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

Accessibility version: https://youtu.be/0ip5imNzLY4

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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
1989–1991 U.S. Measles Epidemic

- **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
MMWR 1992;41(29):522–5

1989–1991 U.S. Measles Epidemic
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

MCV, measles containing vaccine
NVAC, National Vaccine Advisory Committee
http://archive.hhs.gov/nvpo/nvac/The%20Measles%20Epidemic%20-%20JAMA%20-%20091891.pdf
MMWR 1992;41(29):522–5

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

MMWR 1994;43(4):57–60; MMWR 1997;46(29):657–64
NIS, National Immunization Survey, http://www.cdc.gov/nchs/nis.htm
Woods DR, Mason DD. Public Health Rep 1992;107(3):25–6
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**

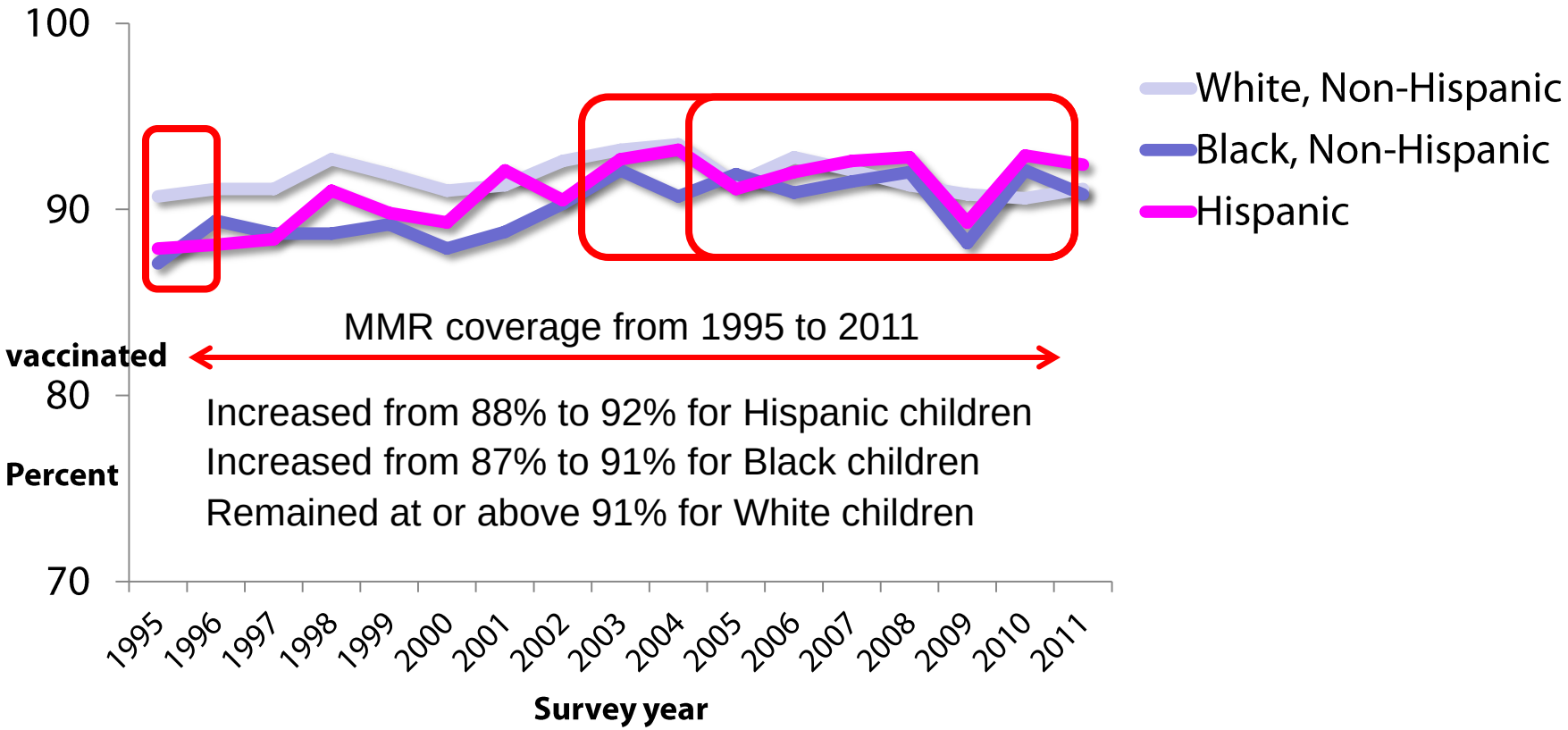
MMWR 2012;61(35):689–96
2010 VFC Program Management Survey available at: http://www2a.cdc.gov/nip/irar/grantee/vfcprovider10.asp
ACIP, Advisory Committee on Immunization Practices, http://www.cdc.gov/vaccines/acip/about.html

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

NIS, National Immunization Survey, http://www.cdc.gov/nchs/nis.htm
MMR, Measles, mumps, rubella vaccine
DTaP, Diphtheria and tetanus toxoids and acellular pertussis vaccine

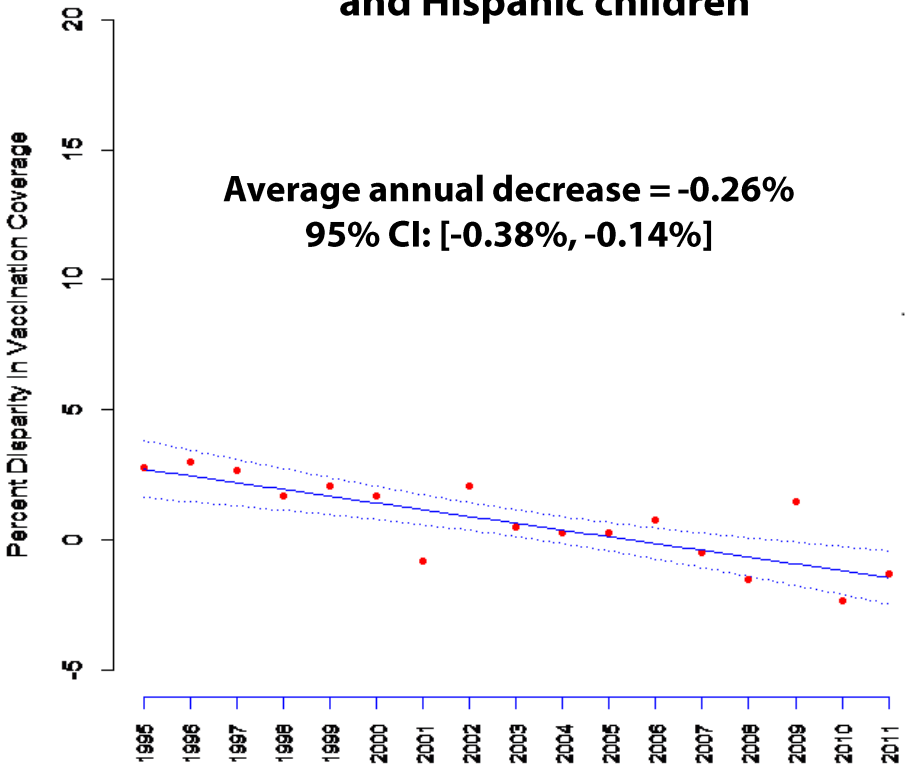
Estimated MMR (≥1 dose) Vaccination Coverage by Racial/Ethnic Category, 1995–2011 NIS Children 19–35 Months Old



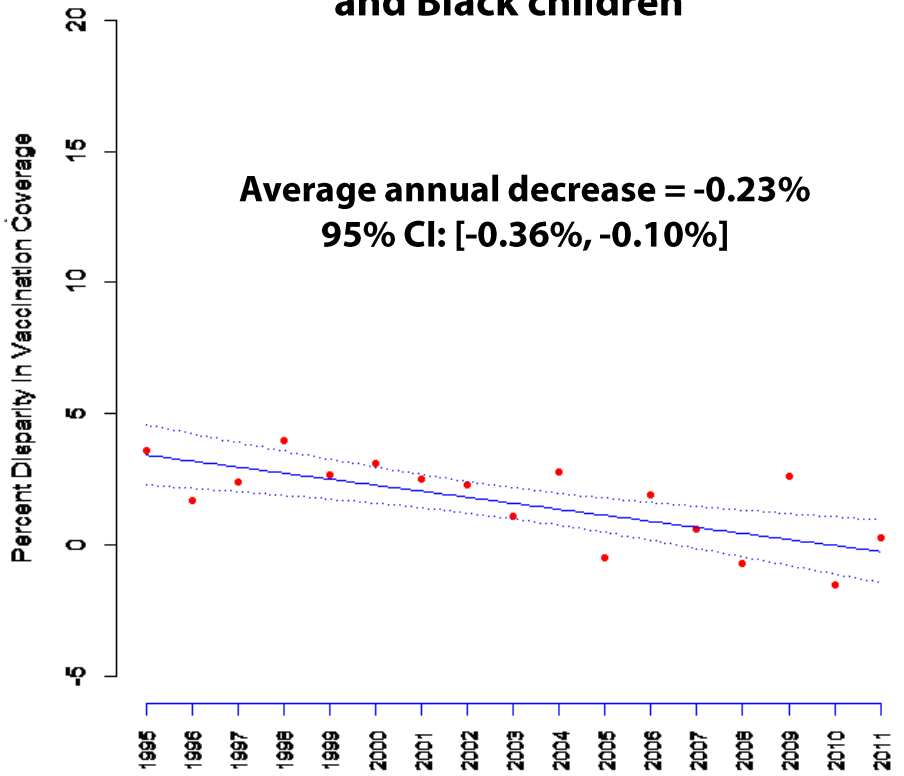
MMR, Measles, mumps, and rubella vaccine
NIS, National Immunization Survey, http://www.cdc.gov/nchs/nis.htm
1995-2011 NIS data available at: http://www.cdc.gov/vaccines/stats-surv/nis/default.htm#nis

Estimated Trend in MMR Vaccination Disparity Between Racial/Ethnic Groups, 1995–2011 NIS Children 19–35 Months Old

