# From Intervention Informatics to Prevention Informatics:   Re-Imagining  Health Information Systems from Local to Global*

Sherrilynne Fuller,  PhD
Professor,  Biomedical & Health Informatics
School of Medicine and
Information School (Joint)
Adjunct Professor, Department of Health Services
School of Public Health
University of Washington

And

RADM Patrick O'Carroll, MD, MPH
Assistant Surgeon General, USPHS

Affiliate Professor,  Biomedical & Health Informatics
School of Medicine; and Departments of Epidemiology
and Health Services, School of Public Health, University of
Washington

# Most Effective Public Health Interventions of the 20th Century

Centers for Disease Control and Prevention

*Morbidity & Mortality Weekly Report 1999; 48(12):241-3 et al.*

# Most Effective Public Health Interventions of the 20<sup>th</sup> Century

1. Vaccination

   - >95% reduction in morbidity from smallpox, diphtheria, tetanus, polio, measles, mumps, rubella, H. influenza type B

*Jonas Salk giving polio vaccine*



*Per MMWR 1999; 48(12):241-3 et al.*

# Most Effective Public Health Interventions of the 20<sup>th</sup> Century

## 2.  Motor-vehicle safety

- >90% mortality reduction, 1925 to 2000 (18 vs. 1.7 deaths per 100 million vehicle miles traveled [VMT]), despite 10-fold increase in VMT.

*Per MMWR 1999; 48(12):241-3 et al.*

# Survived this car crash?



(WA State Patrol Photo)

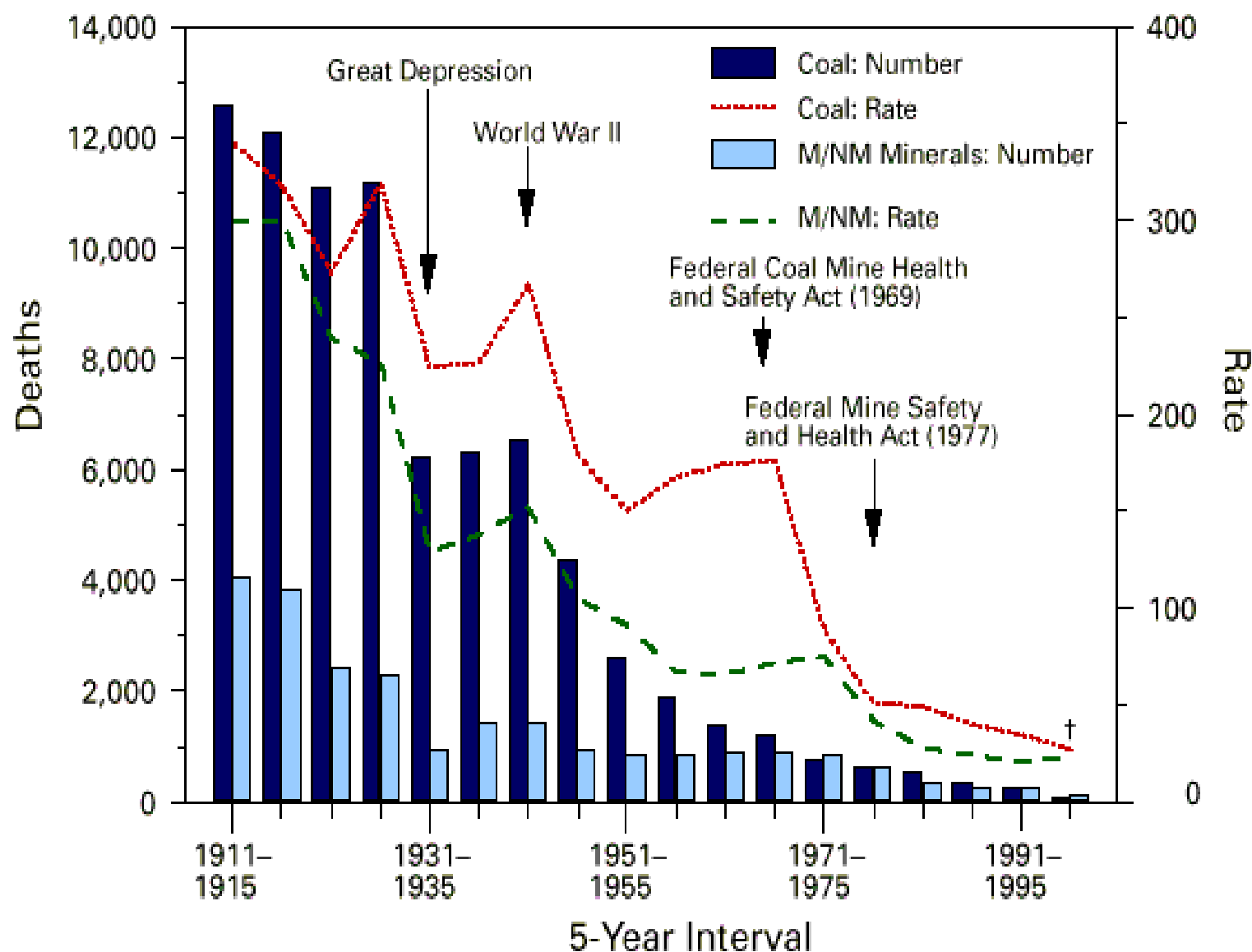# Most Effective Public Health Interventions of the 20ᵗʰ Century

