Vaccine and non-Vaccine Measures for Prevention and Control of Typhoid Fever

Kampala, Uganda, April 5, 2017 Eric Mintz

National Center for Emerging and Zoonotic Infectious Diseases
Division of Foodborne, Waterborne, and Environmental Diseases

Typhoid Vaccine + non-Vaccine Toolkit

- Strong epidemiologic and laboratory surveillance
- Early and accurate diagnosis and appropriate treatment
- Education, information, and communication

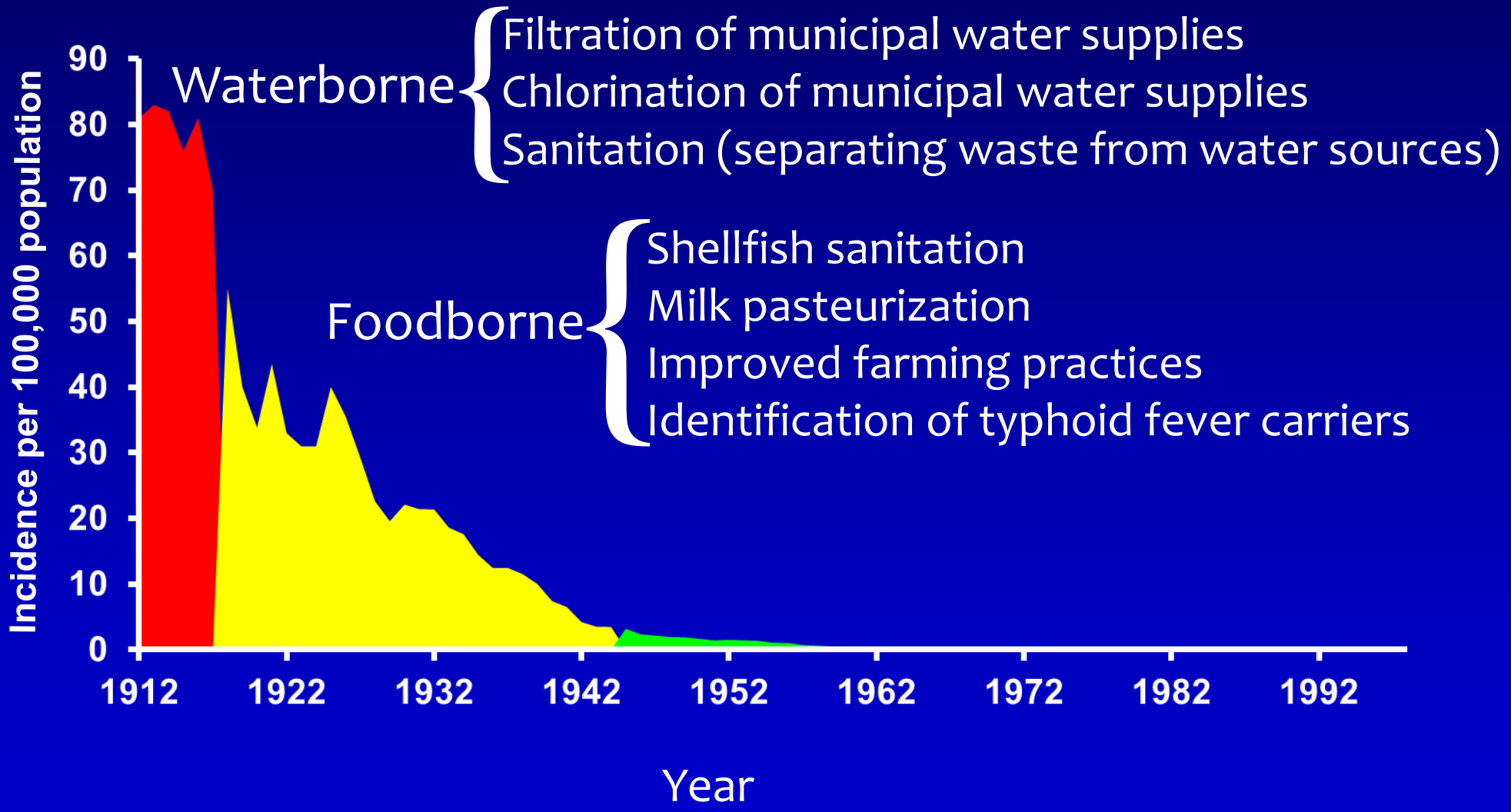
What are the non-vaccine measures?