Difference between White and Hispanic children

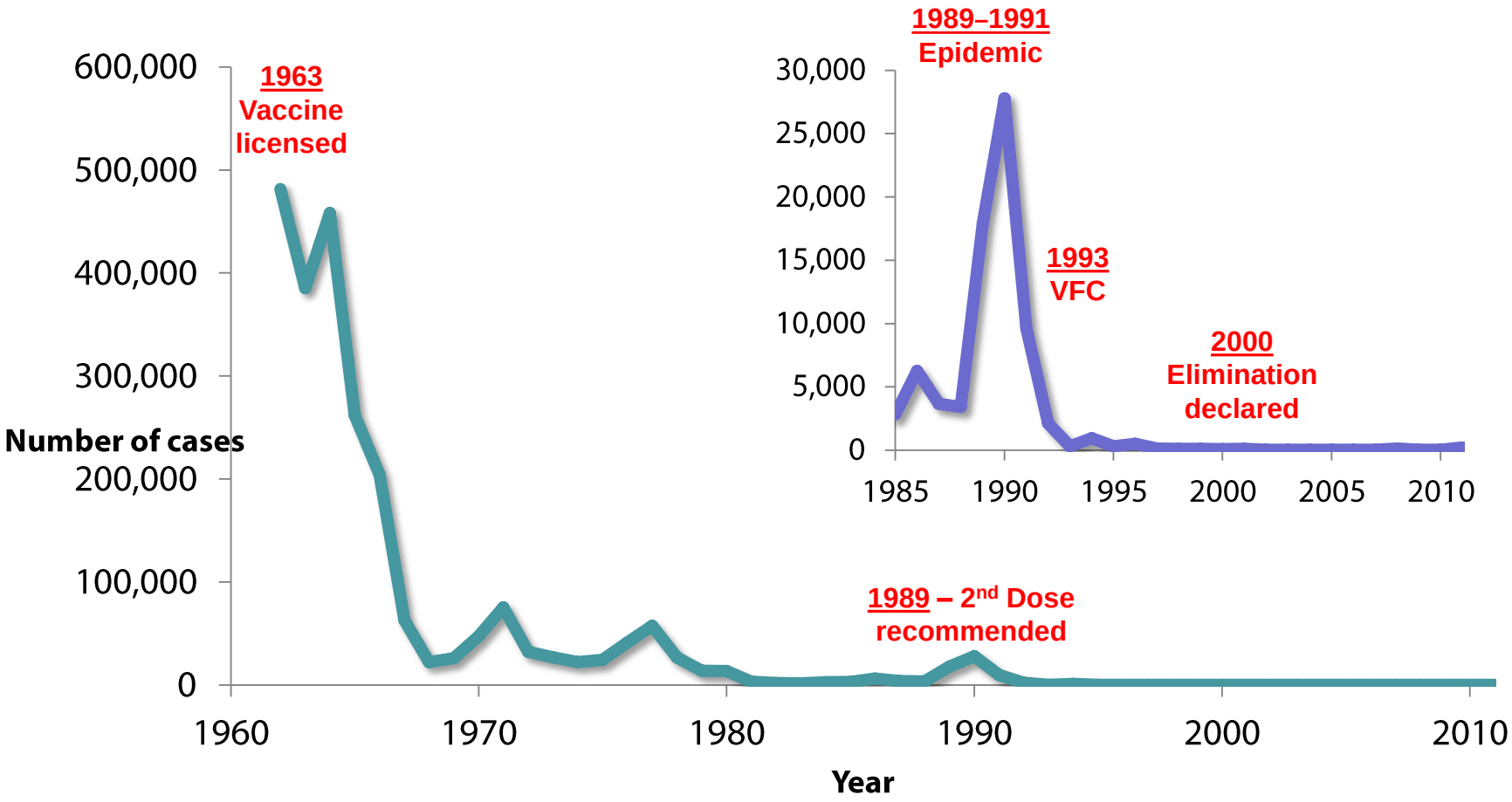


Difference between White and Black children



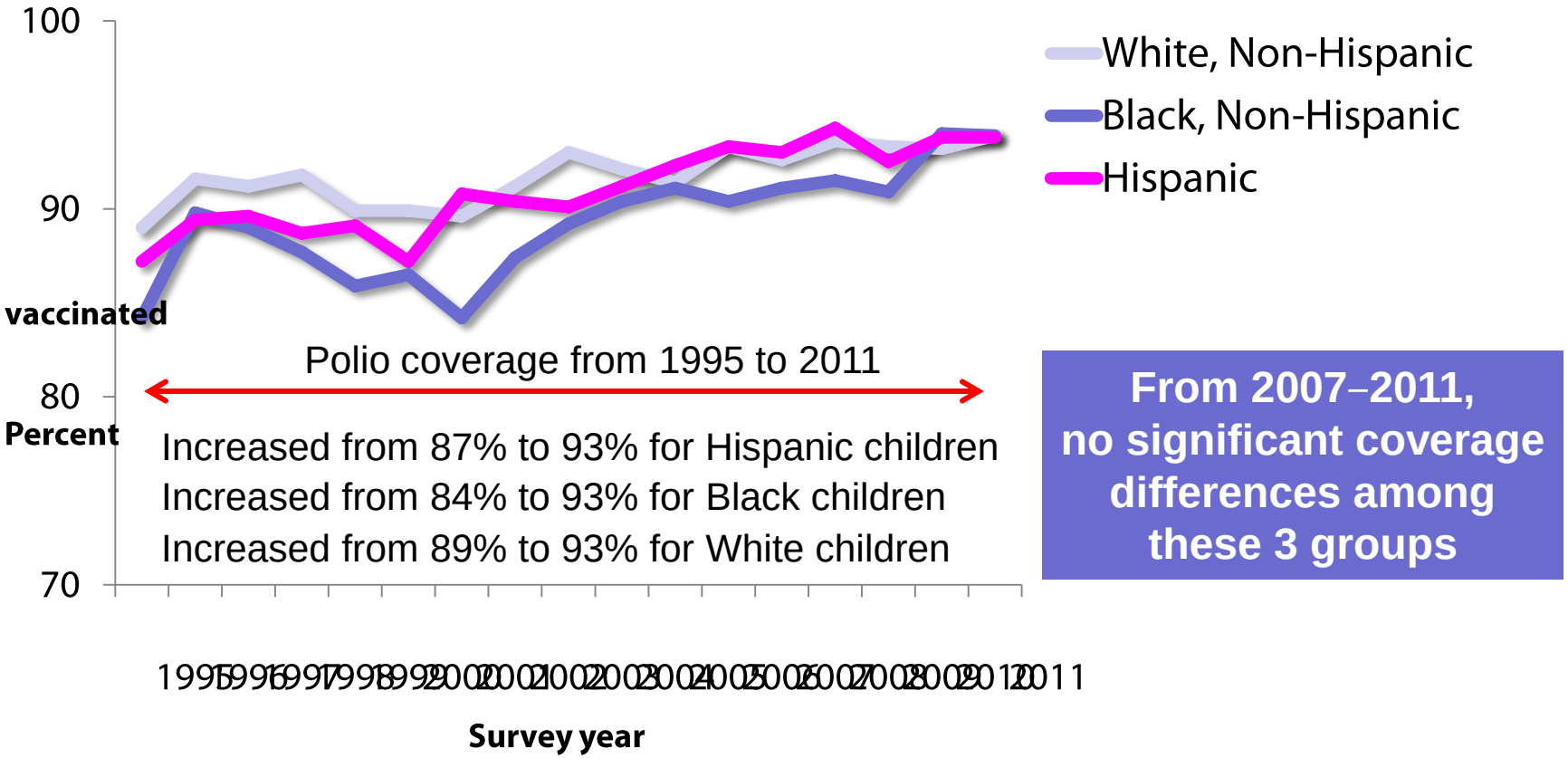
Unpublished CDC data
MMR, Measles, mumps, and rubella vaccine
NIS, National Immunization Survey, http://www.cdc.gov/nchs/nis.htm

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

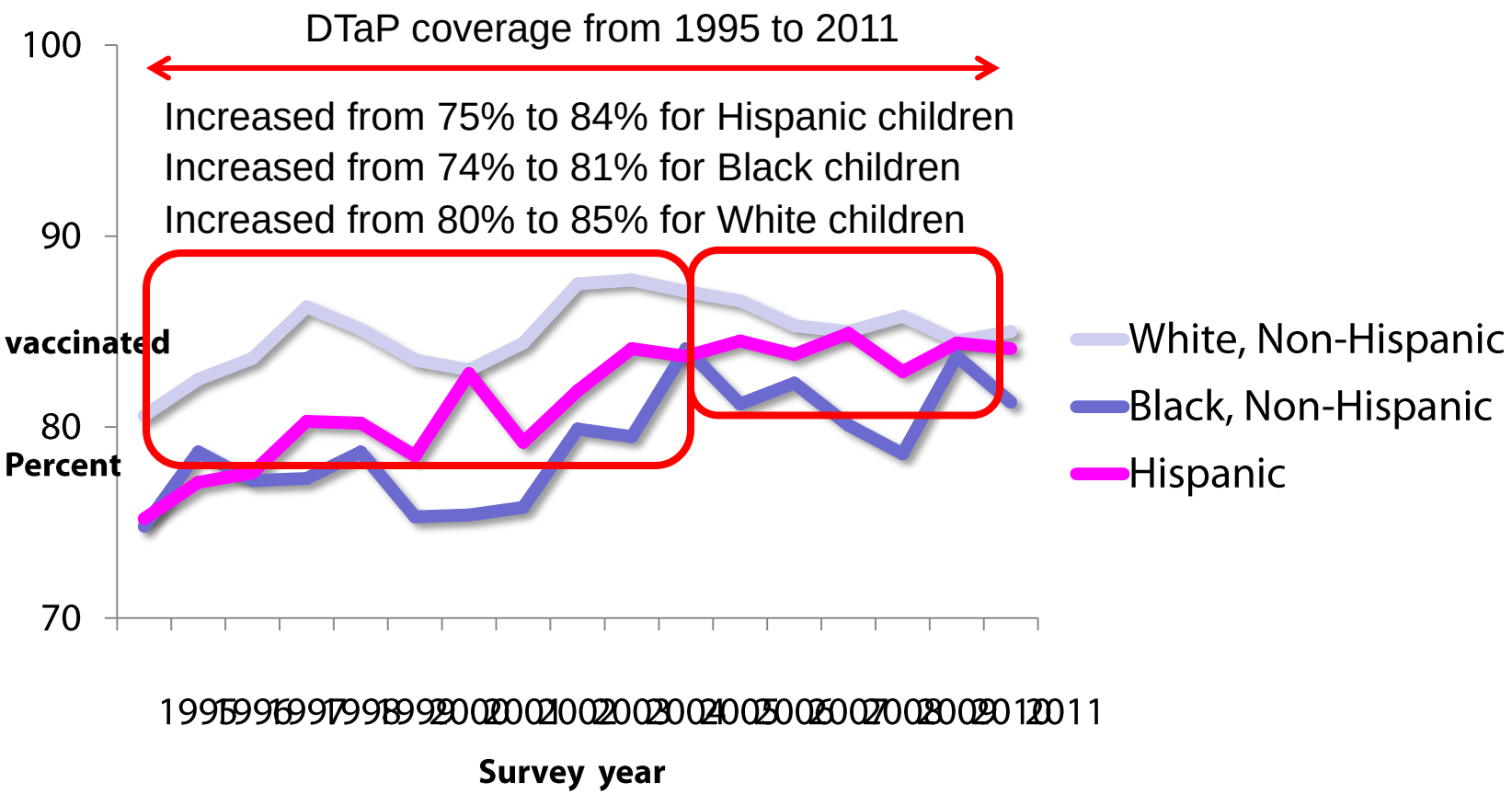
Estimated Polio (≥3 doses) Vaccination Coverage by Racial/Ethnic Category, 1995–2011 NIS Children 19–35 Months Old



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

NIS, National Immunization Survey, http://www.cdc.gov/nchs/nis.htm
1995–2011 NIS data available at: http://www.cdc.gov/vaccines/stats-surv/nis/default.htm#nis

Estimated DTaP (≥4 doses) Vaccination Coverage by Racial/Ethnic Category, 1995–2011 NIS Children Age 19–35 Months



NIS, National Immunization Survey, http://www.cdc.gov/nchs/nis.htm
1995–2011 NIS data available at: http://www.cdc.gov/vaccines/stats-surv/nis/default.htm#nis

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

MMR, Measles, mumps, and rubella vaccine
DTaP, Diptheria, tetanus, and pertussis vaccine

Societal Benefits of the U.S. National Immunization Program

- **Elimination of domestic transmission of polio (1994), measles (2000), and rubella (2004)**
- **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

Zhou F. Abstract presented at the 2012 Pediatric Academic Societies' meeting in Boston on Apr 29, 2012

Progress Toward Eliminating Hepatitis A Disease in the United States

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Division of Viral Hepatitis
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Centers for Disease Control and Prevention

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)**

Armstrong, GL. Pediatrics 2002;109:839–45
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)

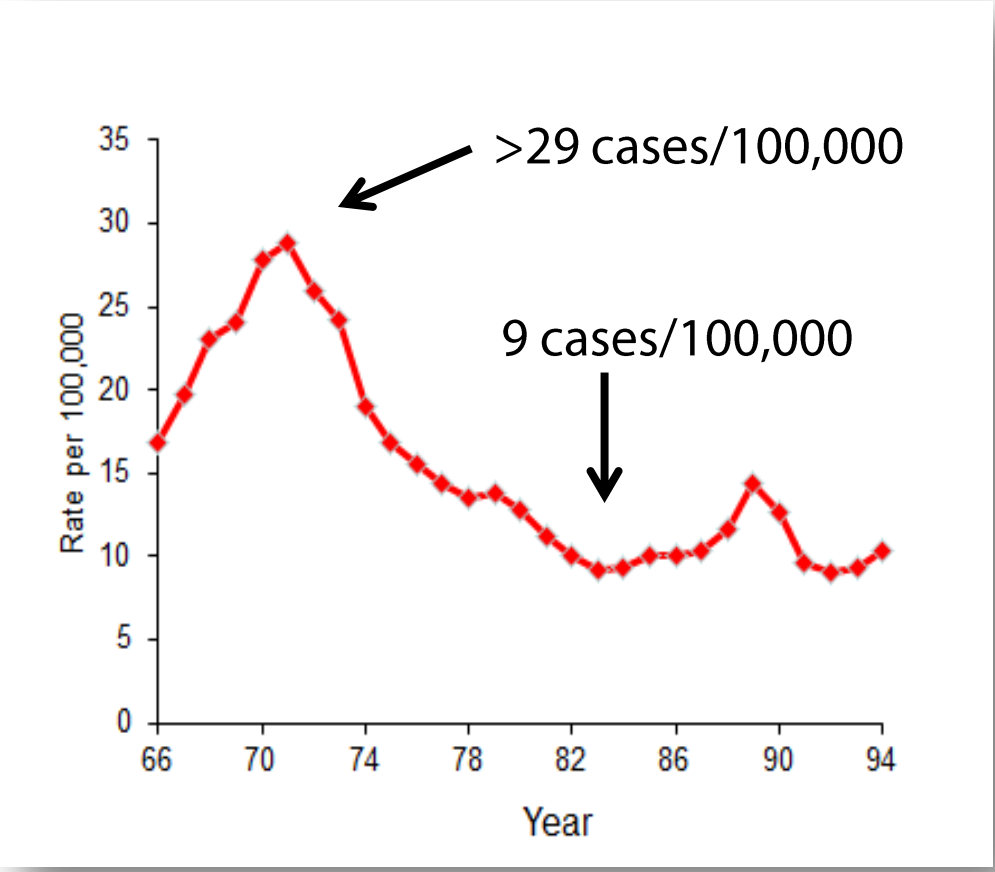
Acute Hepatitis A in Areas in Transition to Low Endemicity

