP-OMP vaccine introduced
Change in vaccine
Return to PRP-OMP vaccine

Singleton, R et al. Pediatrics 2006;118;e421-e429; doi: 10.1542/peds.2006-0287
Unpublished CDC data
PRP-OMP, Polyribosylribotol phosphate-outer membrane protein
Incidence of Hib Disease in Navajo, Apache, Alaska Native, and U.S. Children <5 Years Old

Vaccination Programs for AI/AN Children

- Available at no cost through VFC program
- IHS and Tribal Immunization Programs
  - Population-based approach
    - EHR for vaccine tracking and forecasting within facilities
    - Frequent administration of vaccine outside of health clinics
      - Public health nurses, community-health aides, pharmacists
      - Makes vaccine available to rural and remote populations
- State Immunization Information Systems (IIS)
  - Track immunizations from multiple providers
  - 14 of 35 states with tribal health system have data exchange
    - 10 of 14 States with two-way data exchange can both provide and retrieve data

AI/AN, American Indian, Alaska Native
VFC, Vaccines for Children
IHS, Indian Health Service
EHR, Electronic health records
Immunization Coverage among AI/AN Children

- National Immunization Survey (NIS), 2006–2010
  - Childhood immunizations, ages 19–35 months
  - Similar uptake to U.S. White children for overall series
  - 2 regions had higher uptake among AI/AN for overall series
    - Alaska
    - Southwest: Arizona, New Mexico, Colorado, Utah, Nevada

AI/AN, American Indian, Alaska Native
Groom, AV et al. Pediatrics 2012;130:e1592–9
Elements of Success

- Childhood vaccines have reduced or eliminated health disparities among AI/AN children
  - Universal access to vaccines
  - Population-based delivery and tracking systems
  - Epidemiologic support for
    - Disease surveillance
    - Program evaluation
    - Outbreak investigation
  - Policies that address the unique challenges in this population
    - HBV: Early use of maternal screening and infant immunization
    - Hib: Preferred vaccine for high risk AI/AN children
Remaining Challenges for AI/AN Immunization Programs

- **Regional differences in vaccine uptake**
  - Improved local data are needed for program planning and action

- **Better data connections**
  - State immunization information systems and tribal providers
    - Need to increase number of two-way data exchanges

- **Persistence of childhood vaccine-preventable disparities**
  - Pneumococcal infections and pertussis

- **Adult vaccine-preventable disease disparities**
  - Pneumococcal infections, influenza
  - Can child immunization success be extended to adult AI/AN populations?
Immunization as a Path to Equity

Alan R. Hinman, MD, MPH
Director for Programs
Center for Vaccine Equity
The Task Force for Global Health
Outline

- Immunization’s role in reducing childhood infectious disease disparities in the United States
- Remaining major challenges: Global health disparities and how they are being addressed
What is Responsible for the Reduction in Disparities in Immunization and VPD among Children in the United States?

- School immunization requirements
- Vaccines for Children program
School Immunization Requirements

- In 1977, HEW Secretary J. Califano wrote to the governors of all states, urging enactment and enforcement of laws requiring immunization as a condition of school entry.
- By 1981, all states had requirements.
- Since 1981, >90% of children entering school have proof of immunization.

HEW, Health, Education, and Welfare (predecessor to Department of Health and Human Services)
South Carolina State Vehicle Bumper Sticker, 1980s

it's the law
No Shots - No School
### Measles Vaccine Coverage in 1–4 Year Olds in 1977 and 19–35 Months Old Children in 1996 and 2011

<table>
<thead>
<tr>
<th></th>
<th>1977 (USIS) %</th>
<th>1996 (NIS) %</th>
<th>2011 (NIS) %</th>
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<tbody>
<tr>
<td>Total</td>
<td>63.1</td>
<td>91</td>
<td>91.6</td>
</tr>
<tr>
<td>White</td>
<td>65.5</td>
<td>91</td>
<td>91.6</td>
</tr>
<tr>
<td>Other</td>
<td>52.0</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Black</td>
<td>NA</td>
<td>89</td>
<td>90.8</td>
</tr>
<tr>
<td>Hispanic</td>
<td>NA</td>
<td>88</td>
<td>92.4</td>
</tr>
</tbody>
</table>
Measles and Rubella Elimination in the United States

