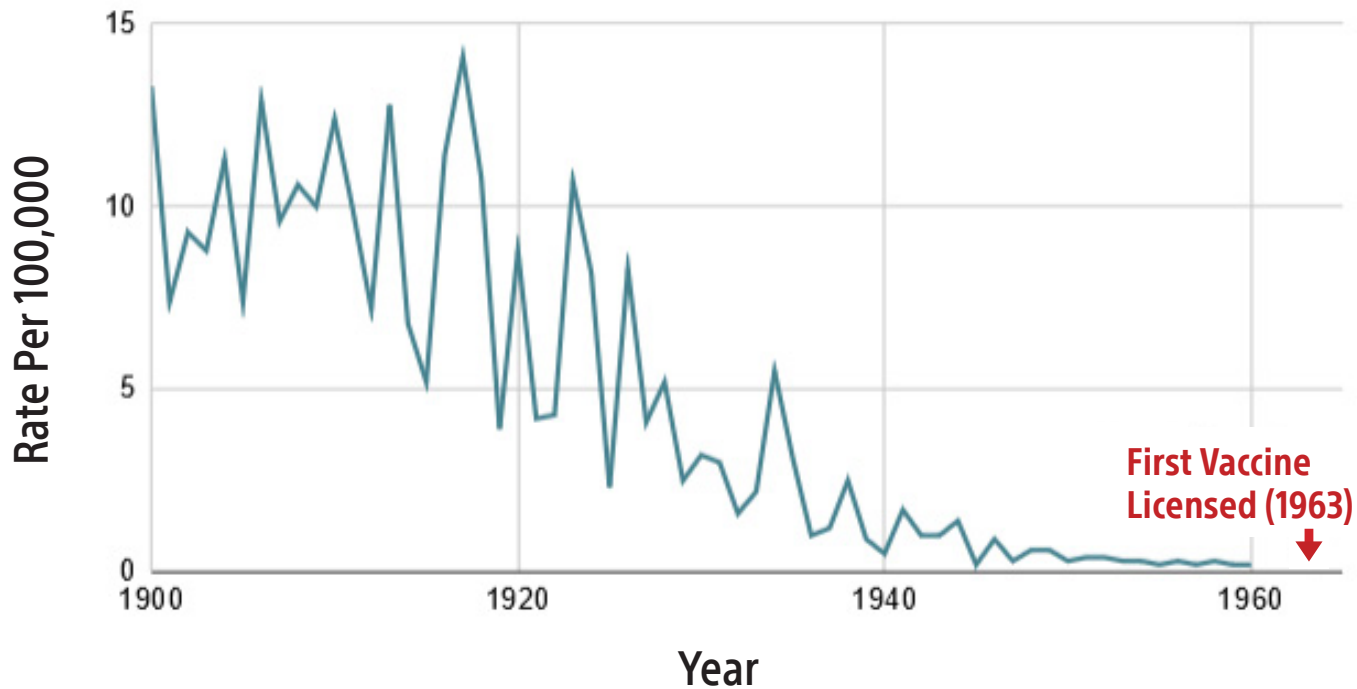


20TH CENTURY DISEASE MORTALITY

Reductions Caused By Improved Living Conditions Prior To Vaccines



Measles Disease Mortality United States, 1900-1960¹



SOURCES:

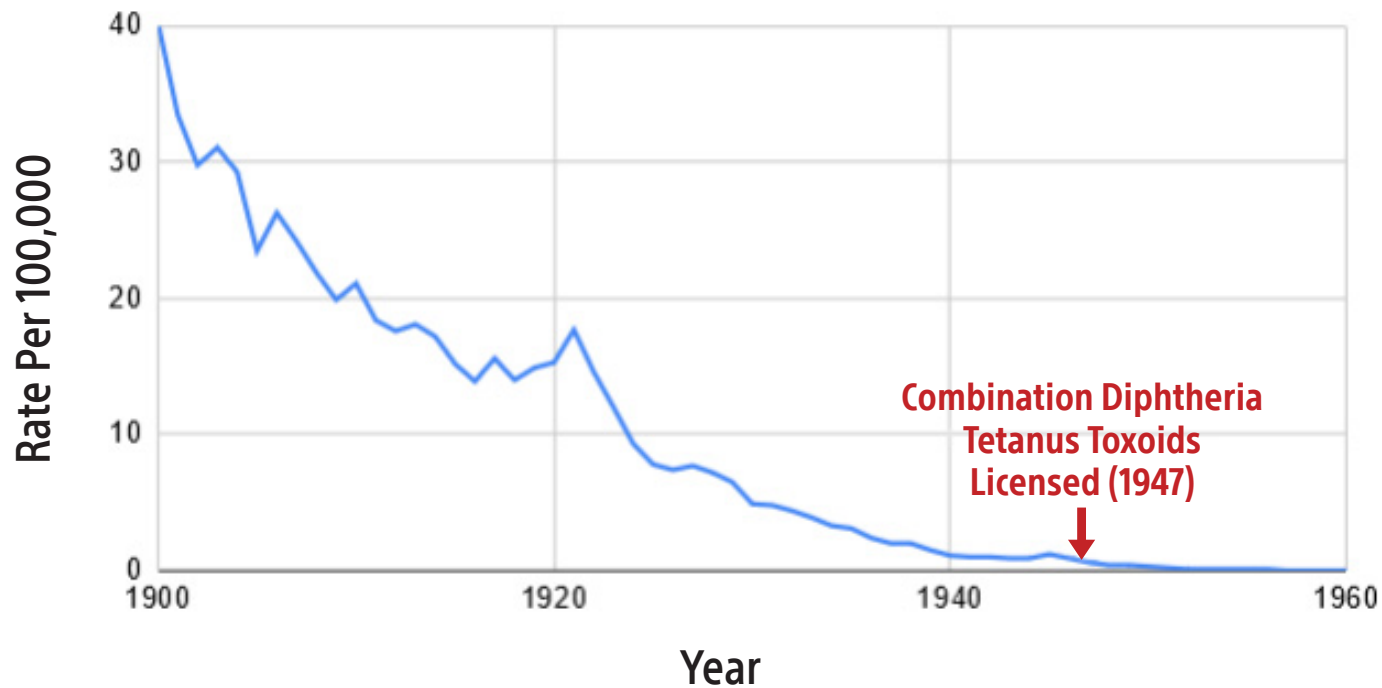
1. Grove, R., D., Hetzel, A., M., (1968). Vital statistics rates in the United States, 1940-1960, pp 559 - 603, Washington, D.C. : U.S. Department of Health, Education, and Welfare, Public Health Service, National Center for Health Statistics, 1968. 2. "The first measles vaccines were licensed in 1963." Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. Hamborsky J, Kroger A, Wolfe S, eds. 13th ed. Washington D.C. Public Health Foundation, 2015.