- **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

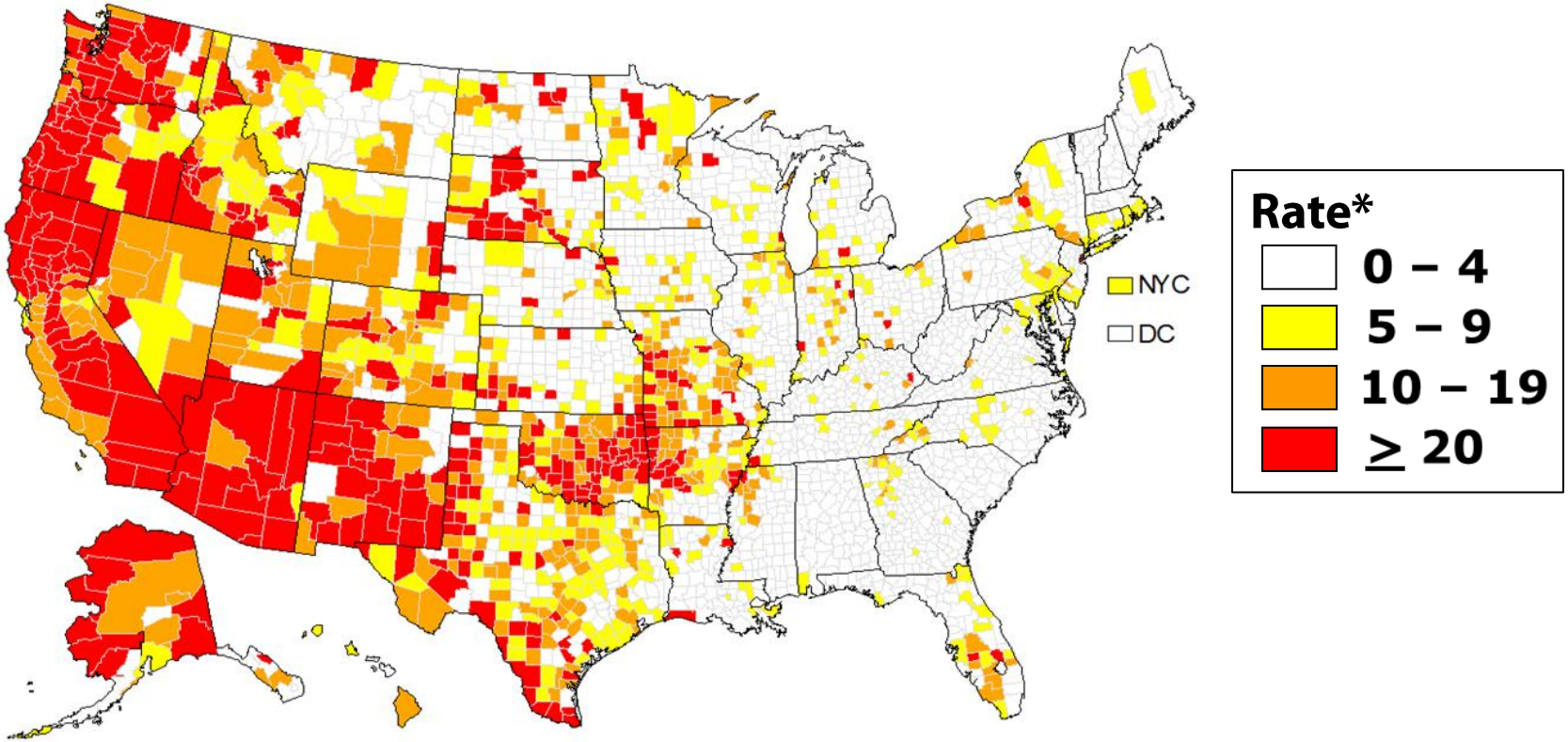
Pre-Vaccine Rates of Reported Acute Hepatitis A, United States, 1966–1994

- **1966–1993**
  - Cyclic increases
  - Annually: ≥22,000 cases
- **1994**
  - 26,796 cases reported
- **Across all years**
  - ~1 in 10 cases reported



CDC National Morbidity Reporting System and National Notifiable Diseases Surveillance System (NNDSS)
MMWR 2009;58 (SS–3); Viral Hepatitis Surveillance, United States, 2010 at
http://www.cdc.gov/hepatitis/Statistics/2010Surveillance/Commentary.htm

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

Race/Ethnicity	Rate/100,000 Population
American Indian/Alaska Native	104.5
Hispanic	21.2
Non-Hispanic White	6.4
Non-Hispanic Black	5.5
Asian/Pacific Islander	4.3
National average	**10.3**

MMWR 1996;45 (RR–15)

Hepatitis A Vaccines in 1995 and 1996 Efficacy of 2–Dose Schedules

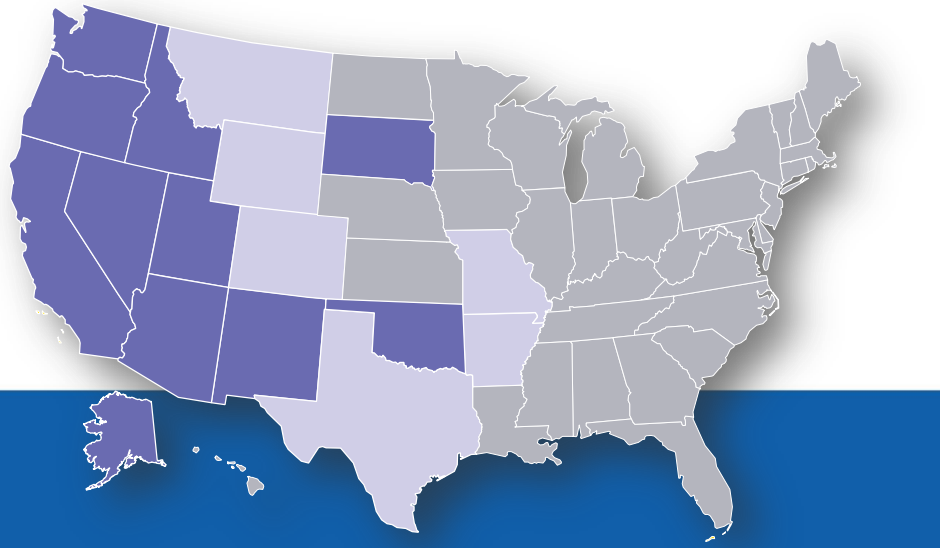
Vaccine*	Site and Age Group	Number in Trial	Vaccine Efficacy (95 %CI)
VAQTA®, MSD	New York 2–16 years	1,037	100% (85–100%)§
HAVRIX®, SKB	Thailand 1–16 years	38,157	94% (74–98%)

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

Werzberger, A et al. New Engl J Medicine. 1992;327:453–7
Innis BL, et al. JAMA 1994;271:1328–34
MSD, Merck, Sharpe, and Dohme
SKB, SmithKline Beecham

History of U.S. Hepatitis A Childhood Vaccine Recommendations, 1996–2006

- **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



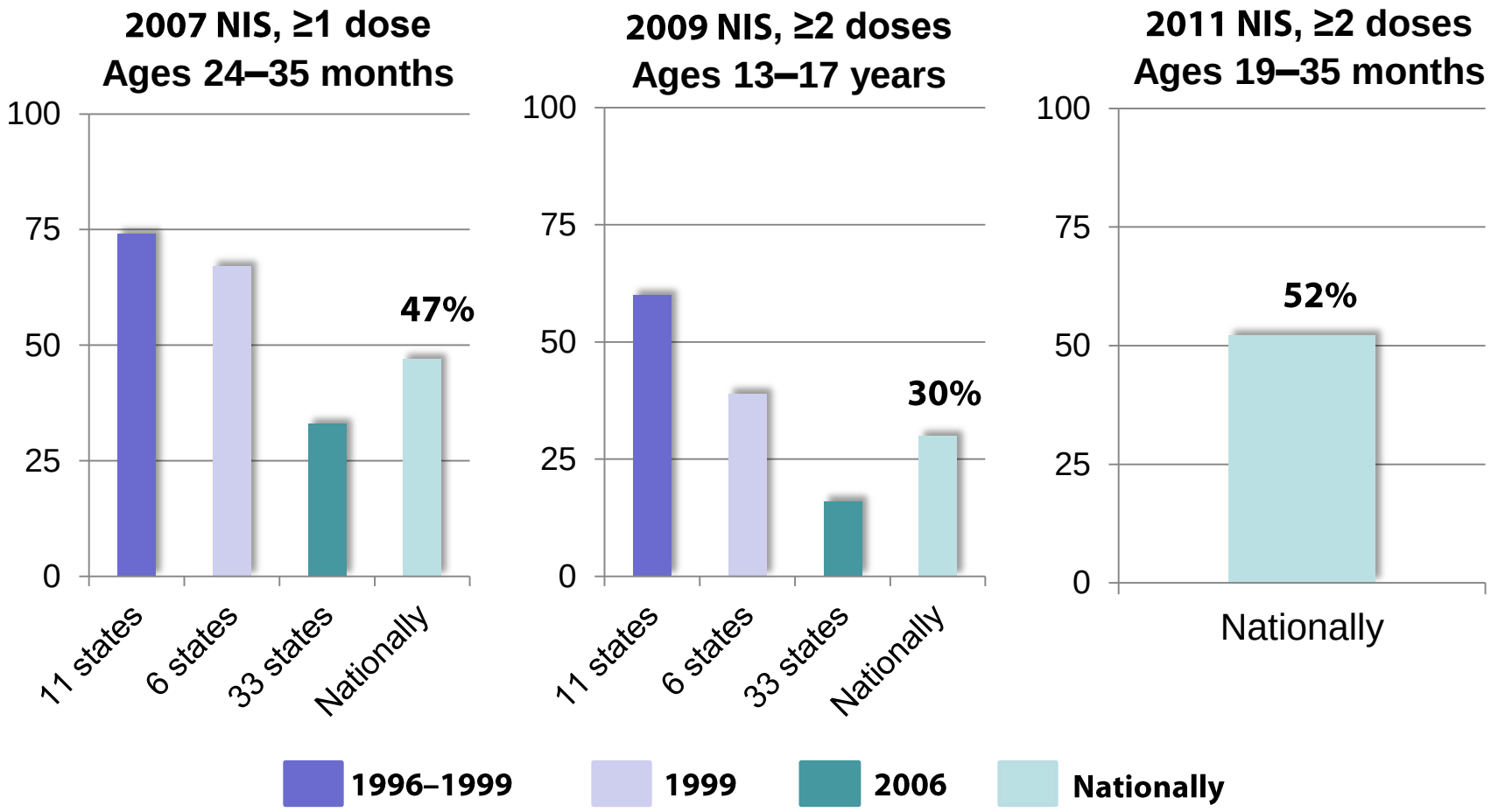
MMWR 1996;45 (RR–15)
MMWR 1999;48 (RR–12)
MMWR 2006;55 (RR–7)

History of U.S. Hepatitis A Childhood Vaccine Recommendations, 1996–2006

- **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

MMWR 1996;45 (RR–15)
MMWR 1999;48 (RR–12)
MMWR 2006;55 (RR–7)

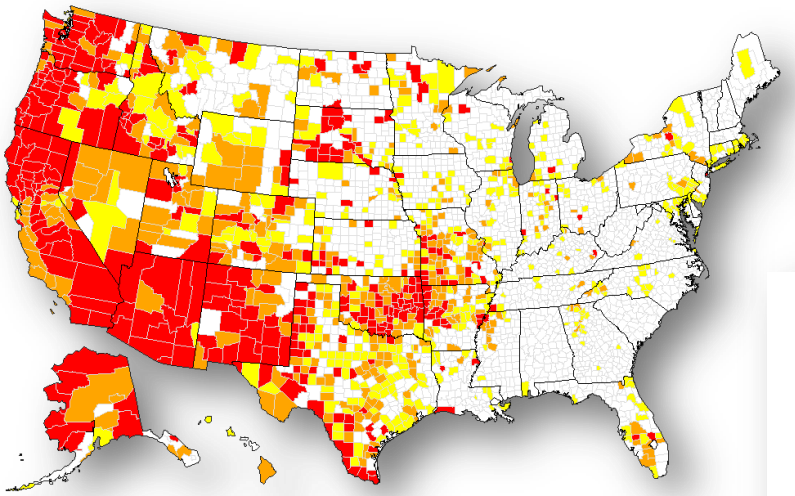
Hepatitis A Vaccine Coverage by Area of Targeted Vaccination