3.  Safer workplaces
    - Unintentional work-related injuries declined 90%, from 37 per 100K workers in 1933 to 4 per 100K in 1997

*Per MMWR 1999; 48(12):241-3 et al.*

# FIGURE 4. Number of deaths and fatality rates* in mining coal and metal/nonmetallic (M/NM) minerals, by 5-year interval — United States, 1911–1997



Legend:
- Coal: Number
- Coal: Rate
- M/NM Minerals: Number
- M/NM: Rate

Annotations: Great Depression; World War II; Federal Coal Mine Health and Safety Act (1969); Federal Mine Safety and Health Act (1977)

X-axis: 5-Year Interval (1911–1915 ... 1931–1935 ... 1951–1955 ... 1971–1975 ... 1991–1995)

Y-axis (left): Deaths (0–14,000)
Y-axis (right): Rate (0–400)

*Per 100,000 workers.
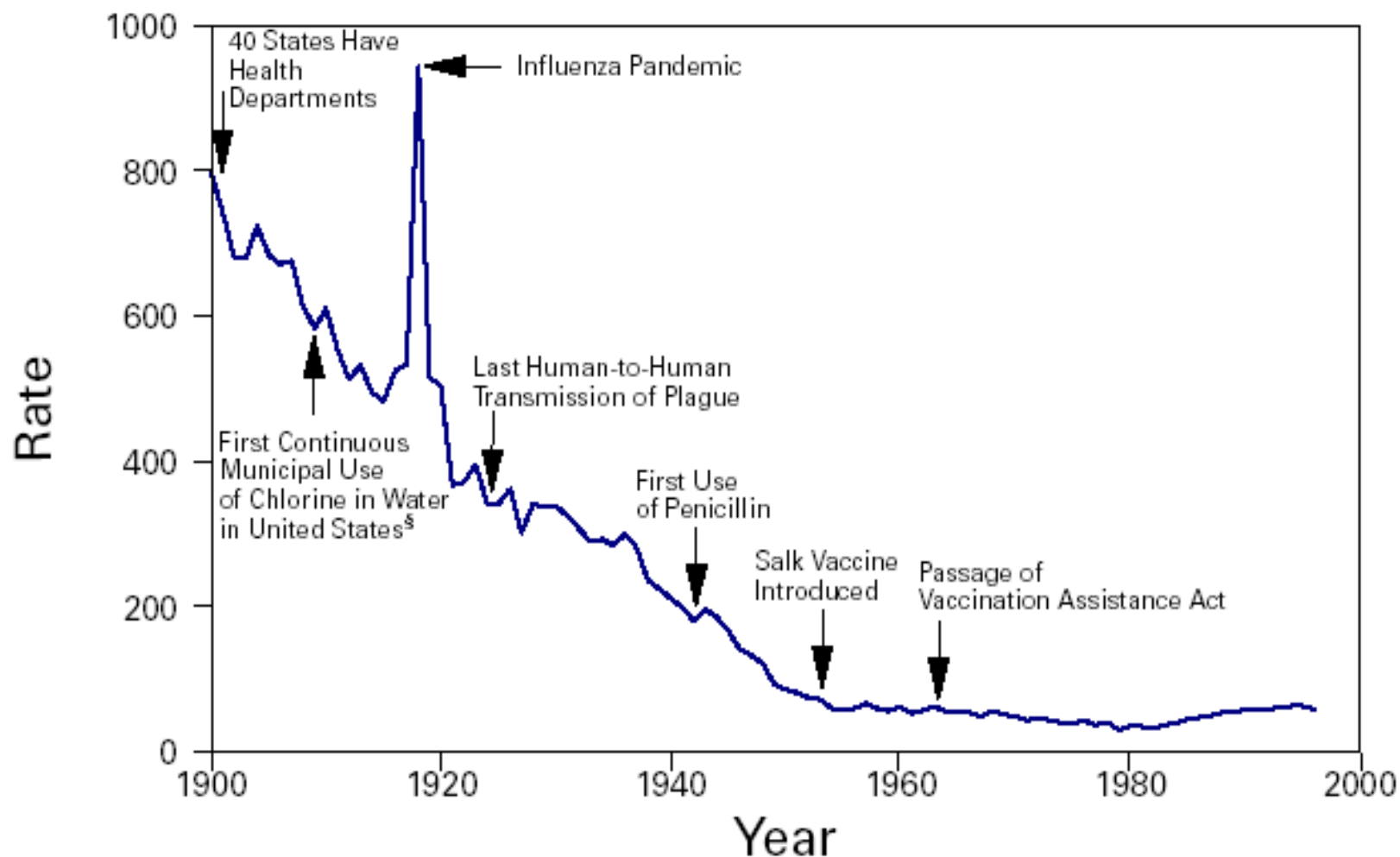†Data are for 1996 and 1997.

# Most Effective Public Health Interventions of the 20ᵗʰ Century

4.  Control of infectious diseases

   • Huge decreases in infant mortality => increases in life expectancy, via clean water, sanitation, hygiene, vaccination, antibiotics (esp. in TB and STD control)