- Prevention *(endemic, non-outbreak, humanitarian crisis)*
  - Safe sanitation and treatment of human feces
  - Safe water for drinking and for hygiene
  - Safe food production and handling
  - Treatment of chronic carriers?

- Control *(epidemic, outbreak, humanitarian crisis)*

  All of the above plus…
  - Investigations of risk factors +/- environmental micro
  - Contact tracing and interventions?

Typhoid fever: annual incidence United States, 1912-2000



What are the non-vaccine measures?

- Prevention *(endemic, non-outbreak, humanitarian crisis)*
  - Safe sanitation and treatment of human feces
  - Safe water for drinking and for hygiene
  - Safe food production and handling
  - Treatment of chronic carriers?

- Control *(epidemic, outbreak, humanitarian crisis)*

  All of the above plus…
  - Investigations of risk factors +/- environmental micro
  - Contact tracing and interventions?

Many different ways to provide safe drinking water

Development

- Long-term safest water supply
  - Piped treated water in homes
  - Centralized municipal systems

- Mid-term safer water supply
  - Protected borehole wells
  - Community standpipes
  - Bunkered water and water trucks

- Short-term water treatment
  - At the point of collection or use
  - Decentralized to household
  - Many different methods

Emergency

Innovation in Drinking Water Supply: Kibera, Kenya

Innovation in Sanitation: Solar

1. Provide in-home, dry, container-based toilets
2. Collect waste and treat it with solar energy

Feces are collected and then heat treated, using solar energy

Innovation in Sanitation: Reuse

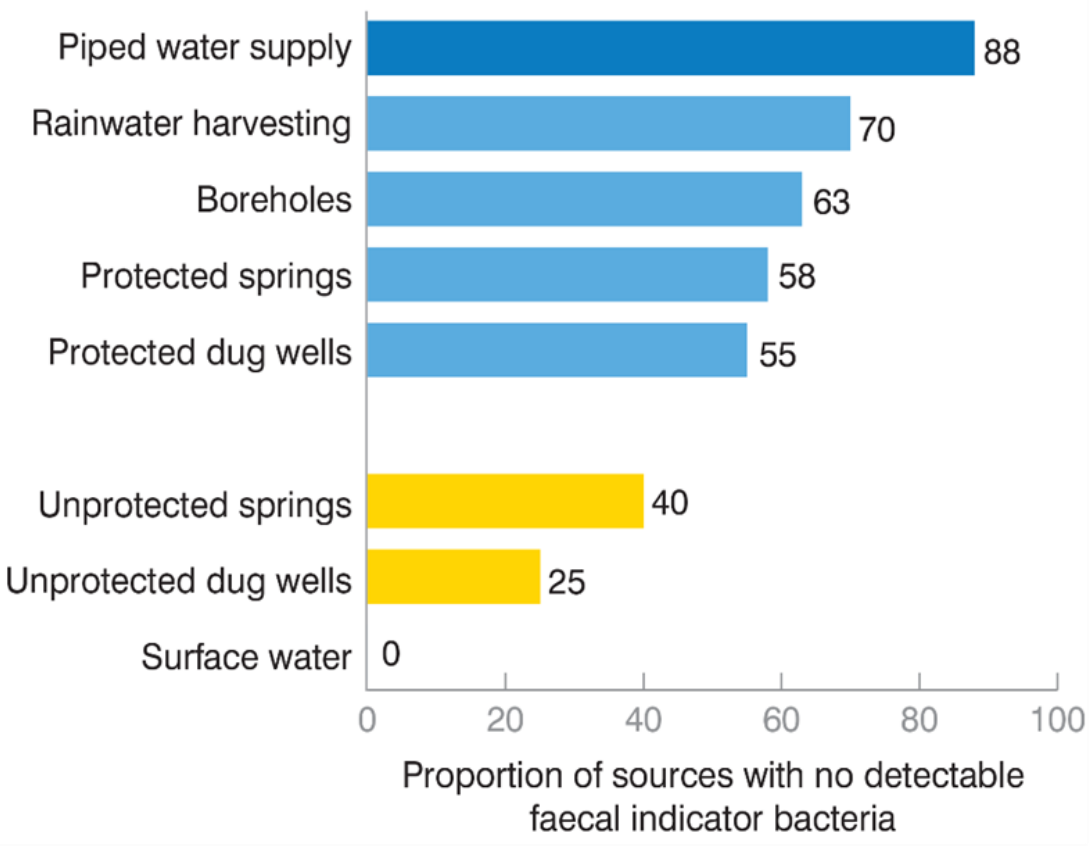
1. Provide in-home, dry, container-based toilets
2. Collect waste and treat it with solar energy
3. Make and sell briquettes from treated waste