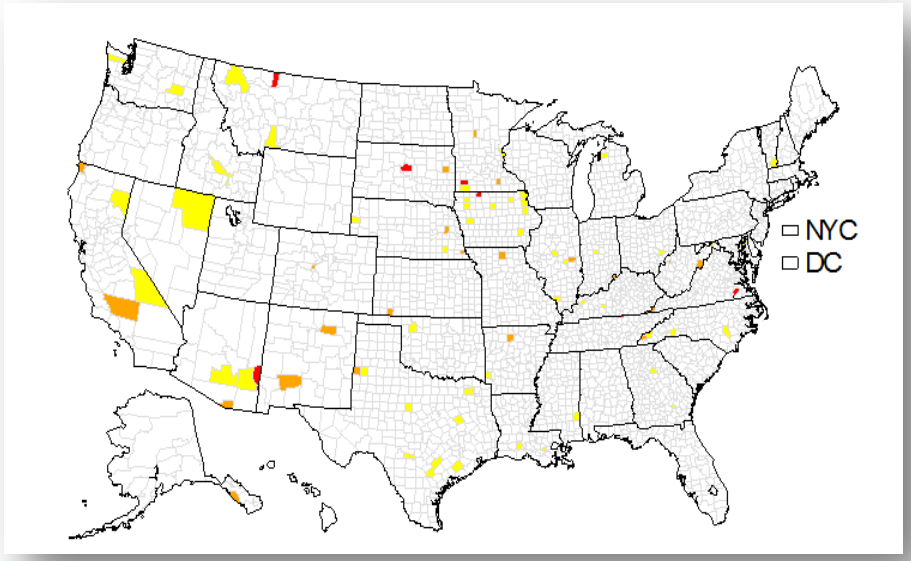
NIS, National Immunization Survey, http://www.cdc.gov/nchs/nis.htm
MMWR 2009;58:689–94
Dorell, CG. Pediatrics 2012;129:213–21
MMWR 2012; 61(35):689

Rates of Reported Acute Hepatitis A Cases 1987–1997 and 2007

1987–1997



2007

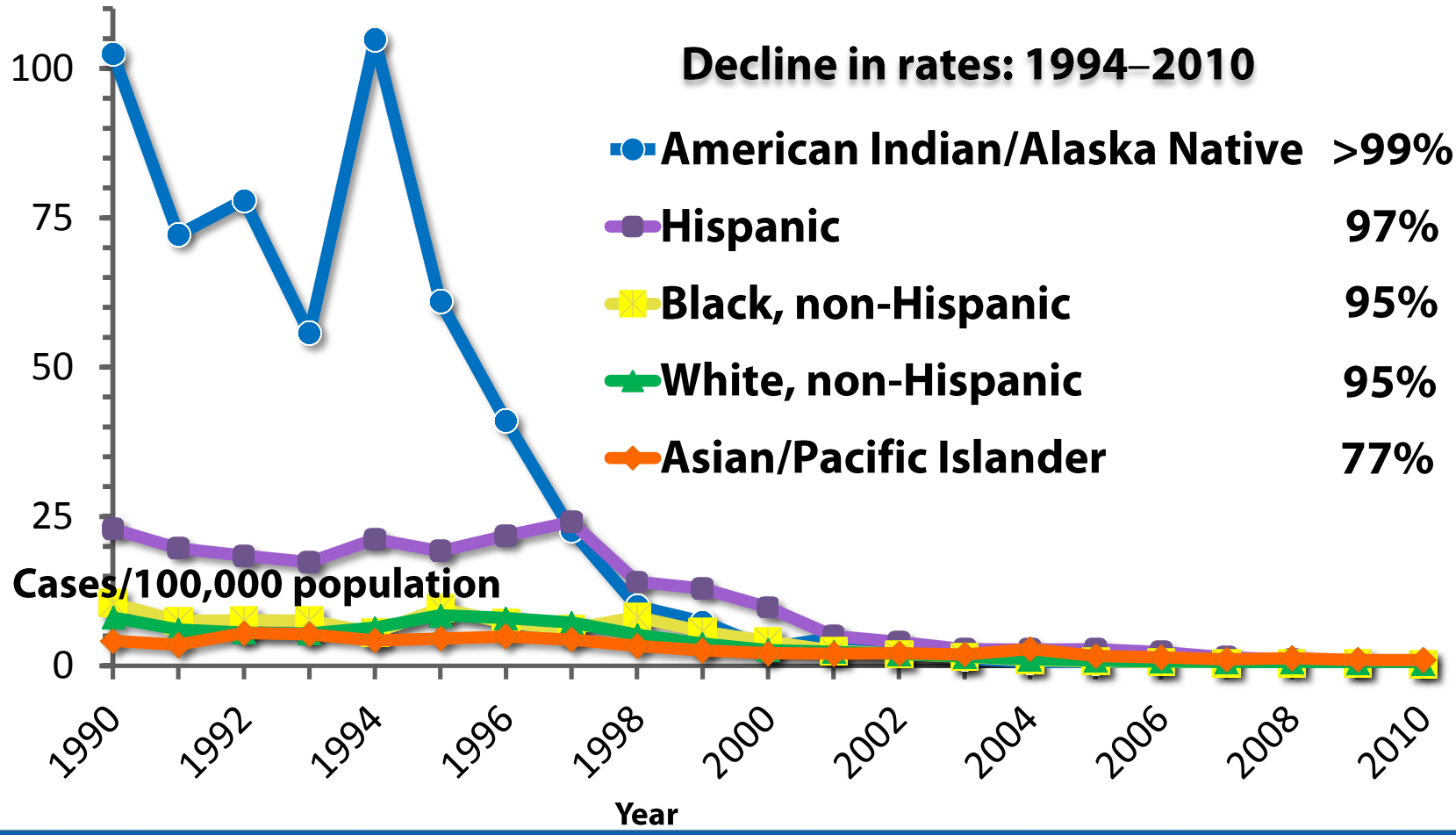


Rate*
- 0–4
- 5–9
- 10–19
- ≥20

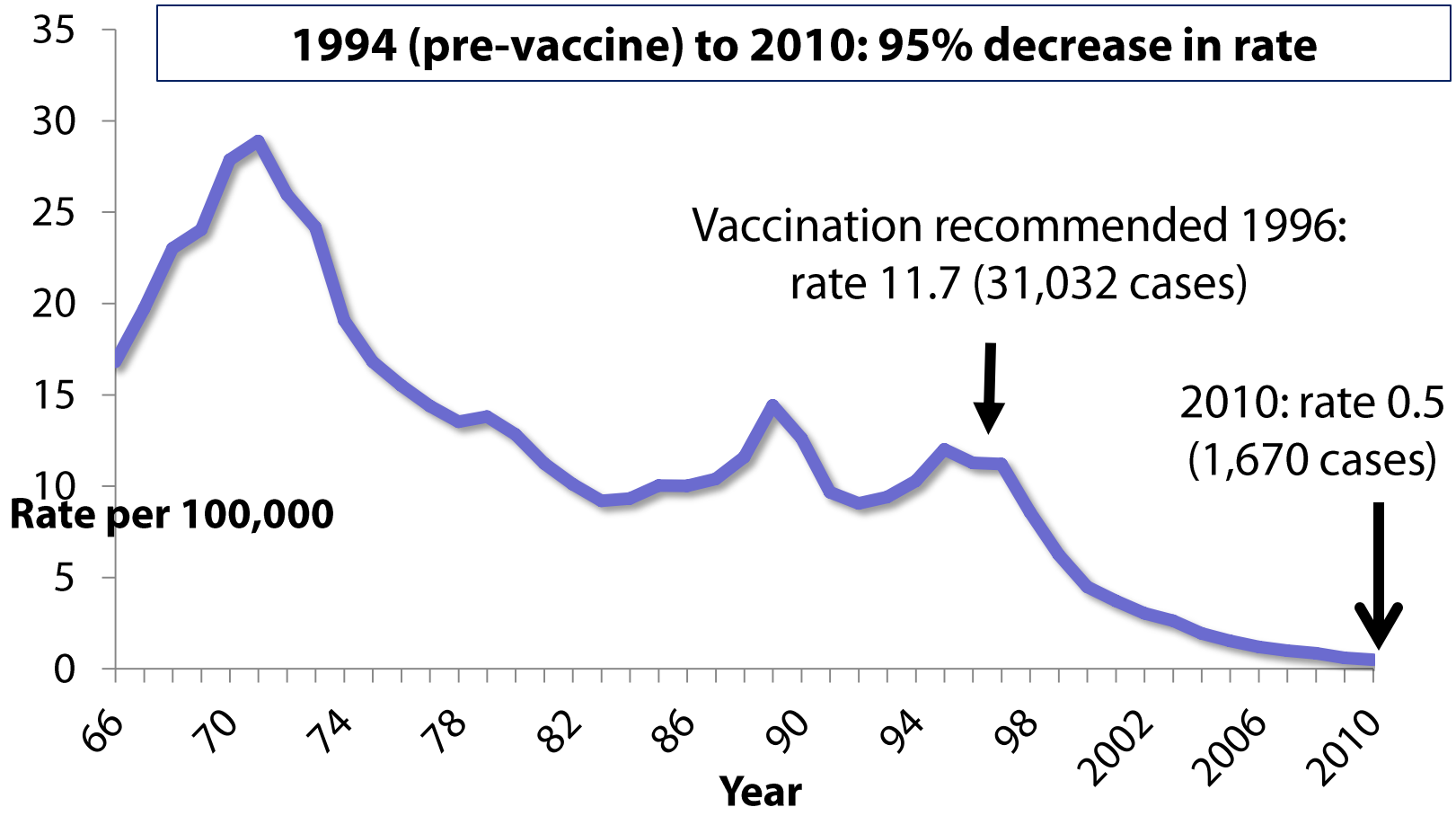
*Per 100,000 population

NNDSS, National Notifiable Diseases Surveillance System

Rates of Reported Hepatitis A Cases by Race/Ethnicity, United States, 1990–2010



Rates of Reported Acute Hepatitis A Cases United States, 1966–2010



NNDSS, National Notifiable Diseases Surveillance System
Armstrong, GL. Pediatrics 2007;119:e22–9