# FIGURE 1. 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.

# Most Effective Public Health Interventions of the 20th Century
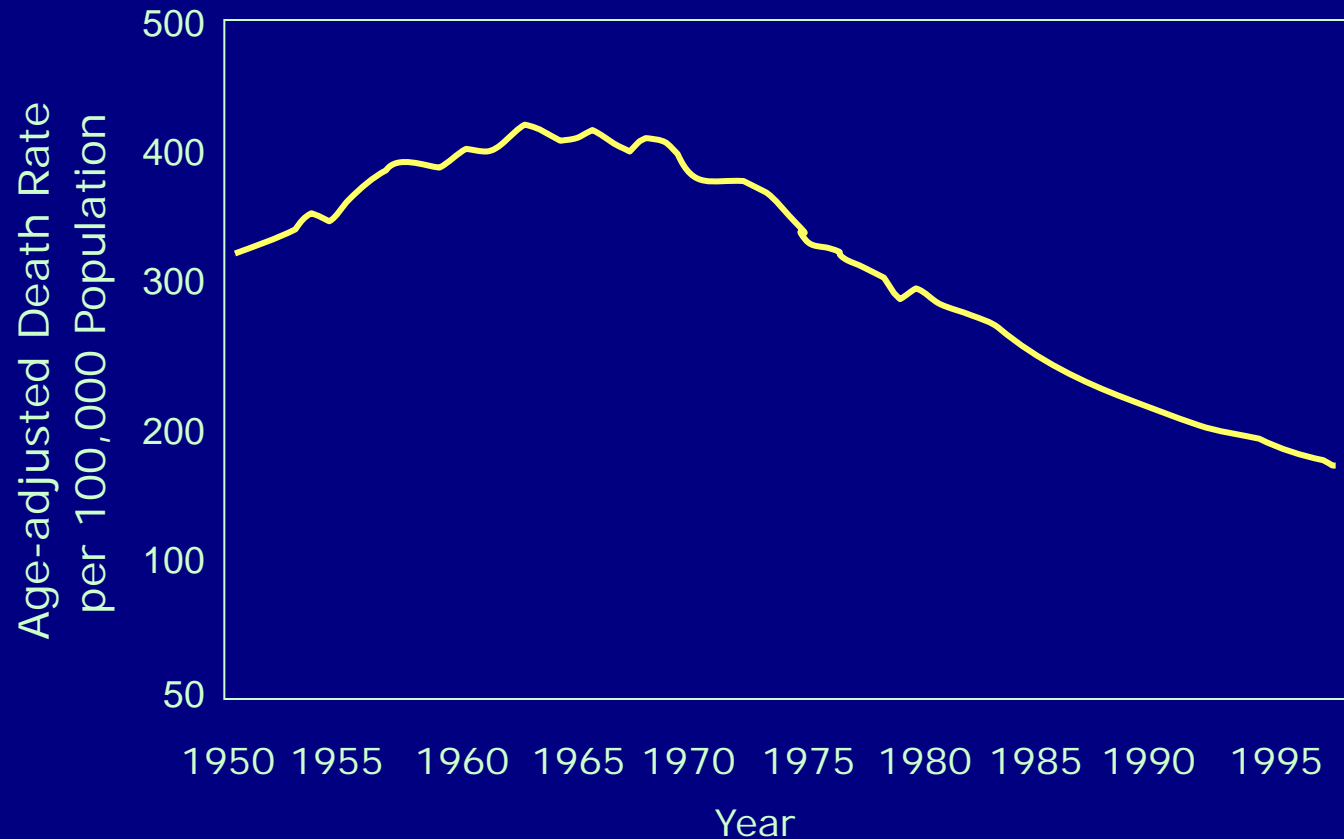
## 5. Decline in heart disease/stroke mortality

- 60% reduction in age-adjusted CVD mortality since 1950, via risk factor identification and modification (hypertension, elevated blood cholesterol, smoking)

# Death Rates for CHD 1950–1998

CHD accounted for 460,000 deaths in 1998.

# Most Effective Public Health Interventions of the 20th Century

## 6. Safer and healthier foods

- decreases in microbial contamination, increases in nutritional content; micronutrient identification and food fortification has almost eliminated rickets, goiter, and pellagra in the US

## 7. Healthier mothers and babies

- Since 1900, infant mortality has decreased 90%, and maternal mortality has decreased 99% (via hygiene, nutrition, improved access to healthcare, antibiotics, technological advances)

# Most Effective Public Health Interventions of the 20th Century

## 8.  Family planning

- Fertility decreased, the age at marriage increased => child mortality ↓, health of infants, children, and women ↑, and ↑ social/ economic role of women

## 9.  Fluoridation of drinking water

- Begun in 1945 => safe, inexpensive reductions in tooth decay (40%-70% in children) and of tooth loss in adults (40%-60%)

## 10.  Reduction of tobacco use

- Millions of smoking-related deaths prevented since first (1964) Surgeon General's Report

# Role of Medical Care in 20<sup>th</sup> Century Public Health Achievements

| *Public Health Achievement* | *Due to Medical Care?* |
|---|---|
| Vaccination | Indirect |
| Motor-vehicle safety | No |
| Safer workplaces | No |
| Control of infectious diseases | +/- |
| ⬇ Coronary heart disease/stroke deaths | +/- |
| Safer and healthier foods | No |
| Healthier mothers and babies | +/- |
| Family planning | No |
| Safer  drinking water | No |
| Recognition of tobacco as health hazard | No |