20TH CENTURY DISEASE MORTALITY



Reductions Caused By Improved Living Conditions Prior To Vaccines

Diphtheria Disease Mortality United States, 1900-1960¹



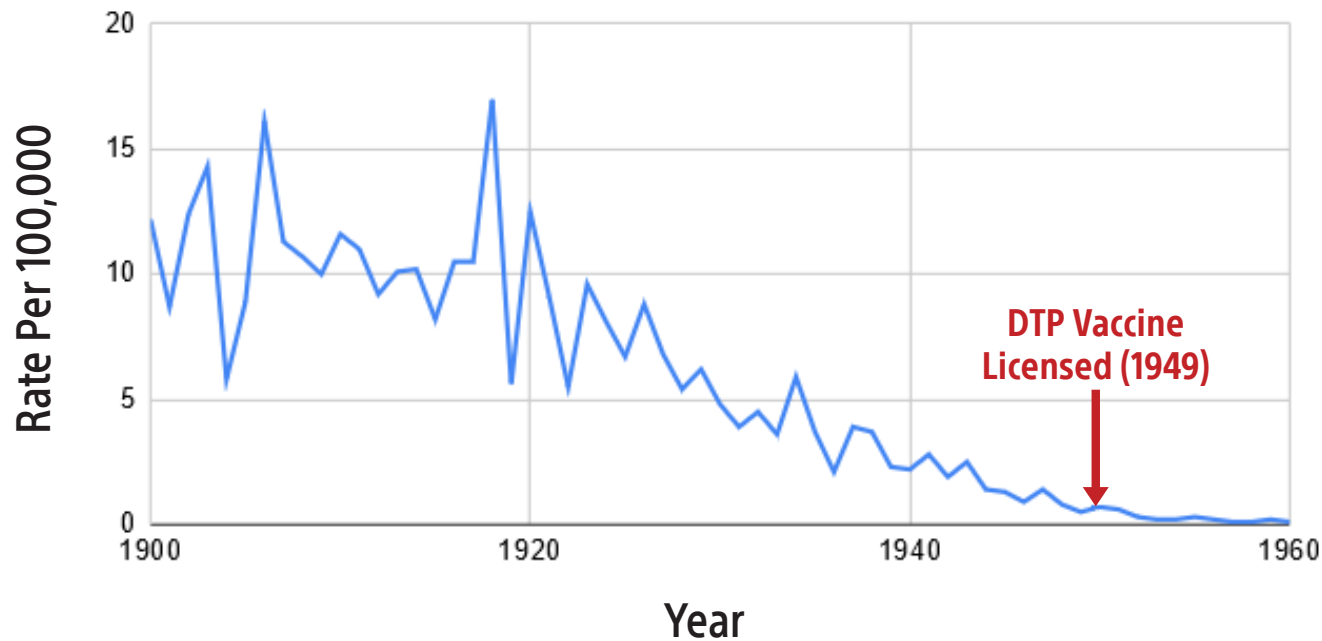
SOURCES:

1. Grove, R., D., Hetzel, A., M., (1968). Vital statistics rates in the United States, 1940-1960, pp 559 - 603, Washington, D.C. : U.S. Department of Health, Education, and Welfare, Public Health Service, National Center for Health Statistics, 1968. 2. Antitoxin was invented in the late 19th century, and toxoid was developed in the 1920s. Widespread use of diphtheria toxoid in the late 1940s. Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. Hamborsky J, Kroger A, Wolfe S, eds. 13th ed. Washington D.C. Public Health Foundation, 2015.

20TH CENTURY DISEASE MORTALITY

Reductions Caused By Improved Living Conditions Prior To Vaccines

Whooping Cough Disease Mortality United States, 1900-1960^{1,2}



SOURCES:

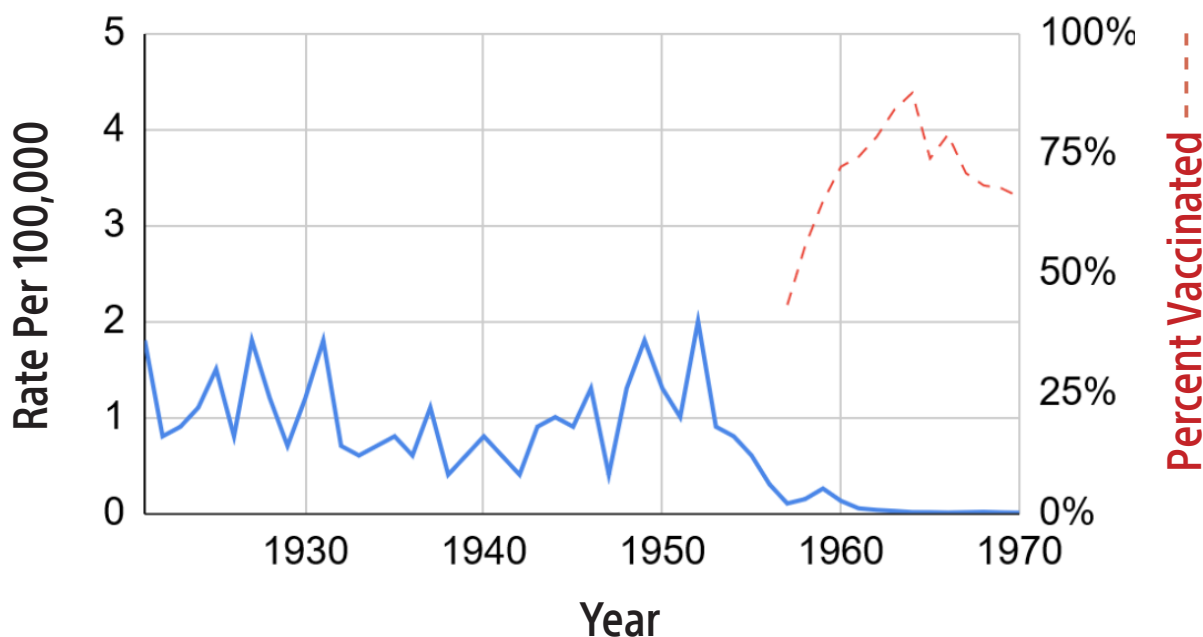
1. Grove, R., D., Hetzel, A., M., (1968). Vital statistics rates in the United States, 1940-1960, pp 559 - 603, Washington, D.C. : U.S. Department of Health, Education, and Welfare, Public Health Service, National Center for Health Statistics, 1968. 2. "Before the availability of pertussis vaccine in the 1940s, more than 200,000 cases of pertussis were reported annually." Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. Hamborsky J, Kroger A, Wolfe S, eds. 13th ed. Washington D.C. Public Health Foundation, 2015.