- Measles elimination documented and verified in 2000
- Rubella and congenital rubella syndrome elimination documented and verified in 2004
- With no disease, there are no disparities
Immunization Disparities Globally

- **Major disparities exist among and within countries**
  - Differences in vaccines used
  - Differences in coverage levels
WHO Estimated Global Measles Mortality

- **1980**
  - 2,500,000 deaths from measles more than 15 years after the measles vaccine had been introduced

- **2000**
  - 548,000 deaths; nearly 80% reduction

- **2011**
  - 158,000 deaths; a further 70% reduction
Expanded Programme on Immunization (EPI)

- EPI established in 1974 by the WHO
- CDC assignee (R. Henderson) seconded to WHO as director
- Originally included vaccines were BCG, DTP, OPV, and measles
- Hepatitis B and Hib vaccines added in 1990s, but implementation was incomplete
Global Immunization 1980–2010
Global Coverage of DTP3 at 85% in 2010

DTP3, Third dose of diphtheria, tetanus, and pertussis vaccine
http://www.who.int/immunization_monitoring/data/SlidesGlobalImmunization.pdf
DTP3 Immunization Rates among Poorest and Richest Population Quintiles, Regional Averages

<table>
<thead>
<tr>
<th>Regions</th>
<th>Poorest Quintile</th>
<th>Richest Quintile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Saharan Africa</td>
<td>33.6</td>
<td>66.9</td>
</tr>
<tr>
<td>South Asia</td>
<td>29.8</td>
<td>64.4</td>
</tr>
<tr>
<td>Middle East, North Africa</td>
<td>53.2</td>
<td>53.2</td>
</tr>
<tr>
<td>South East Asia</td>
<td>48.3</td>
<td>72.9</td>
</tr>
<tr>
<td>Former Soviet Republics</td>
<td>39.6</td>
<td>76</td>
</tr>
<tr>
<td>Latin America, Caribbean</td>
<td>38.5</td>
<td>75.2</td>
</tr>
<tr>
<td>All Countries</td>
<td>38.5</td>
<td>66</td>
</tr>
</tbody>
</table>

Percent immunized
The GAVI Alliance Mission and Programs

- To save children’s lives and protect people’s health by increasing access to immunization in poor countries

- Program areas
  - New and underused vaccines
  - Immunization services
  - Injection safety
  - Health system strengthening
  - Civil society organizations
    - Includes non-governmental, faith-based, and professional organizations
Countries Eligible for GAVI Programme Support in 2013

56 Eligible Countries with Gross National Income per Capita <$1,550/year

http://www.gavialliance.org/
Cost to Vaccinate One Child with Vaccines Universally Recommended from Birth through 18 Years of Age 1990, 2000, and 2012

2012 represents minimum cost to vaccinate a child (birth through 18); exceptions are 1) no preservative influenza vaccine, which is included for children 6–47 months of age, and 2) HPV for males and females. Federal contract prices as of February 1, 1990, September 27, 2000, and April 24, 2012.
## Per Dose Price of Vaccines
### VFC and UNICEF/PAHO, 2010–2011

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>VFC ($)</th>
<th>UNICEF/PAHO ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTaP/DTP</td>
<td>13.25</td>
<td>0.16</td>
</tr>
<tr>
<td>Pentavalent*</td>
<td>34.25</td>
<td>2.70</td>
</tr>
<tr>
<td>IPV/OPV</td>
<td>11.48/NA</td>
<td>4.50/0.16</td>
</tr>
<tr>
<td>MMR</td>
<td>18.99</td>
<td>1.75</td>
</tr>
<tr>
<td>PCV13</td>
<td>97.21</td>
<td>3.50</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>59.76</td>
<td>3–5</td>
</tr>
<tr>
<td>Mening 4/A</td>
<td>82.12/NA</td>
<td>NA/0.40</td>
</tr>
</tbody>
</table>