# Basic Principles of Public Health

- **Primary focus**: health of *populations*
  - Does not exclude individual-level intervention

- **Primary strategy**: Prevention

- **Primary context**: Often, Governmental

- **Primary discipline**: *Whatever works!*

  - Interventions targeted at any and all vulnerable points in causal chain

  - E.g., housing/building codes, solid waste & wastewater systems, food supplementation, fluoridation, smoke alarms, road and auto engineering, municipal design

# Healthcare Costs Versus Results

- **How the United States compares with other O.E.C.D. (Organization for Economic Cooperation and Development) members**

- A country's wealth usually dictates how much money it spends on health care, but spending in the United States is far beyond that of its peer countries.

- **Health care spending as a percentage of gross domestic product (2007)**
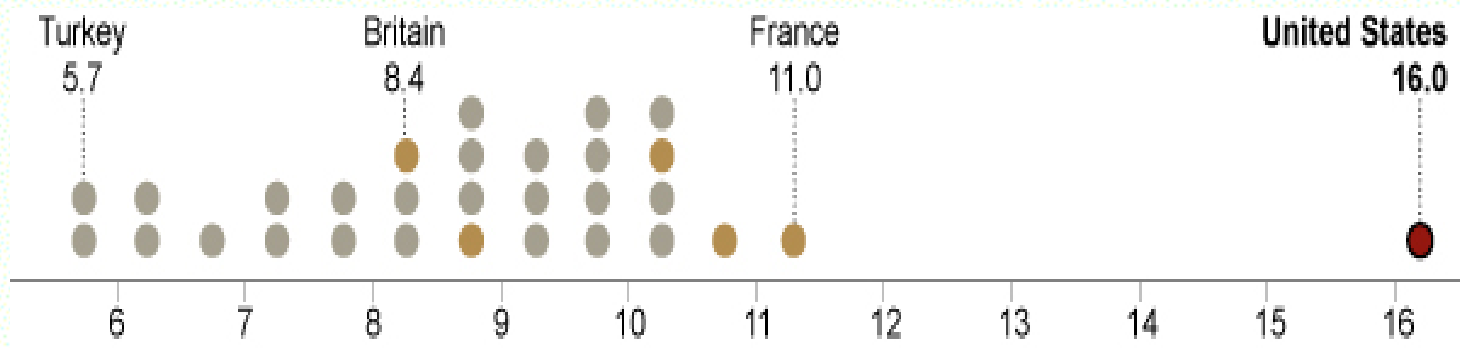