20TH CENTURY DISEASE MORTALITY

Reductions Caused By Improved Living Conditions Prior To Vaccines



Polio Disease Mortality United States, 1921-1970¹⁻⁶



SOURCES:

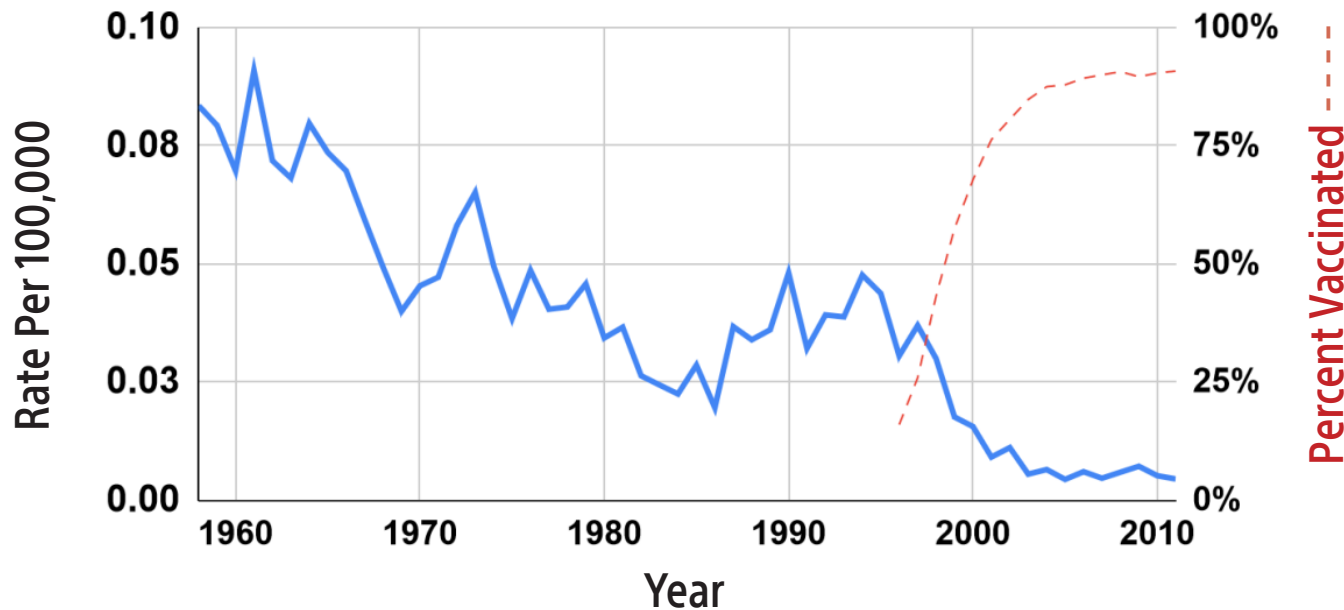
1. Sirken, M.G. National Participation Trends, 1955-61, in the Poliomyelitis Vaccination Program. Pub. Health Rep. 77:661-670 (Aug.), 1962. 2. Morbidity and Mortality Vol. 20, No. 13 (April 3, 1971), pp. 114-115 (2 pages) IMMUNIZATION SURVEY - 1970. (1971). from www.jstor.org/stable/44069987 3. Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. Appendix E, Vaccine Coverage Levels, United States, 1962-2016. Hamborsky J, Kroger A, Wolfe S, eds. 13th ed. Washington D.C. Public Health Foundation, 2018. 4. Grove, R., D., Hetzel, A., M., (1968). Vital statistics rates in the United States, 1940-1960, pp 559 - 603, Washington, D.C.: U.S. Department of Health, Education, and Welfare, Public Health Service, National Center for Health Statistics, 1968. 5. Centers for Disease Control. Annual summary 1969: reported morbidity and mortality in the United States. Morbidity Mortality Weekly Rep 1970;18(54). <https://stacks.cdc.gov/view/cdc/1829> 6. Centers for Disease Control. Annual summary 1971: reported morbidity and mortality in the United States. Morbidity Mortality Weekly Rep 1972;20(53). <https://stacks.cdc.gov/view/cdc/1577>

20TH CENTURY DISEASE MORTALITY

Reductions Caused By Improved Living Conditions Prior To Vaccines



Varicella (Chicken Pox) Disease Mortality United States, 1958–2011¹⁻¹⁰



SOURCES:

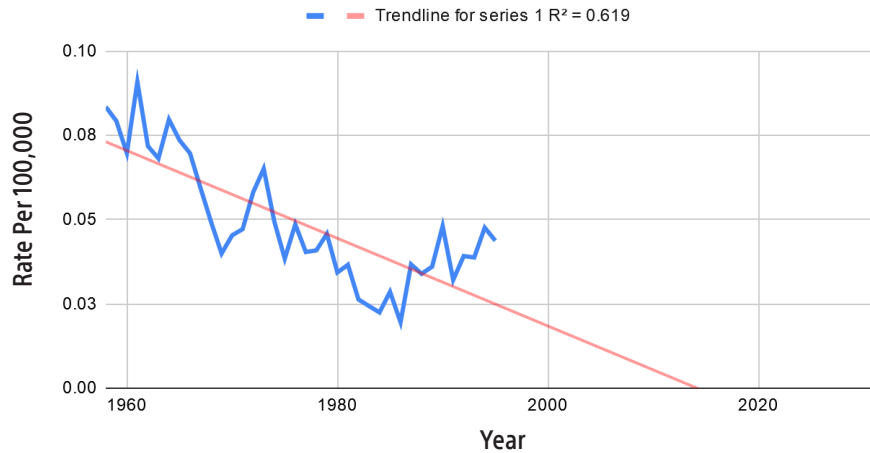
1. 1959 - 1968: Centers for Disease Control. Annual summary 1969: reported morbidity and mortality in the United States. Morbidity Mortality Weekly Rep 1970 ;18(54). <https://stacks.cdc.gov/view/cdc/1829> 2. 1969 - 1978: Centers for Disease Control. Annual summary 1971: reported morbidity and mortality in the United States. Morbidity Mortality Weekly Rep 1972 ;20(53). <https://stacks.cdc.gov/view/cdc/1577> 3. 1970 - 1979: Centers for Disease Control. Annual summary 1980: reported morbidity and mortality in the United States. Morbidity Mortality Weekly Rep 1981 ;29(54). <https://stacks.cdc.gov/view/cdc/1484> 4. 1980 - 1989: Centers for Disease Control. Summary of notifiable diseases, United States, 1991. Morbidity and Mortality Weekly Report 1991 ;40(53). <https://stacks.cdc.gov/view/cdc/36010> 5. 1989 - 1998: Centers for Disease Control and Prevention. Summary of notifiable diseases, United States, 2000. MMWR 2000;49(No. 53):[90]. <https://stacks.cdc.gov/view/cdc/5626> 6. 1996 - 2001: Centers for Disease Control and Prevention. Summary of notifiable diseases—United States, 2003. Published April 22, 2005, for MMWR 2003; 52(No. 54):[78]. <https://stacks.cdc.gov/view/cdc/5560> 7. 2002 - 2003: Centers for Disease Control and Prevention. [Summary of notifiable diseases, 2010]. MMWR 2007;56:[82]. <https://stacks.cdc.gov/view/cdc/21266> 8. 2004 - 2010: Centers for Disease Control and Prevention. [Summary of Notifiable Diseases, 2012]. Published September 19, 2014 for MMWR 2014;61(No. 53):[112]. <https://stacks.cdc.gov/view/cdc/25289> 9. 2008 - 2014: Adams DA, Thomas KR, Jajosky R, et al. Summary of Notifiable Infectious Diseases and Conditions — United States, 2014. MMWR Morb Mortal Wkly Rep 2016;63:1-152 DOI: <http://dx.doi.org/10.15585/mmwr.mm6354a1external icon> 10. Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. Appendix E, Vaccine Coverage Levels, United States, 1962-2016. Hamborsky J, Kroger A, Wolfe S, eds. 13th ed. Washington D.C. Public Health Foundation, 2018.

20TH CENTURY DISEASE MORTALITY

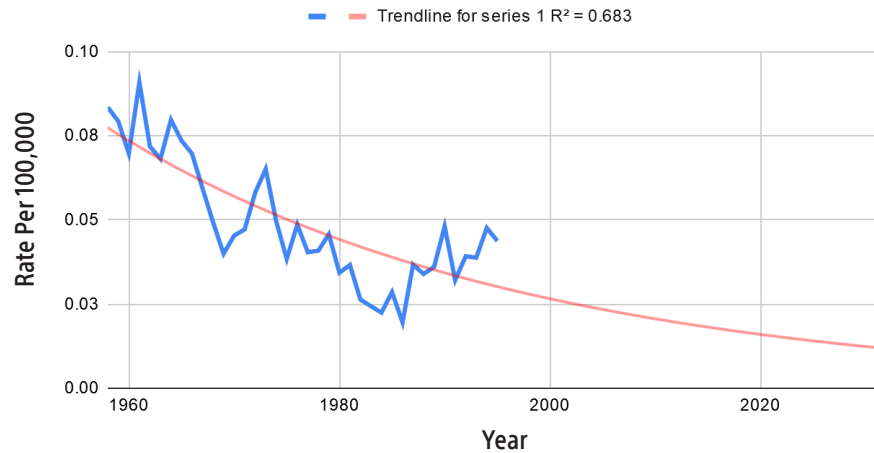
Reductions Caused By Improved Living Conditions Prior To Vaccines



Varicella (Chicken Pox) Disease Mortality with Trendline (Linear)¹⁻¹⁰



Varicella (Chicken Pox) Disease Mortality with Trendline (Exponential)¹⁻¹⁰



A linear regression for varicella mortality data 1958 – 1994 shows the rate of decline pre-vaccine, allowing an estimate using simple linear fit model that were the vaccine not licensed in 1995 the varicella mortality was already on track to approach zero by 2015.

Refer to “x-intercept” below

Best-fit values

Slope 0.001291 ± 0.0001738
 Y-intercept 2.601 ± 0.3436
 X-intercept 2015
 1/Slope -774.5

95% Confidence Intervals

Slope -0.001644 to -0.0009384
 Y-intercept 1.904 to 3.299
 X-intercept 2006 to 2030

Goodness of Fit

R square 0.6051
 Sy.x 0.01175

Is slope significantly non-zero?