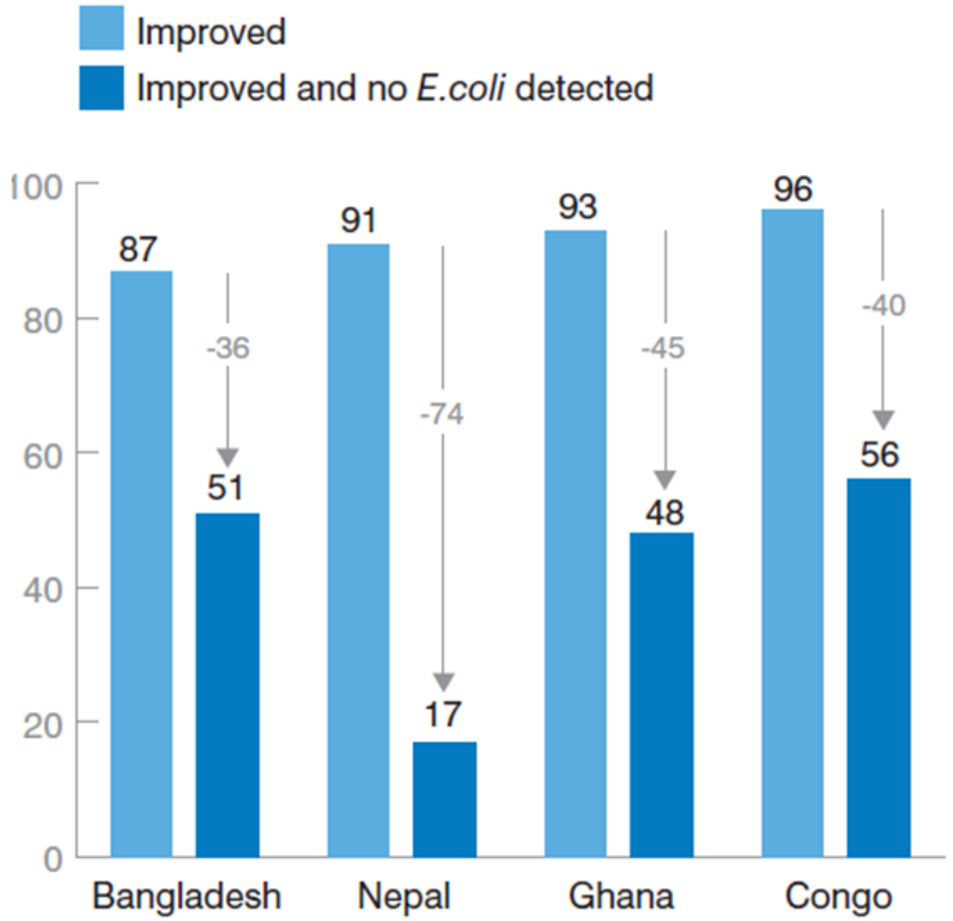
Briquettes drying and in-use

WASH Policy: Millennium Development Goals

- Millennium Development Goals (1990 - 2015)
  - Reduce by 50% the proportion of the population without access to an "improved water source"
  - Reduce by 50% the proportion of the population without access to "improved sanitation"