New York Times – June 5, 2010
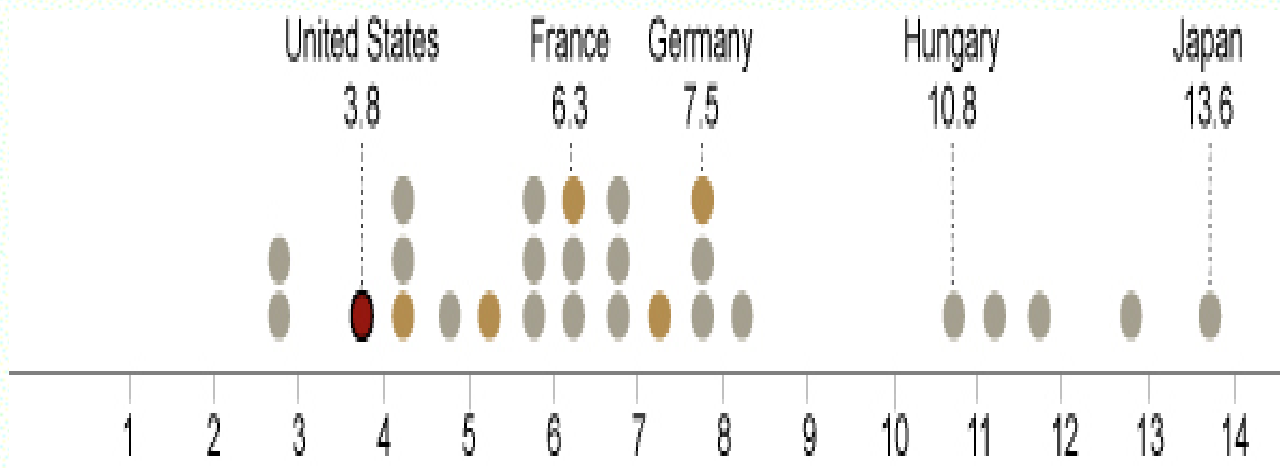
# Life Expectancy at Birth
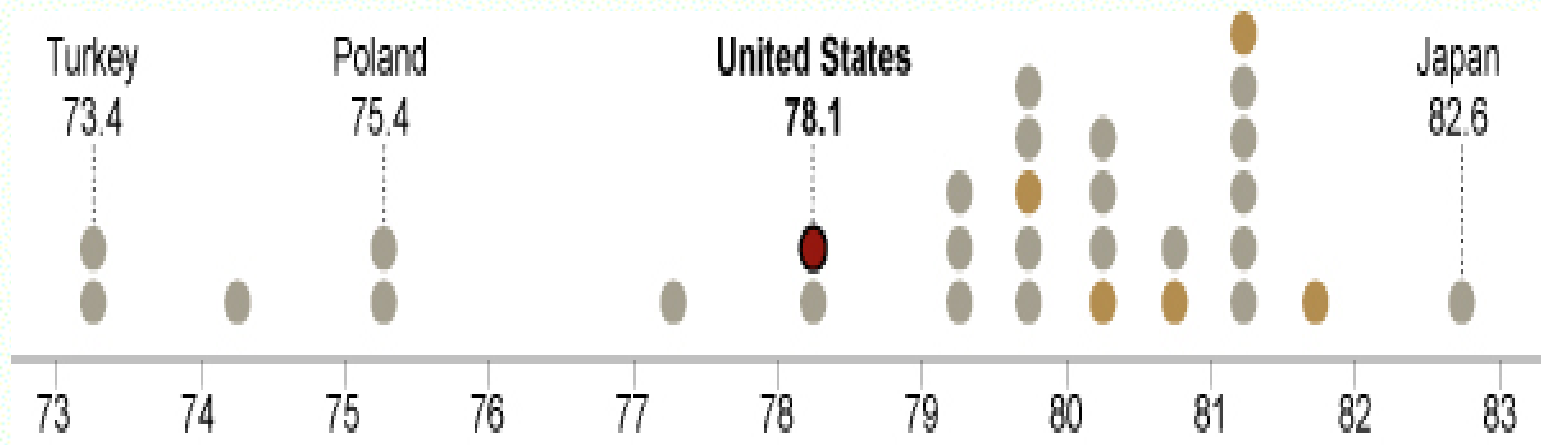


New York Times – June 5, 2010

# Prevention Consultations

United States lags in basic preventive care, like annual checkups, and relies heavily on expensive specialists rather than primary care practitioners

Number of primary care visits/yearY



New York Times – June 5, 2010

# Definitions

Intervention Informatics:

- Focus:
  - Individual
  - Patient with injury, disease, abnormal condition
  - Track:  actions, procedures, diagnoses, therapies
  - Reactive – after the health problem occurs
- Lacks Context:
  - Community (rural, urban, agricultural, inner city)
  - Family members/relationships
  - Individual (home, travel, hobbies, etc. .)

# Definitions

Prevention Informatics:

Focus:

- Individual in context: family, community, country, the world
- Health & well-being of individual & populations
- Safe environment
  - Hospital (preventing medical errors)
  - Home (water & sanitation)
  - Work (preventing injuries)
  - Roads and travel conveyances
- Proactive
- Highly data-intensive and data-driven

# Classification Systems: Building Blocks for Information Systems

What do these have in common?