F 55.16
 DFn,DFd 1,36
 P Value < 0.0001
 Deviation from horizontal? Significant

Data

Number of XY pairs 38
 Equation $Y = -0.001291 * X + 2.601$

SOURCES:

1. 1959 - 1968: Centers for Disease Control. Annual summary 1969: reported morbidity and mortality in the United States. Morbidity Mortality Weekly Rep 1970 ;18(54). <https://stacks.cdc.gov/view/cdc/1829> 2. 1969 - 1978: Centers for Disease Control. Annual summary 1971: reported morbidity and mortality in the United States. Morbidity Mortality Weekly Rep 1972 ;20(53). <https://stacks.cdc.gov/view/cdc/1577> 3. 1970 - 1979: Centers for Disease Control. Annual summary 1980: reported morbidity and mortality in the United States. Morbidity Mortality Weekly Rep 1981 ;29(54). <https://stacks.cdc.gov/view/cdc/1484> 4. 1980 - 1989: Centers for Disease Control. Summary of notifiable diseases, United States, 1991. Morbidity and Mortality Weekly Report 1991 ;40(53). <https://stacks.cdc.gov/view/cdc/36010> 5. 1989 - 1998: Centers for Disease Control and Prevention. Summary of notifiable diseases, United States, 2000. MMWR 2000;49(No. 53):[90]. <https://stacks.cdc.gov/view/cdc/5626> 6. 1996 - 2001: Centers for Disease Control and Prevention. Summary of notifiable diseases—United States, 2003. Published April 22, 2005, for MMWR 2003; 52(No. 54):[78]. <https://stacks.cdc.gov/view/cdc/5560> 7. 2002 - 2003: Centers for Disease Control and Prevention. [Summary of notifiable diseases, 2010]. MMWR 2007;56:[82]. <https://stacks.cdc.gov/view/cdc/21266> 8. 2004 - 2010: Centers for Disease Control and Prevention. [Summary of Notifiable Diseases, 2012]. Published September 19, 2014 for MMWR 2014;61(No. 53):[112]. <https://stacks.cdc.gov/view/cdc/25289> 9. 2008 - 2014: Adams DA, Thomas KR, Jajosky R, et al. Summary of Notifiable Infectious Diseases and Conditions — United States, 2014. MMWR Morb Mortal Wkly Rep 2016;63:1-152 DOI: <http://dx.doi.org/10.15585/mmwr.mm6354a1external> 10. Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. Appendix E, Vaccine Coverage Levels, United States, 1962-2016. Hamborsky J, Kroger A, Wolfe S, eds. 13th ed. Washington D.C.Public Health Foundation, 2018.

20TH CENTURY DISEASE MORTALITY

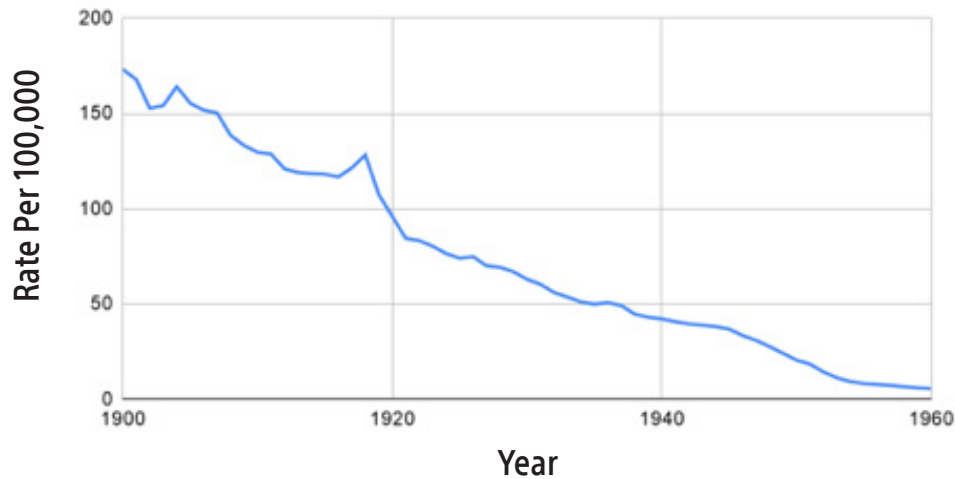
Reductions Caused By Improved Living Conditions Prior To Vaccines



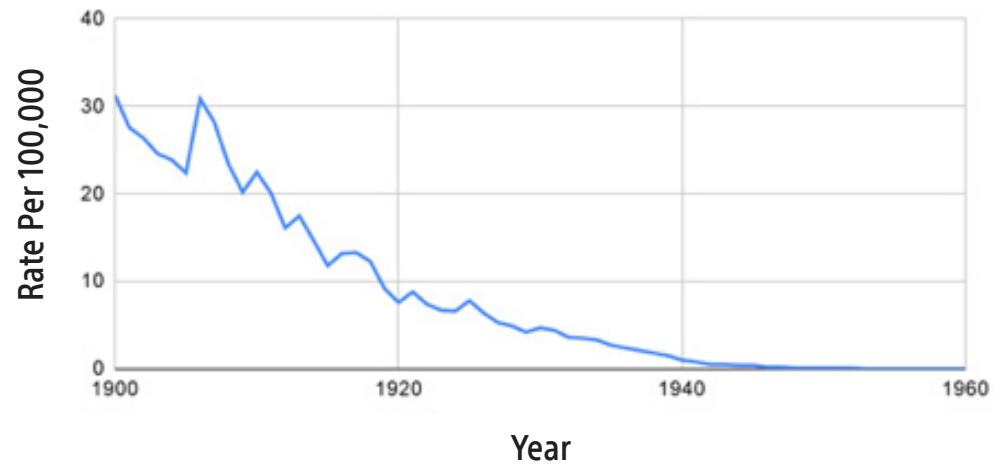
Disease Mortality, United States, 1900–1960¹

No Vaccine in General Usage

Tuberculosis (Respiratory)



Typhoid Fever



SOURCES:

1. Grove, R., D., Hetzel, A., M., (1968). Vital statistics rates in the United States, 1940-1960, pp 559 - 603, Washington, D.C.: U.S. Department of Health, Education, and Welfare, Public Health Service, National Center for Health Statistics, 1968.