Preventing New Cases of Hepatitis A: Challenges and Opportunities

- **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

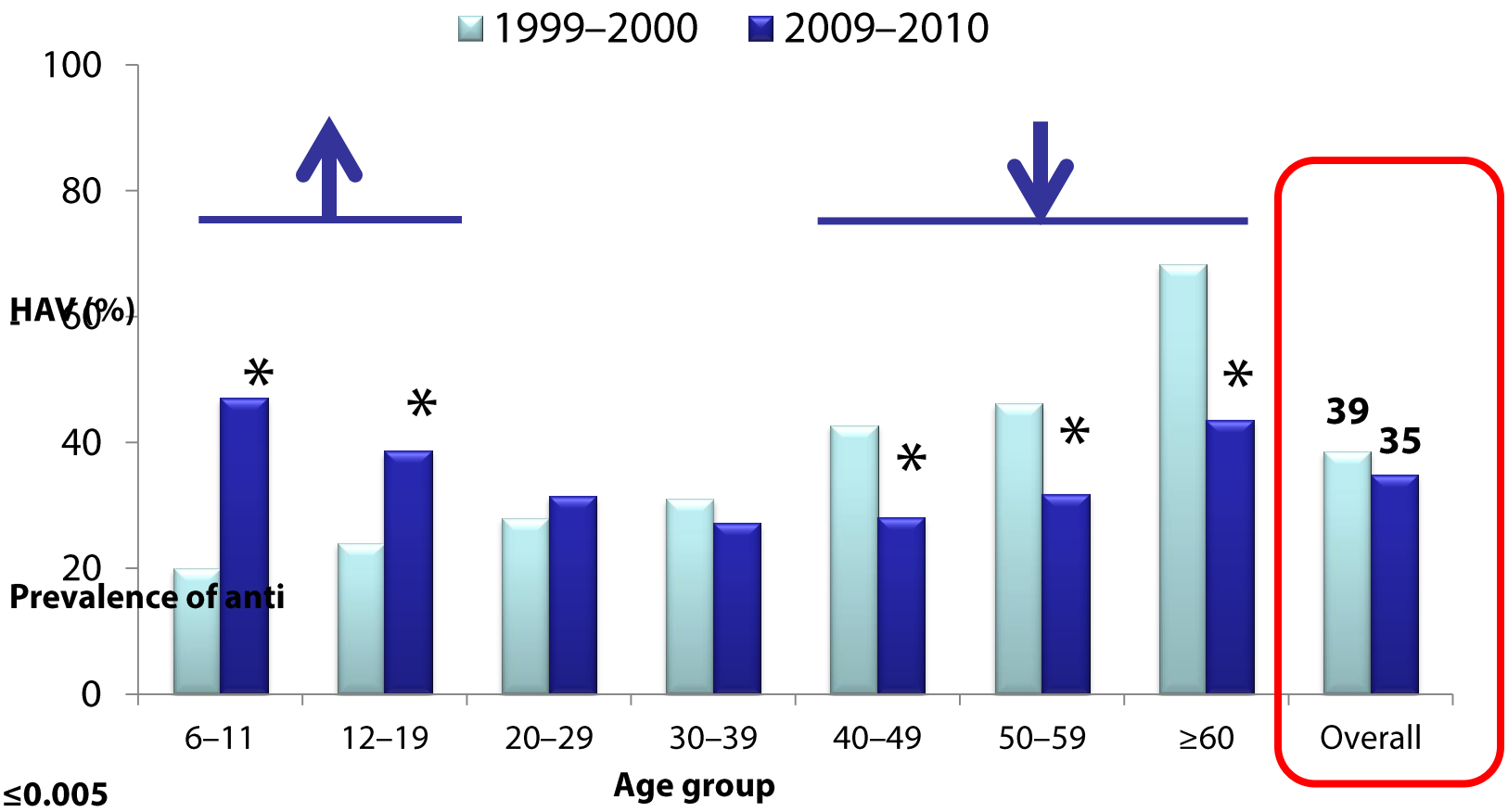
NNDSS, National Notifiable Diseases Surveillance, 2010
Van Effelterre, T. Human Vaccines Immunotherapeurtics 2012;8:1–10
Wheeler, C. N Engl J Med 2005;353:890–7
Nelson, N. Unpublished data, 2013

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

Sharapov, UM. Hepatology 2012;56:516–22
Van Effelterre ,T. Human Vaccines Immunotherapeutics 2012;8:1–10
MMWR 2013;62:66–72

Prevalence of anti-HAV by Age Group, NHANES 1999–2000 and 2009–2010



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

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)

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
Causes of Death in Alaska, 1950, 1980–89, State of Alaska,1991
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

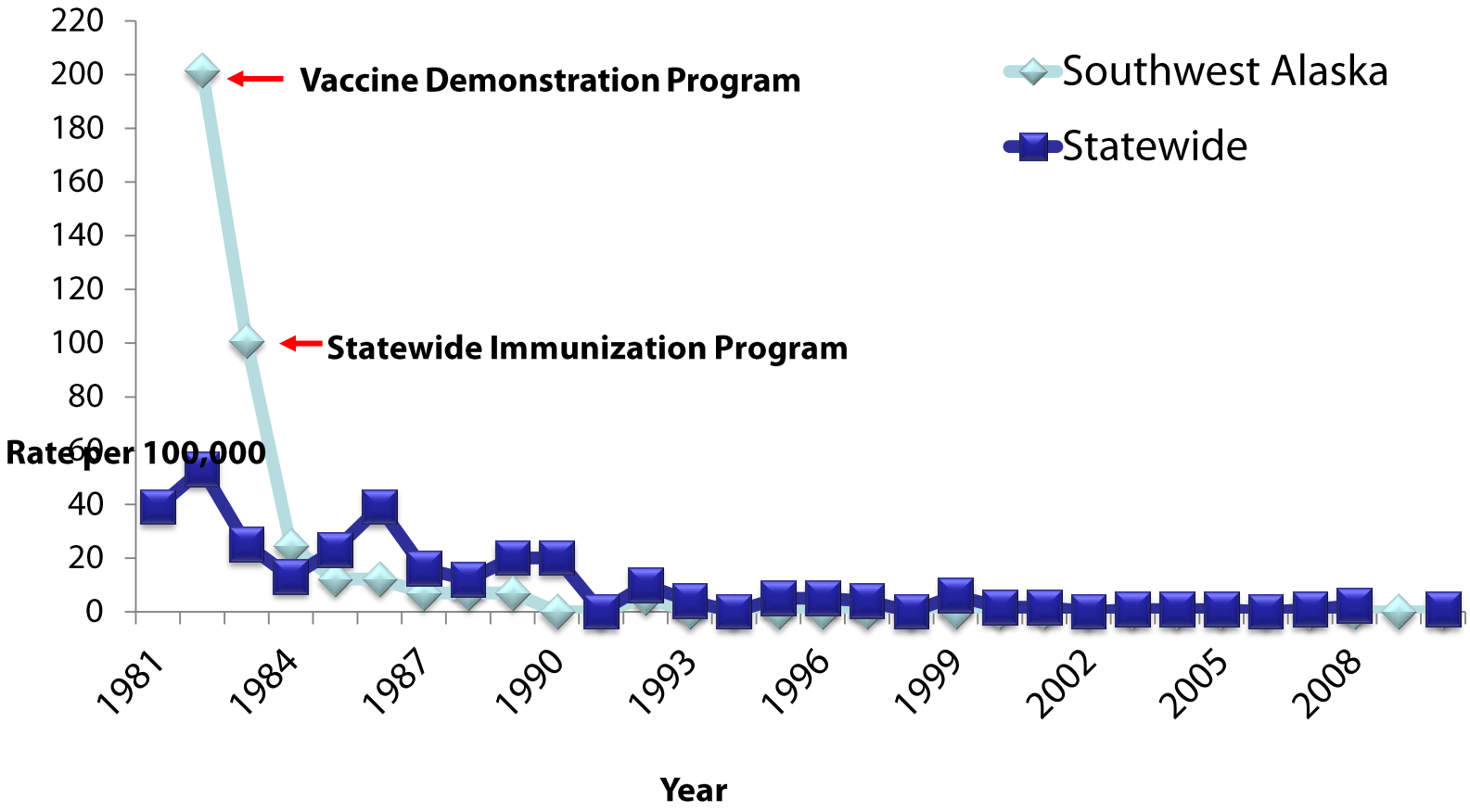
Hepatitis B among Alaska Native (AN) Persons

- **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

McMahon, BJ et al. Hepatology 2011;54:801–7

Incidence of Symptomatic Hepatitis B in Alaska Natives, 1981–2010



McMahon, BJ et al. Hepatology 2011;54:801–7

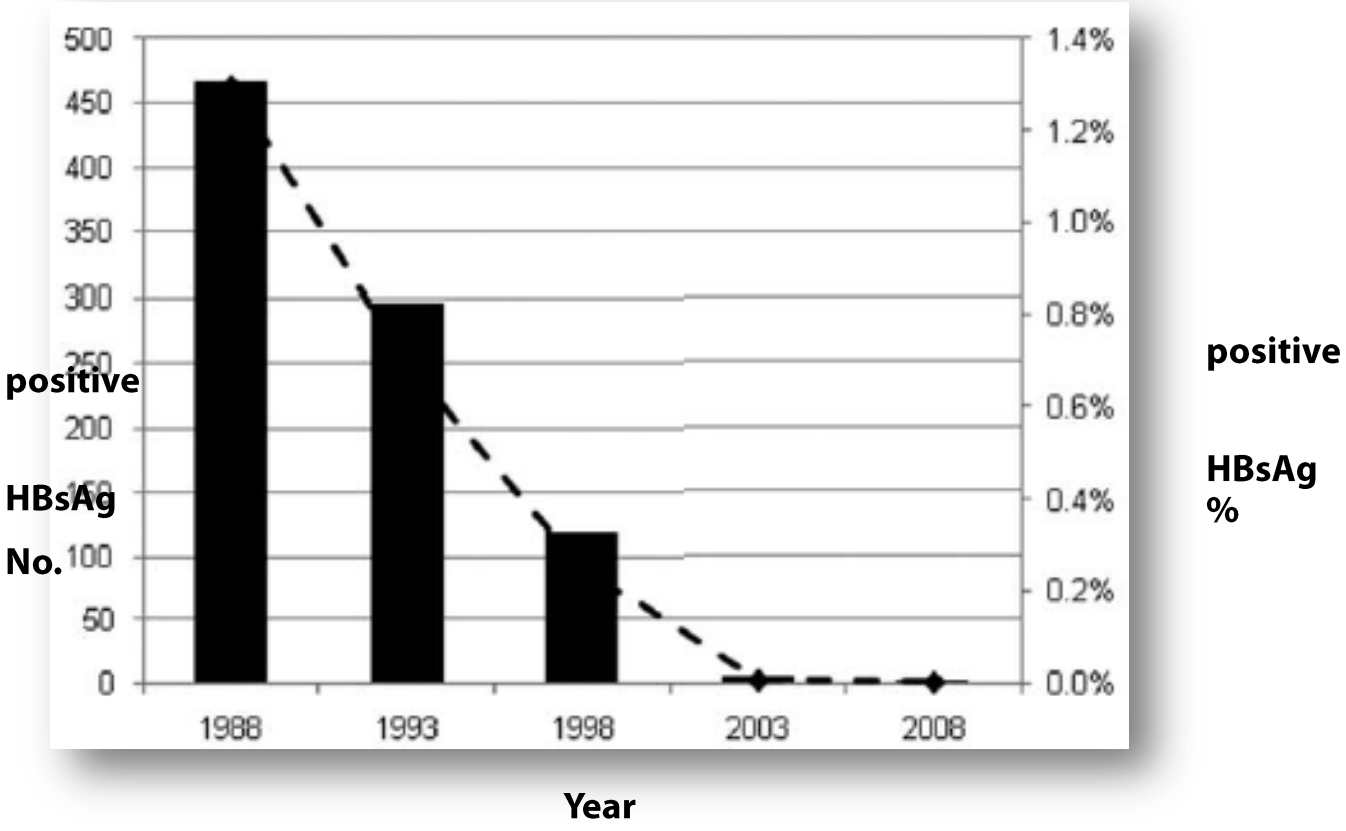
Hepatitis B Immunization Coverage and Impact in Alaska

- **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

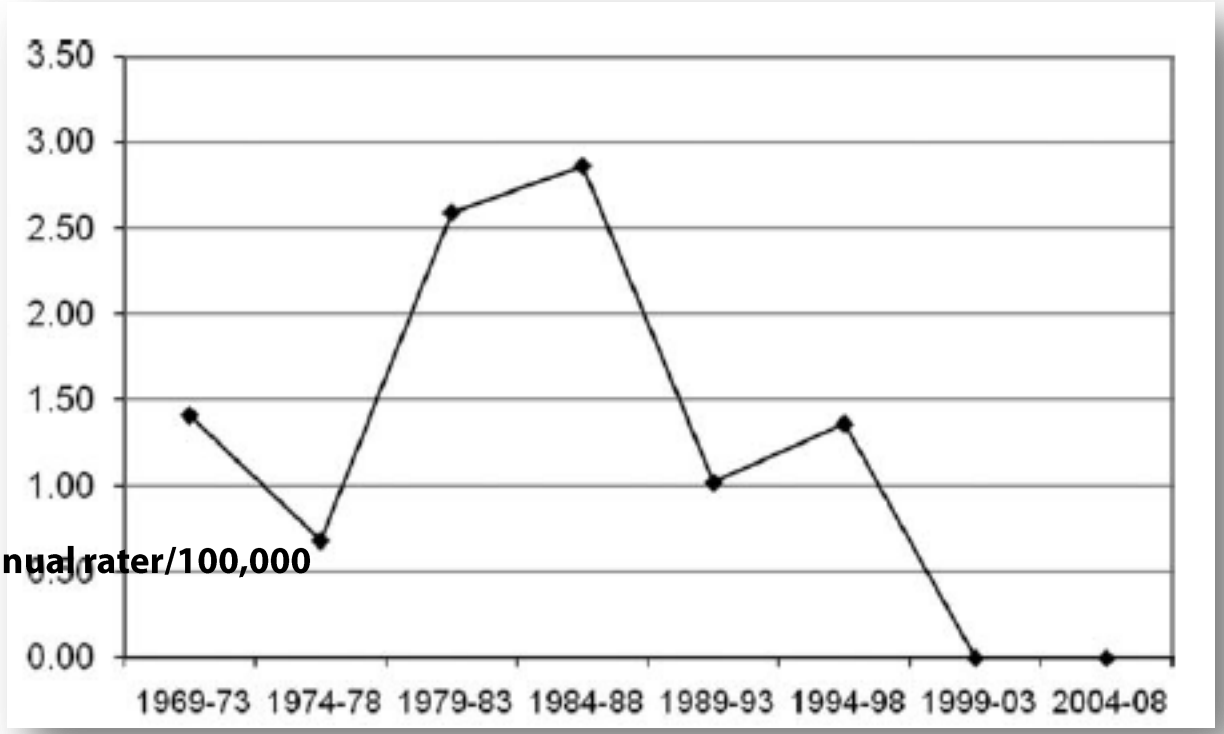
National Immunization Survey, http://www.cdc.gov/nchs/nis.htm
McMahon, BJ et al. Hepatology 2011;54:801–7