*DTP/HepB/Hib

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**VFC**, Vaccines for Children  
**PAHO**, Pan-American Health Organization  
**NA**, Not available
<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Number of doses x per-dose price</th>
<th>Per-series cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCG</td>
<td>1 x $0.06</td>
<td>$0.06</td>
</tr>
<tr>
<td>Pentavalent*</td>
<td>3 x $2.70</td>
<td>$8.10</td>
</tr>
<tr>
<td>OPV</td>
<td>3 x $0.16</td>
<td>$0.48</td>
</tr>
<tr>
<td>Measles</td>
<td>1 x $0.21</td>
<td>$0.21</td>
</tr>
<tr>
<td>PCV13</td>
<td>3 x $3.50</td>
<td>$10.50</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>3 x $5.00</td>
<td>$15.00</td>
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<tr>
<td>Administration</td>
<td></td>
<td>~$15.00</td>
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<tr>
<td></td>
<td></td>
<td>~$50.00</td>
</tr>
</tbody>
</table>

*DTP/HepB/Hib

GAVI, Global Alliance for Vaccines and Immunisation
### Countries with Annual Health Expenditures per Capita of <25 in 2010

<table>
<thead>
<tr>
<th>Country</th>
<th>Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>$18.43</td>
</tr>
<tr>
<td>Burundi</td>
<td>$19.71</td>
</tr>
<tr>
<td>CAR</td>
<td>$19.34</td>
</tr>
<tr>
<td>DRC</td>
<td>$15.58</td>
</tr>
<tr>
<td>Eritrea</td>
<td>$10.12</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>$14.68</td>
</tr>
<tr>
<td>Guinea</td>
<td>$18.77</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>$18.36</td>
</tr>
<tr>
<td>Madagascar</td>
<td>$17.97</td>
</tr>
<tr>
<td>Malawi</td>
<td>$19.07</td>
</tr>
<tr>
<td>Mauritania</td>
<td>$21.92</td>
</tr>
<tr>
<td>Mozambique</td>
<td>$24.72</td>
</tr>
<tr>
<td>Myanmar</td>
<td>$12.47</td>
</tr>
<tr>
<td>Niger</td>
<td>$20.89</td>
</tr>
<tr>
<td>Pakistan</td>
<td>$22.50</td>
</tr>
</tbody>
</table>
Annual Cost to Immunize All Children in GAVI-eligible Countries

$50 \times 74 \text{ million births} = $3.7 \text{ billion}

2011 U.S. expenditures on pets >$50 \text{ billion}

Hinman, AR. Unpublished data
http://www.americanpetproducts.org
GAVI, Global Alliance for Vaccines and Immunisation, www.gavialliance.org
Hepatitis B Vaccine Introduction in High- and Low-income Countries

First introduction: 12-year delay

Introduction in 50% of countries: 6-year delay

Percentage of countries introducing HepB vaccine (%)

Year

Launch of GAVI

http://www.gavialliance.org/support/nvs/hepb/
Routine Use of Hepatitis B Vaccines

Percentage of countries (%)

High-income countries

Low-income countries


World Health Organization, vaccine introduction database
The Rising Price of Immunizing One Child

- **Baseline**
  - BCG
  - 3 OPV, 3 DTP
  - Measles
- **Cost added when WHO recommended and GAVI support more widely available**
- **Price increase of >2,700%**
- **Price will increase**
  - GAVI HPV Window, etc.

Source: "The Right Shot"

[Link](http://www.msfaccess.org/content/rightshot)
GAVI Alliance: Actual and Projected Disbursements ($Million)

- Business plan
- Other vaccines & investment cases (Original)
- Yellow fever – campaign & routine
- Pentavalent vaccine
- Pneumococcal vaccine – GAVI funded
- Cash based programmes
- Meningitis – campaign & routine
- HPV, JE, Measles – Rubella & Typhoid
- Rotavirus vaccine
- Pneumococcal vaccine – AMC funded

http://www.gavialliance.org
$M, U.S. dollars, in millions
Conclusions

- Disease is bad! Vaccines are good!
- Children have a right to immunization
- Immunization is not equitably available
- Social justice will only be achieved when ALL the children of the world are able to enjoy the right to immunization
Childhood Immunization as a Tool to Address Health Disparities