20TH CENTURY DISEASE MORTALITY

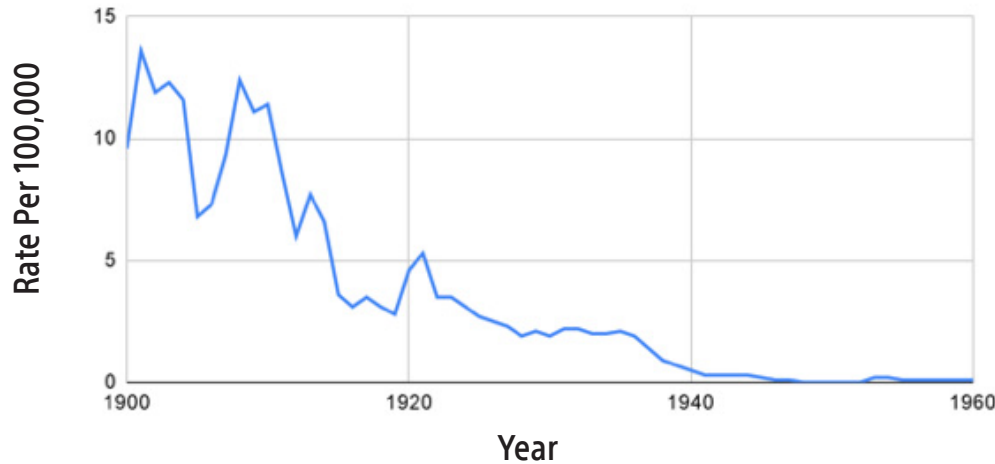
Reductions Caused By Improved Living Conditions Prior To Vaccines



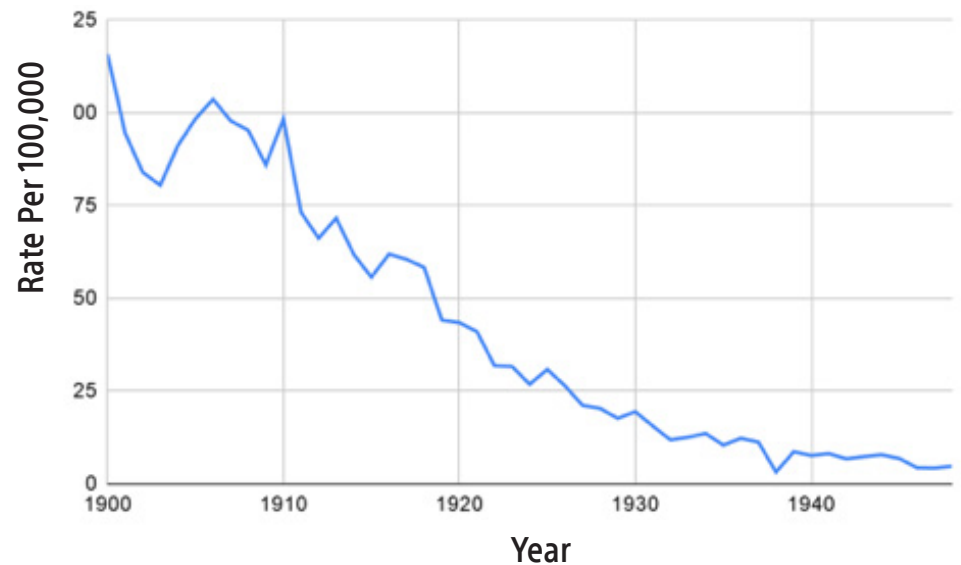
Disease Mortality, United States, 1900–1960¹

No Vaccine in General Usage

Scarlet Fever



Diarrhea and Enteritis (under 2 years)



SOURCES:

1. Grove, R., D., Hetzel, A., M., (1968). Vital statistics rates in the United States, 1940-1960, pp 559 - 603, Washington, D.C.: U.S. Department of Health, Education, and Welfare, Public Health Service, National Center for Health Statistics, 1968.

20TH CENTURY DISEASE MORTALITY

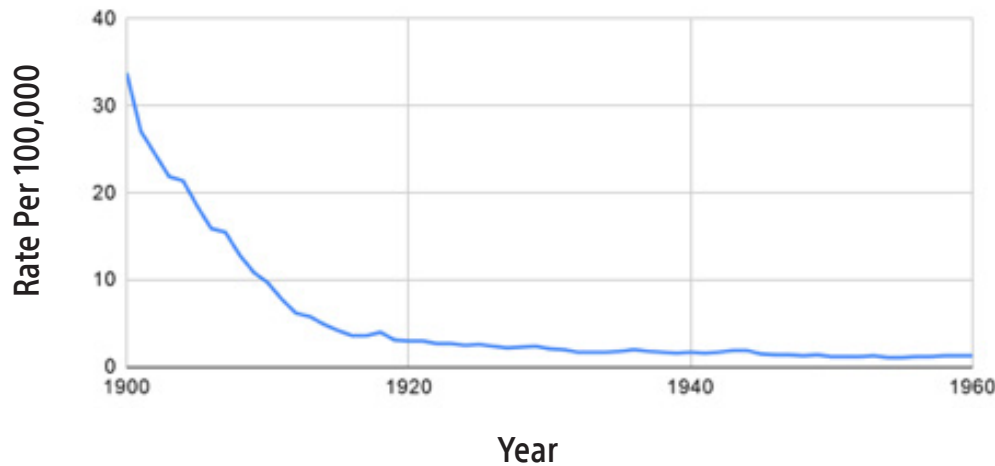
Reductions Caused By Improved Living Conditions Prior To Vaccines



Disease Mortality, United States, 1900–1960¹

No Vaccine in General Usage

Meningitis (Simple)



Dysentery Disease



SOURCES:

1. Grove, R., D., Hetzel, A., M., (1968). Vital statistics rates in the United States, 1940-1960, pp 559 - 603, Washington, D.C.: U.S. Department of Health, Education, and Welfare, Public Health Service, National Center for Health Statistics, 1968.

20TH CENTURY DISEASE MORTALITY

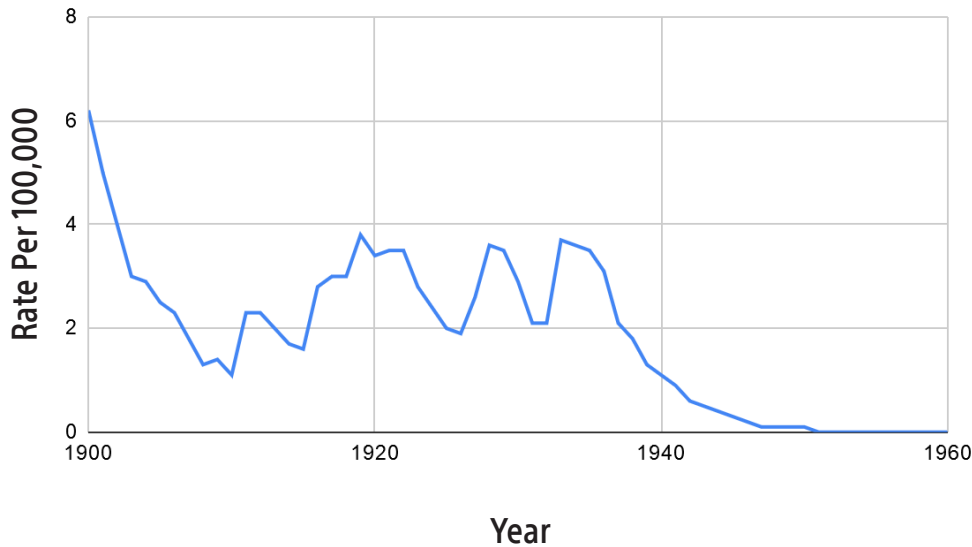
Reductions Caused By Improved Living Conditions Prior To Vaccines