Prevalence of Hepatitis B Surface Antigen in Alaska Native Children <20 Years Old, 1998–2008



McMahon, BJ et al. Hepatology 2011;54:801–7

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



McMahon, BJ et al. Hepatology 2011;54:801–7

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)

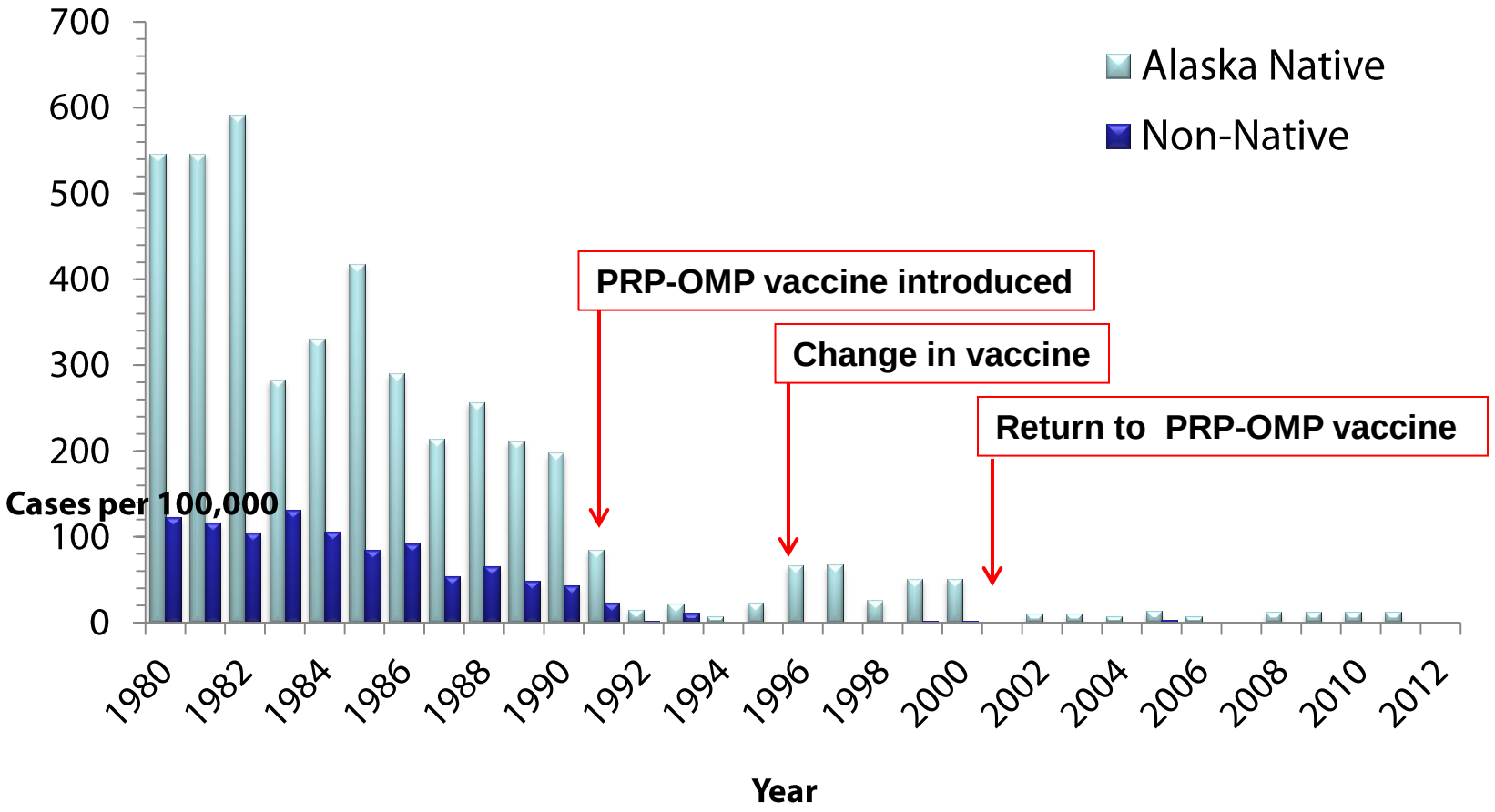
Hib Disease in AI/AN Children

- **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

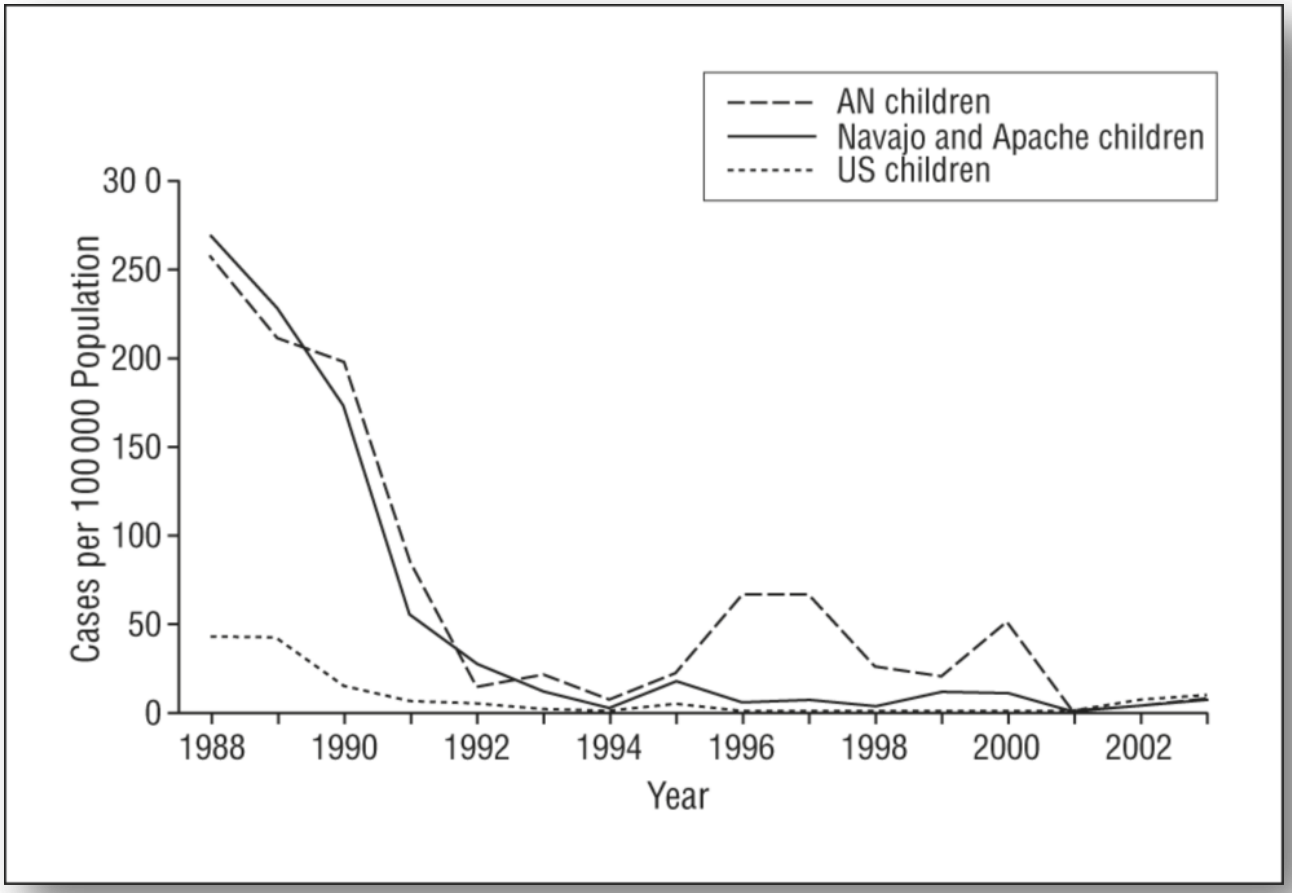
Singleton, R et al. Pediatrics 2006; 118 (2):421–9
Ward, JI et al. JID 1986; 153(1):17–26
Murphy, TV et al. JID 1992;165(Suppl1):s7–10

Invasive Hib Disease, Children Aged <5 Years Alaska, 1980–2012



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



Takala, A et al. Arch Pediatr Adolesc Med 2009;163(5):446–53

Blanket toss, Alaska

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

AI/AN, American Indian, Alaska Native
HBV, Hepatitis B vaccine
Hib, *H. influenzae* type b

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?

AI/AN, American Indian, Alaska Native

Immunization as a Path to Equity

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

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

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

VPD, Vaccine-preventable diseases

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)
Hinman, AR, Proceedings of the 39th National Immunization Conference. Washington DC, March 23, 2005, p.146–52

South Carolina State Vehicle Bumper Sticker, 1980s

Measles Vaccine Coverage in 1–4 Year Olds in 1977 and 19–35 Months Old Children in 1996 and 2011

	1977 (USIS) %	1996 (NIS) %	2011 (NIS) %
Total	63.1	91	91.6
White	65.5	91	91.6
Other	52.0	NA	NA
Black	NA	89	90.8
Hispanic	NA	88	92.4

USIS, U.S. Immunization Survey
NIS, National Immunization Survey, http://www.cdc.gov/nchs/nis.htm
NA, Not applicable

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

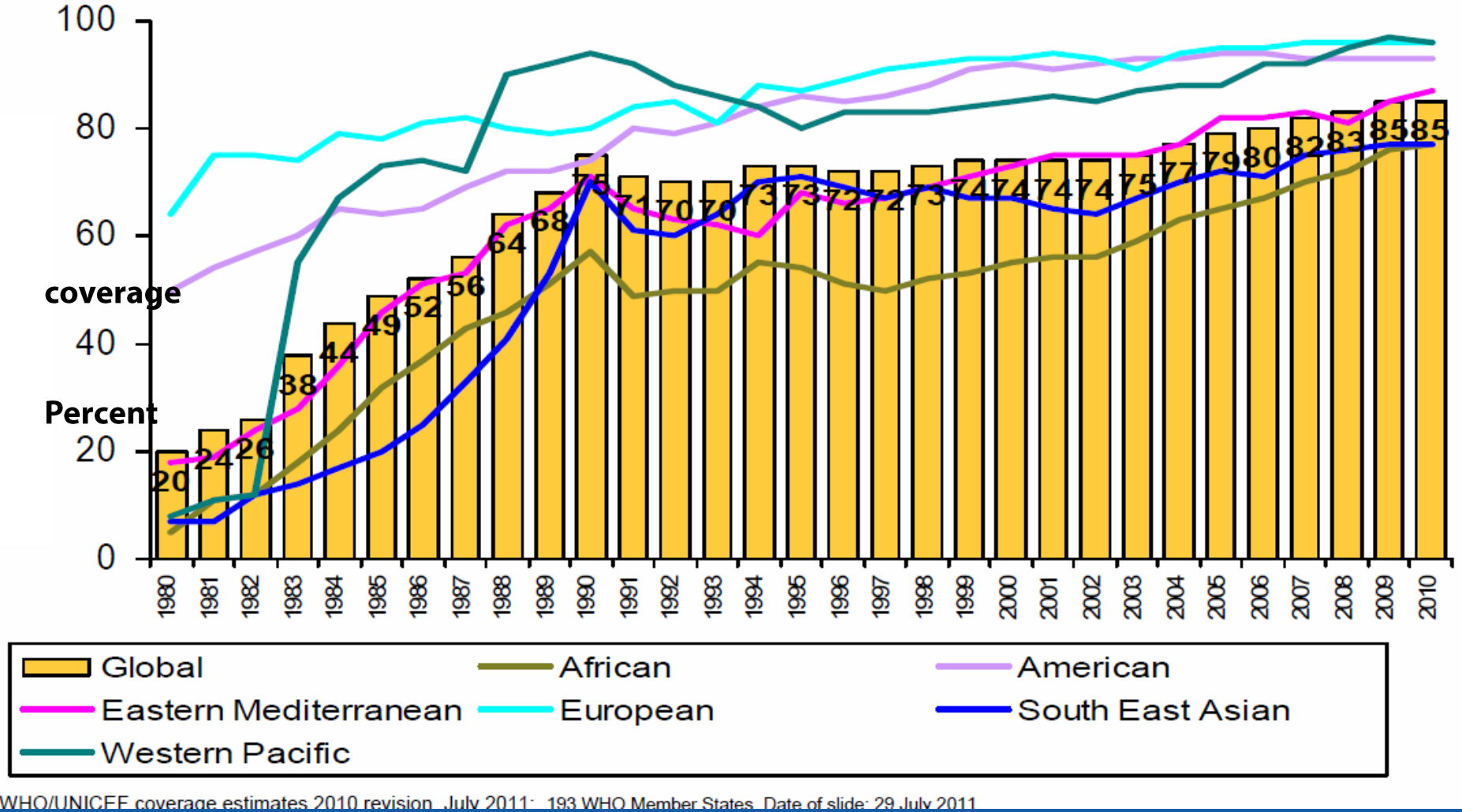
- **1980**
  - 2,500,000 deaths from measles more than 15 years after the measles vaccine had been introduced
- **2000**
  - 548,000 deaths; nearly 80% reduction
- **2011**
  - 158,000 deaths; a further 70% reduction