Improved sources not always safe





Target 6.1: Drinking water

*By 2030, achieve **universal** and **equitable** access to **safe** and **affordable** drinking water **for all***

6.1.1: Population using safely managed drinking water services

Definition: Pop. using an improved drinking water source which is:

1. located on premises, **Accessibility**
2. available when needed, and **Availability**
3. free of faecal and priority chemical contamination **Quality**
   (*E. coli*/thermotolerant coliforms, arsenic, fluoride)

Three new things

Drinking water

- On premises
- Available
- Quality

Sanitation

- Sewage treatment
- Faecal sludge management
- Safely disposed on site

Completely new

- Wastewater treatment
- Handwashing
- WASH in Institutions

Example scenarios for integration

- Endemic scenario
  - Institute routine vaccination along with
  - Long term improvements in WASH infrastructure
- Epidemic on endemic scenario
  - Mix of targeted routine vaccination and campaigns
  - Mix of infrastructure and emergency water treatment
- Epidemic scenario
  - Start point-of-use and point-of-collection water treatment
  - Ensure chlorination of municipal and community systems
  - Consider vaccination in combination with WASH products and education

Potential integration examples

- Endemic scenario
  - Host government and partners identify specific WASH infrastructure goals and timelines for each community targeted for vaccination
- Epidemic on endemic scenario
  - Ensure that all fixed vaccination points in targeted communities have optimal WASH infrastructure
  - Include other community institutions (health facilities, schools, markets) and chlorination of all community water systems
- Epidemic scenario
  - Offer safe water storage containers, chlorine tablets for water treatment, and/or soap with vaccination

Facing the Future

- Emerging multi-antimicrobial resistance
- Environmental (climate) and social stressors (conflict)
- Emerging pathogens (Paratyphi A, non-Typhi Salmonella)

Thank you

For more information please contact Centers for Disease Control and Prevention
1600 Clifton Road NE, Atlanta, GA 30333
Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

National Center for Emerging and Zoonotic Infectious Diseases
Division of Foodborne, Waterborne, and Environmental Diseases