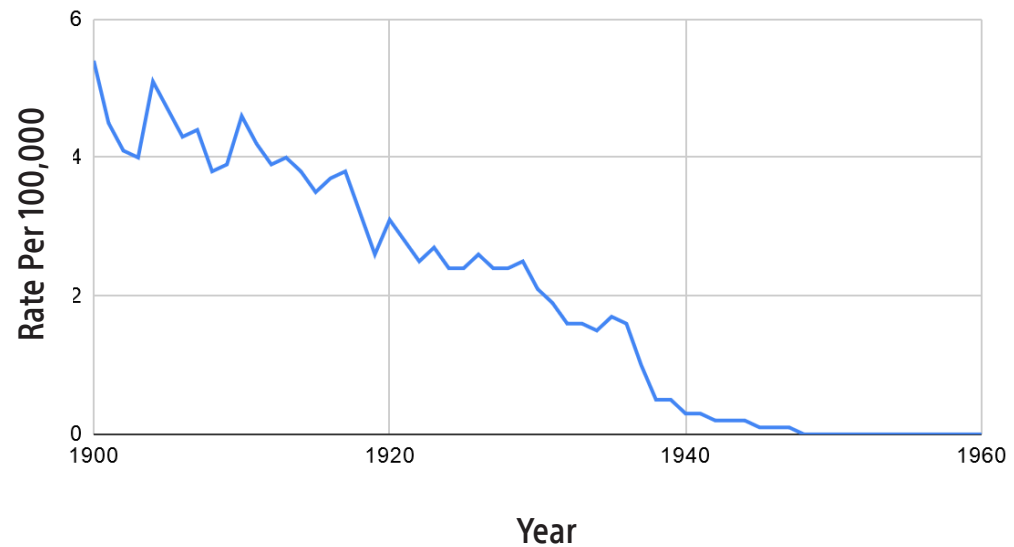
Disease Mortality, United States, 1900–1960¹

No Vaccine in General Usage

Malaria



Erysepilas



SOURCES:

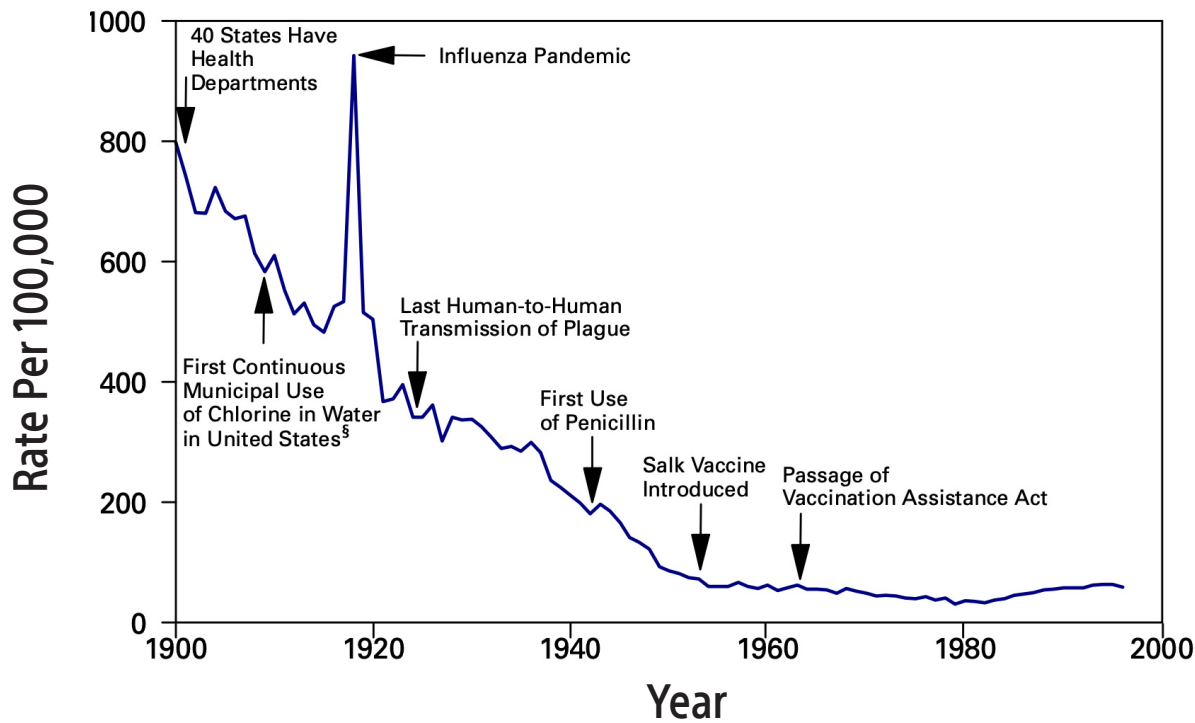
1. Grove, R., D., Hetzel, A., M., (1968). Vital statistics rates in the United States, 1940-1960, pp 559 - 603, Washington, D.C.: U.S. Department of Health, Education, and Welfare, Public Health Service, National Center for Health Statistics, 1968.

20TH CENTURY DISEASE MORTALITY

Reductions Caused By Improved Living Conditions Prior To Vaccines



Crude Death Rate* for Infectious Diseases United States, 1900-1996†



*Per 100,000 population per year.
 †Adapted from Armstrong GL, Conn LA, Pinner RW. Trends in infectious disease mortality in the United States during the 20th century. JAMA 1999;281:61-6.
 §American Water Works Association. Water chlorination principles and practices: AWWA manual M20. Denver, Colorado: American Water Works Association, 1973.