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

BCG, Bacile Calmette-Guerin
DTP, Diphtheria, tetanus, and pertussis
OPV, Oral polio vaccine
Hib, *Haemophilus influenzae* type b

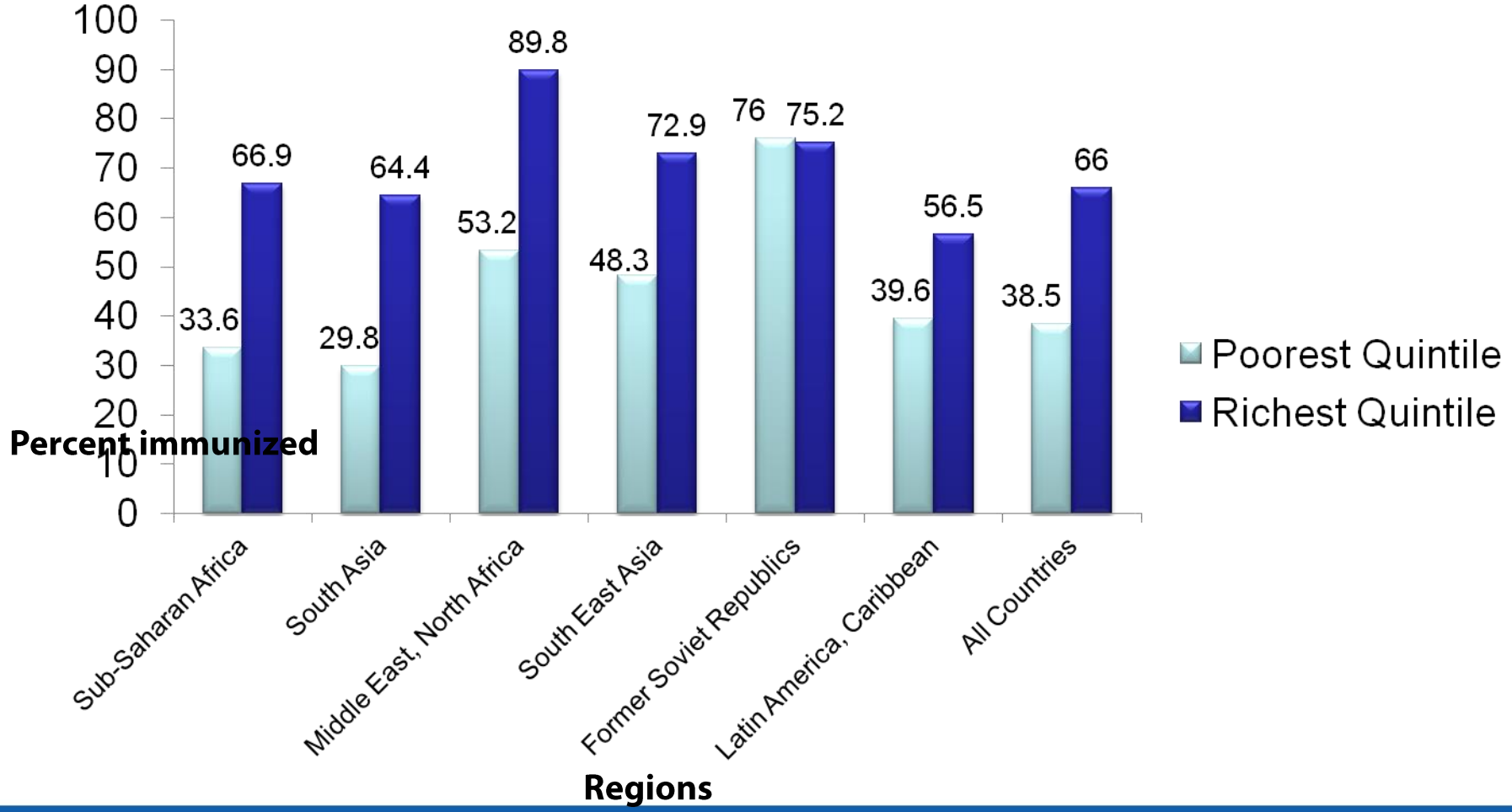
Global Immunization 1980–2010
Global Coverage of DTP3 at 85% in 2010



e: WHO/UNICEF coverage estimates 2010 revision, July 2011; 193 WHO Member States. Date of slide: 29 July 2011

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



The GAVI Alliance Mission and Programs

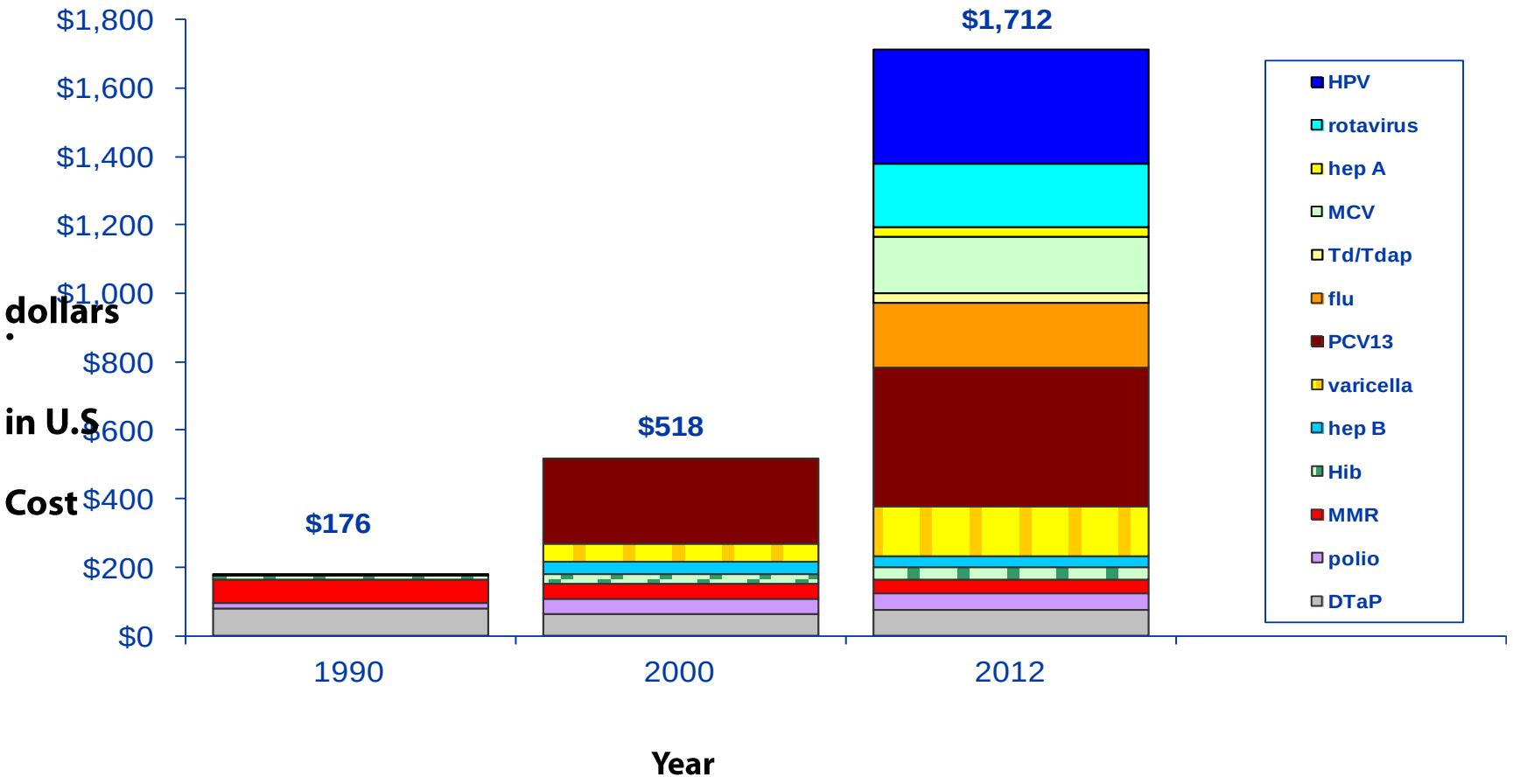
- **To save children's lives and protect people's health by increasing access to immunization in poor countries**
- **Program areas**
  - New and underused vaccines
  - Immunization services
  - Injection safety
  - Health system strengthening
  - Civil society organizations
    - Includes non-governmental, 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

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

*DTP/HepB/Hib

VFC, Vaccines for Children
UNICEF, United Nations International Children's Emergency Fund
PAHO, Pan-American Health Organization
NA, Not available

Cost to Immunize a Child in GAVI-eligible Countries, 2010

Vaccine	Number of doses x per-dose price	Per-series cost
BCG	1 x $0.06	$0.06
Pentavalent*	3 x $2.70	$8.10
OPV	3 x $0.16	$0.48
Measles	1 x $0.21	$0.21
PCV13	3 x $3.50	$10.50
Rotavirus	3 x $5.00	$15.00
Administration		~$15.00 ~$50.00

*DTP/HepB/Hib

GAVI, Global Alliance for Vaccines and Immunisation

Countries with Annual Health Expenditures per Capita of <25 in 2010

Bangladesh	$18.43
Burundi	$19.71
CAR	$19.34
DRC	$15.58
Eritrea	$10.12
Ethiopia	$14.68
Guinea	$18.77
Guinea-Bissau	$18.36

Madagascar	$17.97
Malawi	$19.07
Mauritania	$21.92
Mozambique	$24.72
Myanmar	$12.47
Niger	$20.89
Pakistan	$22.50