• seventeenth-century mortality table whose causes of death include "fainted in a bath," "frighted," and "itch");

• the assignment of subject headings to books in a library;

• and the separation of machine-washable clothes from hand-washables have in common??

All, of course,  are examples of classification – upon which information systems of all types are built.

# William Farr (1837)

"The advantages of a uniform statistical nomenclature, however imperfect, are so obvious, that it is surprising no attention has been paid to its enforcement in Bills of Mortality. Each disease has, in many instances, been denoted by <u>three or four terms</u>, and each term has been applied to as many different diseases: <u>vague, inconvenient names have been employed</u>, or <u>complications have been registered instead of primary diseases</u>…

The nomenclature is of as much importance in this department of inquiry as weights and measures in the physical sciences, and should be settled without delay."

Sources:
http://www.who.int/classifications/icd/en/HistoryOfICD.pdf

# International Classification of Diseases

- Inconsistency
- Lack of concept permanence
- Disregard for context
- Language translation
- Slow adaptation to new/emerging disease terminology

Cimino JJ. Desiderata for controlled medical vocabularies in the
twenty-first century. Methods Inf Med. 1998 Nov;37(4-5):394-403

# Clinical ⟷ Public Health Information Interchange –

- Need for a prevention classification system?

- PH clinical data  (e.g. immunization, disease status, relevant community-based information – e.g. lives near toxic landfill)  in context in the EMR – a "prevention tab"?

- Clinical information to community-based chronic and infectious disease interventions : what is the minimum data set for prevention?

- Reminders driven by prevention algorithms (e.g. if cancer patient over 65 administer shingles vaccine before chemotherapy)

- Utilization of community health information for decision support for individual patients (as component of the patient record)?

# Volunteered Geographic Information for Disaster Relief:  Harnessing the Wisdom and Power of the Public

## A Case Study of the Haitian Earthquake*

- Lack of detailed maps for emergency response led to the use of crowd-sourced contributions to build critical maps

# Case study:
# Google gadget for influenza surveillance
# "Where is the flu?"

Ta-Chien Chan, Peggy Lee, Chwan-Chuen King

Institute of Epidemiology, National Taiwan University

**PRINCE MAHIDOL AWARD CONFERENCE 2010**

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Chan TC et al.

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# Aims of the project

- An informal surveillance system
    - utilizing bi-directional communication between researchers, public health workers, and the publics.
- The target population →Citizens
    - Added values: latest flu news and health education (risk communication)
    - Reported flu cases in their surrounding environment
- Easy to assess and manage
- Free software

# Some Final Thoughts

- Re-think the EMR to include prevention as explicit, actionable component (s)

- Reduce barriers to timely data exchange of critical information between clinical and public health information systems to enhance prevention at the individual and the community level

- Citizen generated information offers new means to respond to health challenges, disasters

- With the availability of instant communications need to recognize and prepare for and prevent unexpected and unhelpful "crowd" reactions to threats

# Resources

1. O'Carroll, P et al.  <u>Public Health Informatics and Information Systems.</u>   Springer 2003.

2. Fuller, S. (2010). "Tracking the Global Express: new tools addressing disease threats across the world." <u>Epidemiology. 21(6): 769-771.</u>

3. Brownstein JS, Freifield CC, Madoff LC. (2009) Digital disease detection—harnessing the web for public health surveillance. *N Engl J Med.*;360:2153–21576.

4. Zook M, Graham M, Shelton T, et al. *(2010)* Volunteered geographic information and crowdsourcing disaster relief: a case study of the Haitian earthquake. *World Med Health Policy. 2:2.* Available at: **http://www.psocommons.org/wmhp/vol2/iss2/art2**

5.  Fuller S. (2011) From Intervention to Prevention Informatics. <u>Bulletin of the American Society for Information Science</u> 38 (1): 36-41.