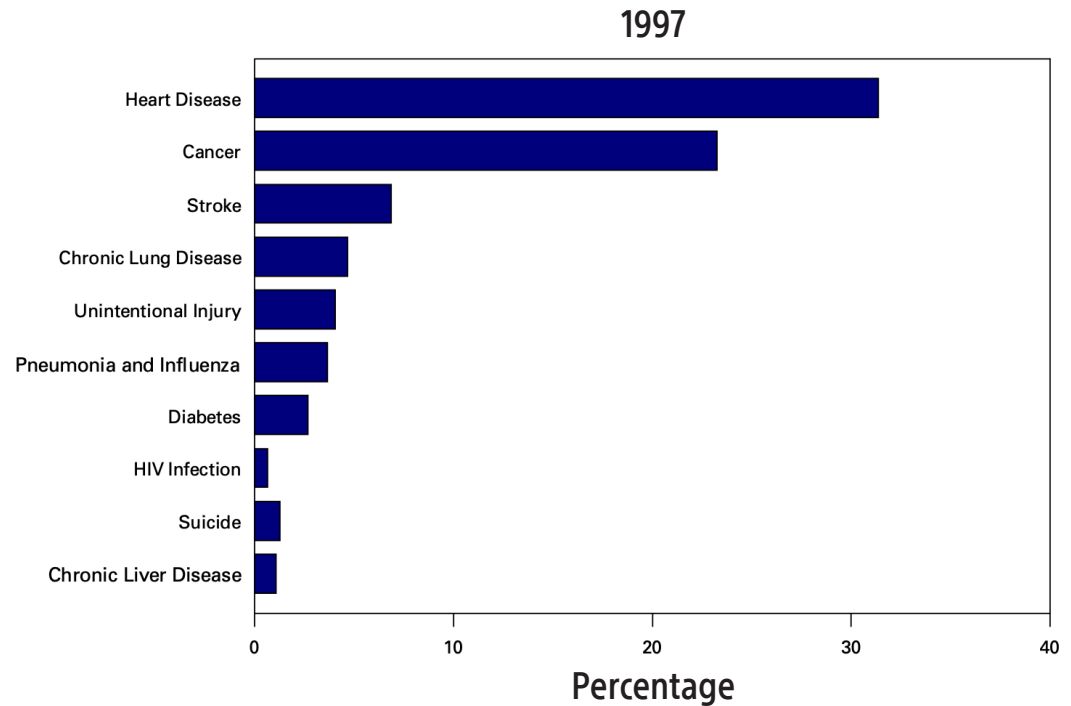
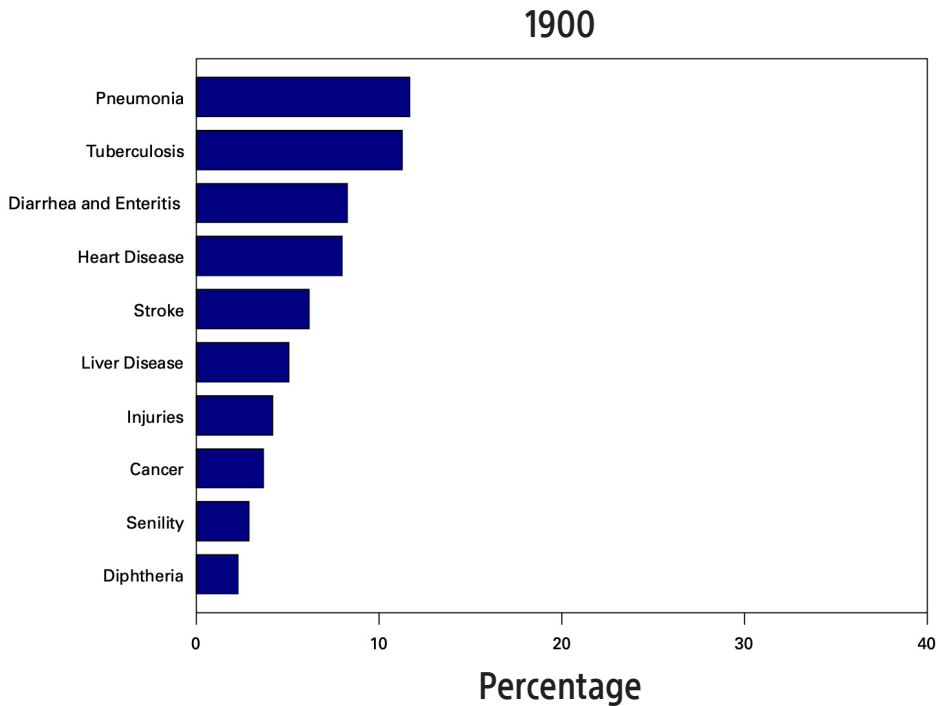
SOURCES:
 Centers for Disease Control (U.S.), & Centers for Disease Control and Prevention (U.S.). (1999). Morbidity and mortality weekly report: MMWR 1999; 48; 29:[621-629]. Atlanta, Ga.: U.S. Dept. of Health, Education, and Welfare, Public Health Service, Center for Disease Control. <https://www.cdc.gov/mmWR/PDF/wk/mm4829.pdf>

20TH CENTURY DISEASE MORTALITY

Reductions Caused By Improved Living Conditions Prior To Vaccines



The 10 leading causes of death as a percentage of all deaths United States, 1900¹ and 1997²



SOURCES:

1. Centers for Disease Control (U.S.), & Centers for Disease Control and Prevention (U.S.). (1999). Morbidity and mortality weekly report: MMWR 1999; 48; 29:[621-629]. Atlanta, Ga.: U.S. Dept. of Health, Education, and Welfare, Public Health Service, Center for Disease Control. <https://www.cdc.gov/mmWR/PDF/wk/mm4829.pdf> 2. Centers for Disease Control (U.S.), & Centers for Disease Control and Prevention (U.S.). (1999). Morbidity and mortality weekly report: MMWR 1999; 48; 29:[621-629]. Atlanta, Ga.: U.S. Dept. of Health, Education, and Welfare, Public Health Service, Center for Disease Control. <https://www.cdc.gov/mmWR/PDF/wk/mm4829.pdf>