World Bank
CAR, Central African Republic
DRC, Democratic Republic of the Congo

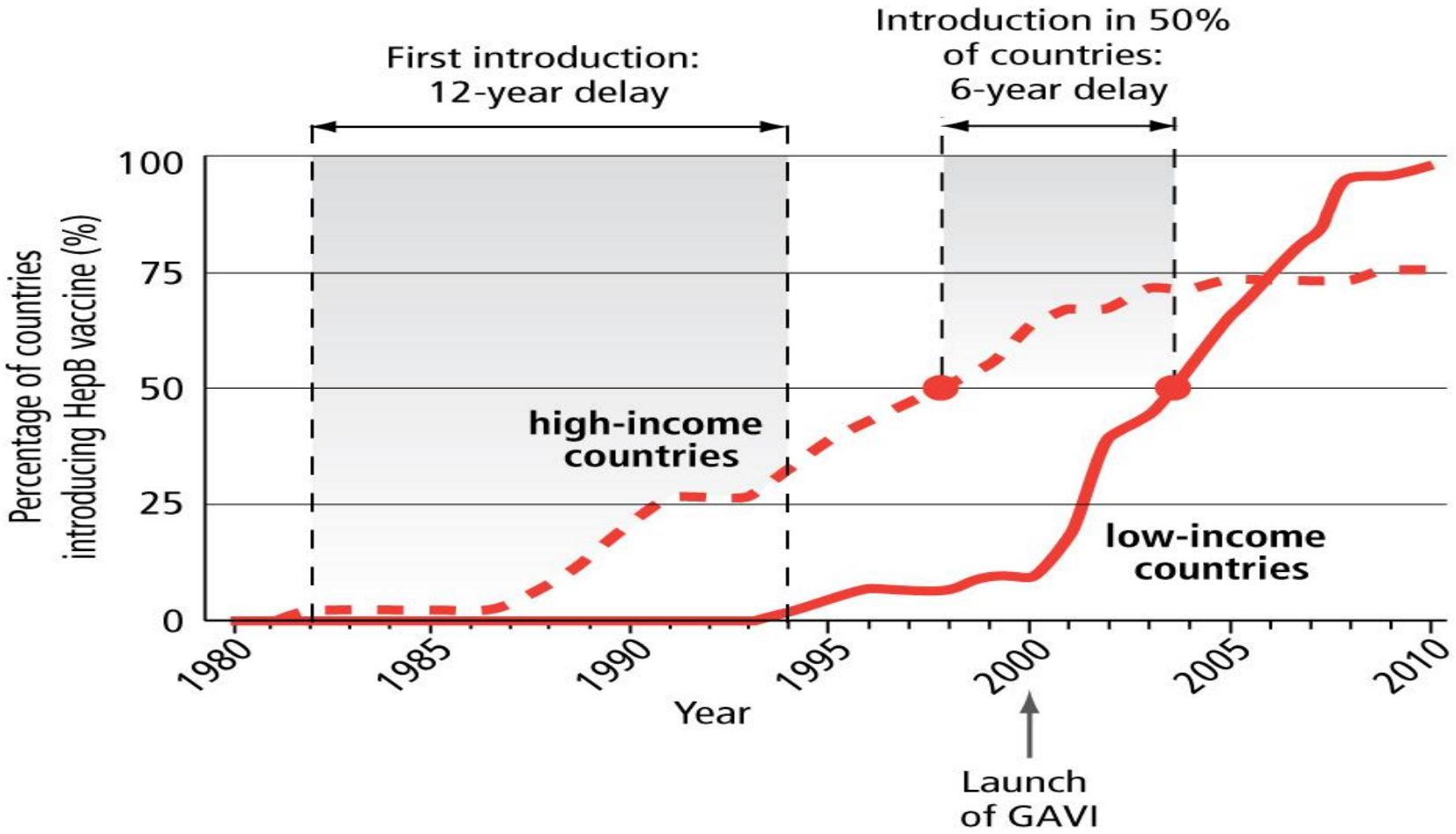
Annual Cost to Immunize All Children in GAVI-eligible Countries

$50 X 74 million births = $3.7 billion

2011 U.S. expenditures on pets >$50 billion

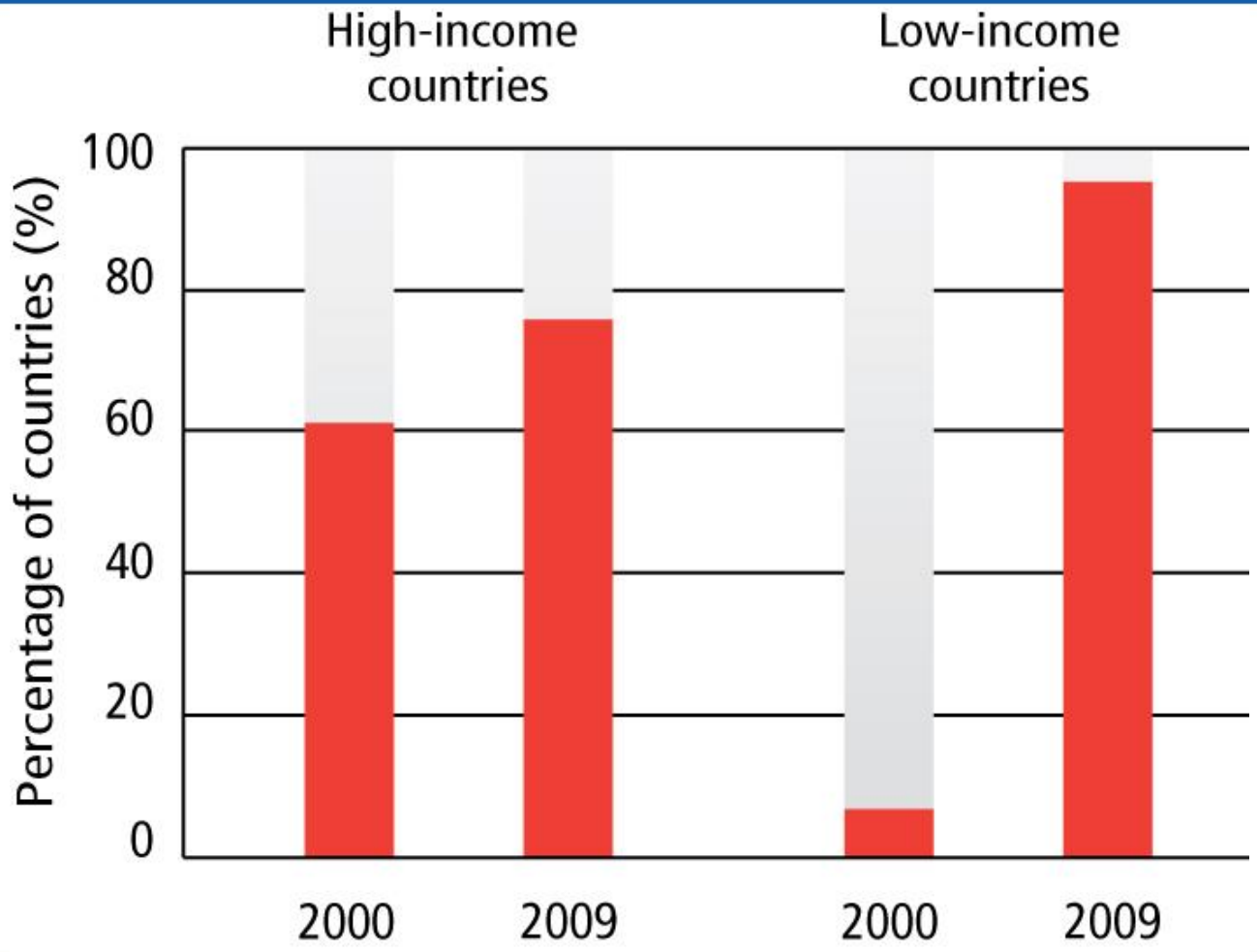
Hinman, AR. Unpublished data
http://www.americanpetproducts.org
GAVI, Global Alliance for Vaccines and Immunisation, www.gavialliance.org

Hepatitis B Vaccine Introduction in High- and Low-income Countries



http://www.gavialliance.org/support/nvs/hepb/

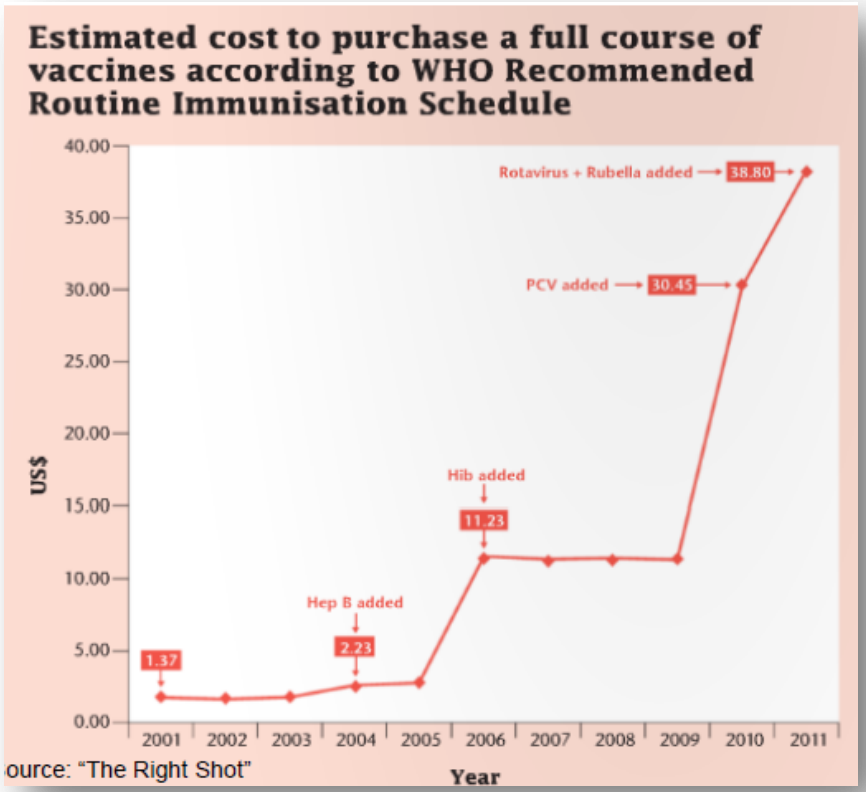
Routine Use of Hepatitis B Vaccines



World Health Organization, vaccine introduction database

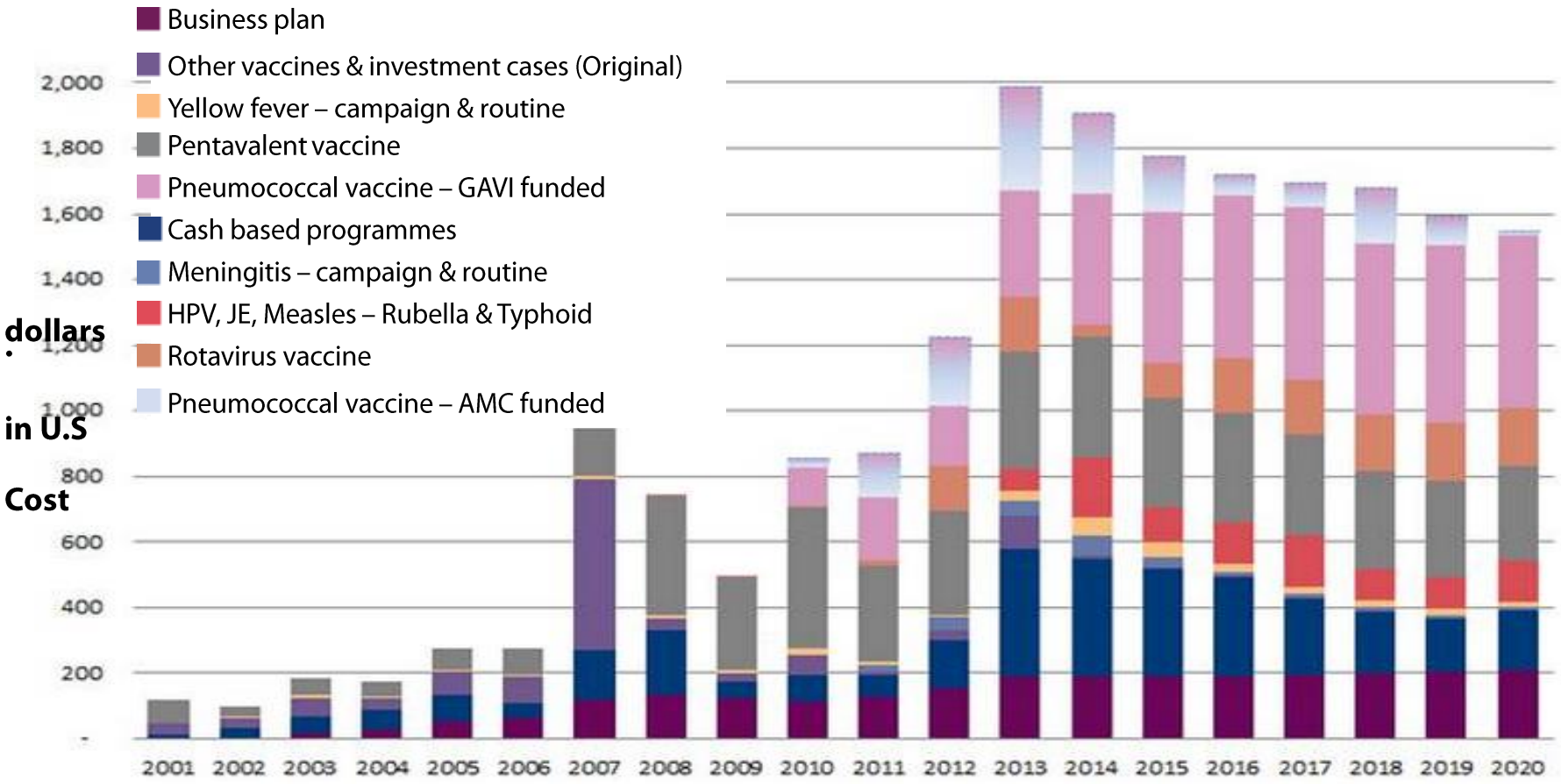
The Rising Price of Immunizing One Child

- **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.



http://www.msfaccess.org/content/rightshot

GAVI Alliance: Actual and Projected Disbursements ($Million)



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

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