Target 6.2: **Sanitation** and hygiene

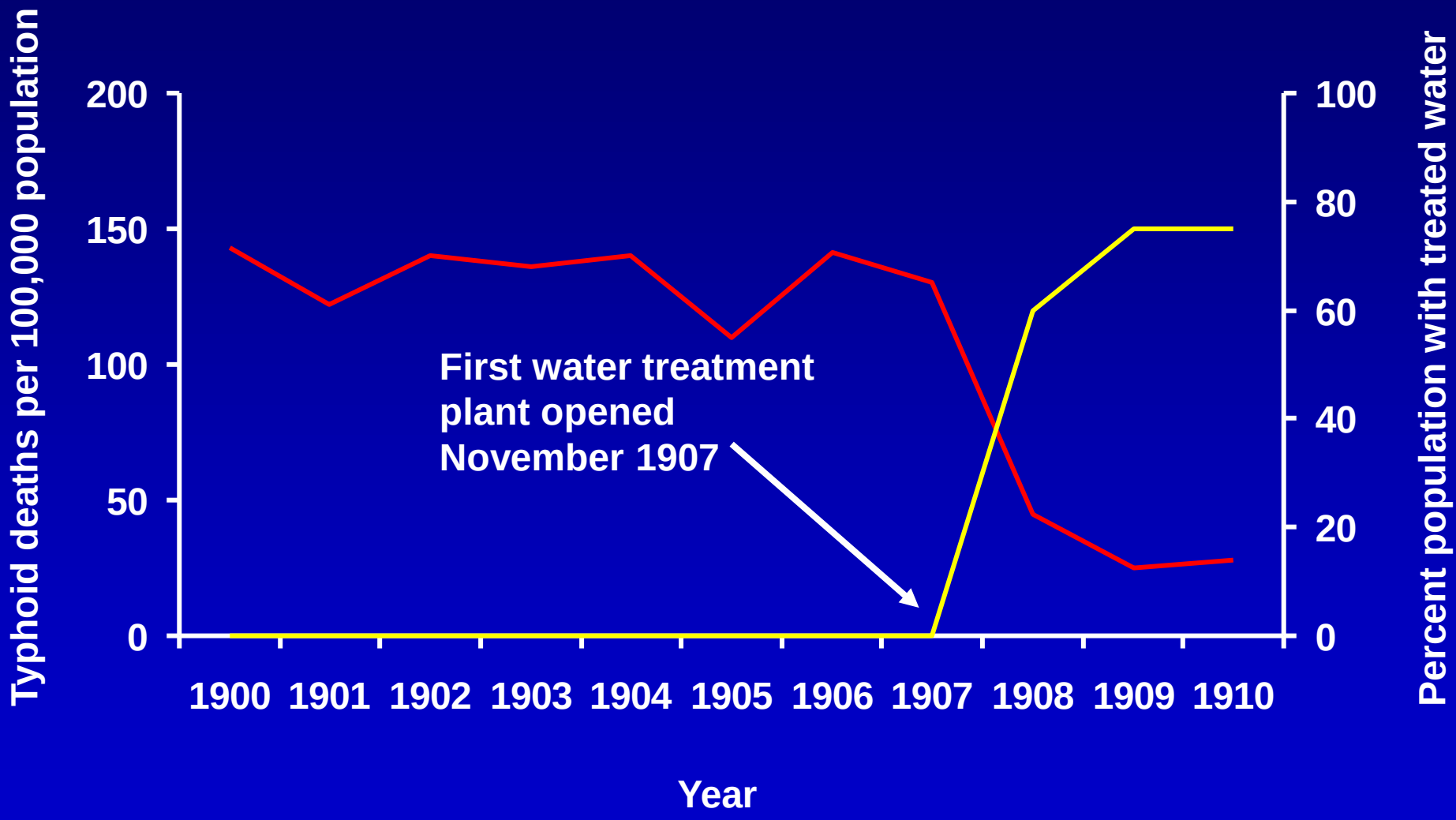
*By 2030, achieve access to **adequate** and **equitable sanitation** and hygiene for all, and **end open defecation**, paying special attention to the needs of **women and girls** and those in **vulnerable situations***

6.2.1: Population using safely managed sanitation services including a handwashing facility with soap and water

Definition: Pop. using an improved sanitation facility which is:

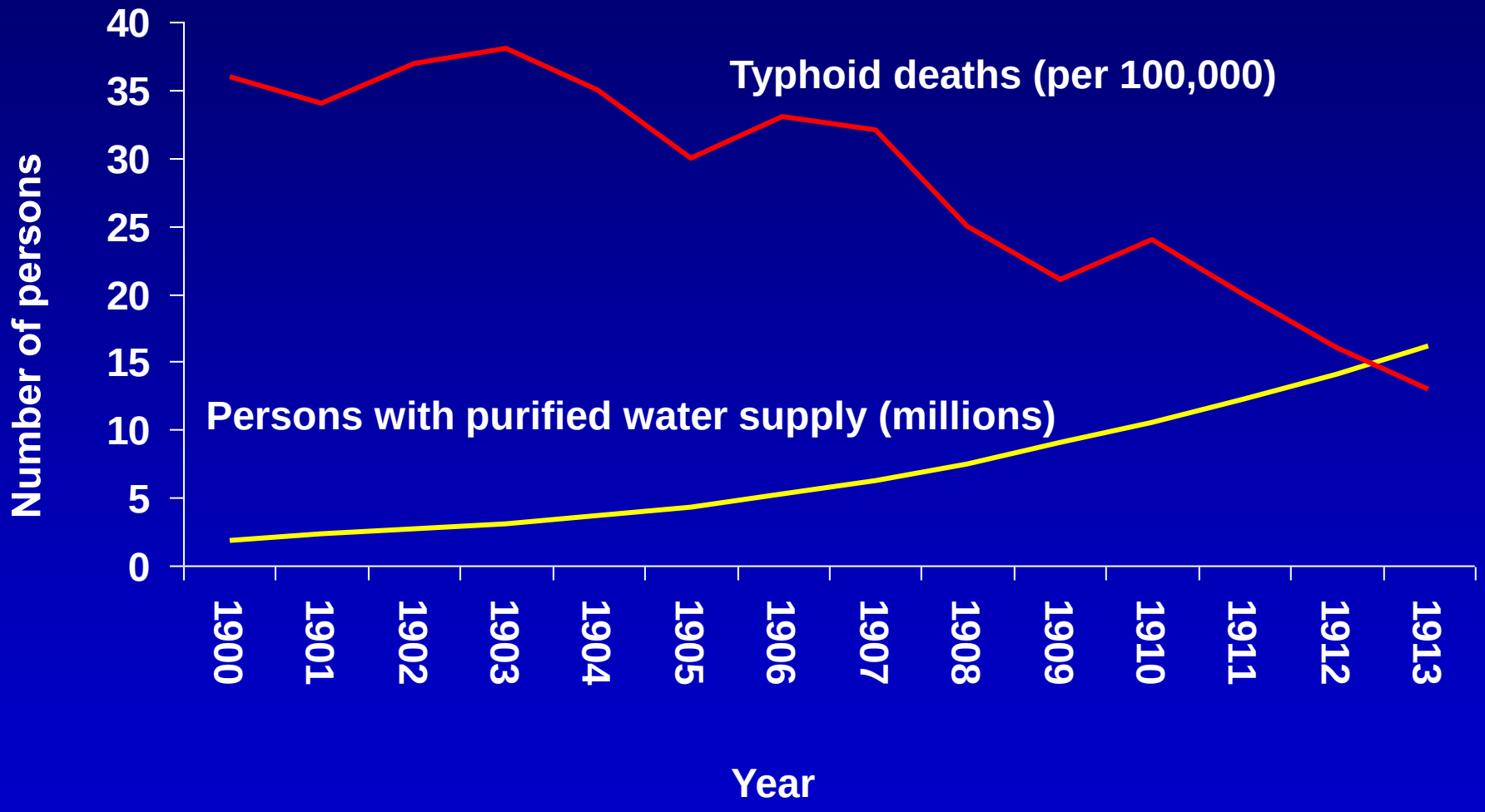
- not shared with other households and where **Accessibility**
- excreta are safely disposed in situ or **Quality**
- transported and treated off-site

Typhoid fever deaths, Pittsburgh PA, 1900-1910



Rosenau MJ. Preventive Medicine and Hygiene, 5th ed, 1927, p 111

Growth of water purification and decline in typhoid fever deaths, United States cities 1900-1913



Adapted from: Johnson GA. The typhoid toll. Journal of the American Water Works Association 1916; 3: 249-326

The Role of Public Health Improvements in Health Advances: The 20th-century United States

- Mortality rates fell by 40% from 1900 to 1940, an average decline of about 1% per year. Life expectancy at birth rose from 47 to 63.
- Nearly all the mortality decline is accounted for by reductions in infectious disease
- It also coincided with the disappearance of the "urban penalty"—the higher mortality rates observed in urban areas throughout the 19th century

Cutler D and Miller G. The Role of Public Health Improvements in Health Advances: The 20th century United States. Demography. 2005;42: 1-22.

Many point-of-use water treatment options

- Physical
  - Filtration
  - Flocculation
- Chemical disinfection
  - Chlorination
  - Nanoparticles
  - Metals
- Thermal disinfection
  - Pasteurization
  - Distillation
  - Solar heat
- Radiation
  - UV light