



The Role of **Chronic Disease Surveillance** and Epidemiology in **Public Health Decision Making**

**The Case of Type 2 Diabetes**

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*The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the CDC.*

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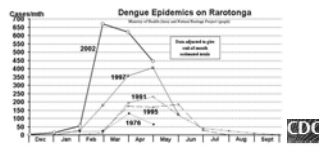
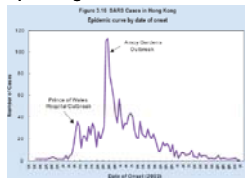
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**Traditional Surveillance Activities**

- Surveillance and mandatory reporting.
- Environmental change.
- Regulation
- Clinical care and monitoring.
- Outbreak investigation
- Case management and contact tracing.
- Health Education




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Table 3. Major surveillance methods

Surveillance methods	Comments
Mandatory disease notification by health-care providers or facilities	<ul style="list-style-type: none"> <li>• Requires immediate public health response or</li> <li>• Recognizable solely by providers</li> </ul>
Reports by laboratories (reporting source)	<ul style="list-style-type: none"> <li>• Immediate public health response may or may not be needed</li> <li>• Laboratory test needed for recognition or to meet case definition</li> <li>• Laboratory test adds relevant information (such as salmonella serotypes, antibiotic susceptibilities for TB and pneumococci, cell type for cancer)</li> <li>• Back-up to clinician's reporting</li> </ul>
Sentinel surveillance	<ul style="list-style-type: none"> <li>• Useful for collecting detailed information on a subset of cases</li> <li>• Designed so findings can be generalized to a specified population</li> <li>• Collect limited information to recognize the onset, termination and characteristics of a particular public health problem of limited duration (such as influenza)</li> <li>• Used when incidence of a condition is high (such as diarrheal diseases, acute respiratory infection [ARI])</li> </ul>
Periodic or ongoing prevalence surveys	<ul style="list-style-type: none"> <li>• To assess prevalence trends over time (such as HIV seroprevalence surveys, BRF surveys)</li> <li>• Optimal if designed to be useful to state and local public health agencies</li> <li>• Generate hypotheses regarding risk factors</li> <li>• Evaluate the effectiveness of a public health or clinical intervention</li> </ul>
Vital records	<ul style="list-style-type: none"> <li>• Surveillance of births and deaths, trends in causes of death</li> <li>• Key for infant and maternal mortality surveillance</li> <li>• May be used alone for some analyses</li> </ul>
Secondary analysis of datasets collected for other purposes	<ul style="list-style-type: none"> <li>• Places no additional burden on public health surveillance systems</li> <li>• Care must be taken in analysis and interpretation</li> <li>• Immediate public health response are not needed</li> <li>• Assess the public health impact or monitor trends</li> <li>• Measure morbidity costs due to chronic or recurrent health events</li> <li>• Potential data sources include hospital discharges, billing, insurance, emergency room, school/work attendance, immunization registries, work-site injury and law enforcement records</li> </ul>

\*These diseases vary from country to country, and even from state to state. Source: Adapted from WHO 1999.

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**Main Objectives of *Chronic Disease Surveillance Systems*:**

- **Monitor:**
  - Detect new health problems.
  - Assess and track magnitude of diabetes and risk factors and status of care of the population.
- **Prioritize:**
  - Identify / prioritize key problems and groups for intervention.
  - Set national objectives for management and prevention.
  - Identify research needs.
  - Plan, facilitate and justify rational use of available resources.
- **Evaluate:**
  - Evaluate and track the public health response to the problem.
  - Examine progress on national health objectives
    - (including Healthy People, GPRA, GAO, etc.)



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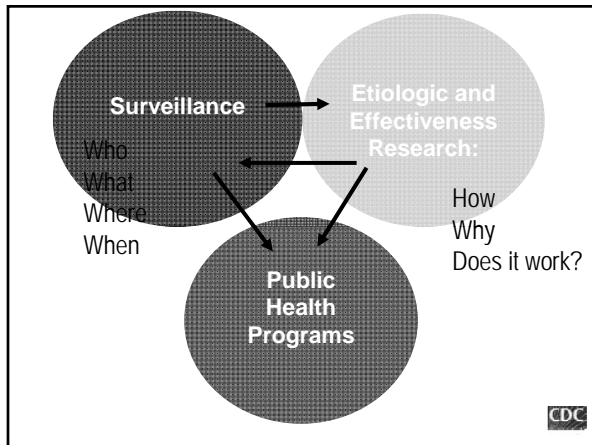
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**Measurement Issues**



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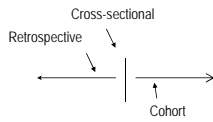
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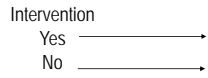
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### Common Study Designs Used in Epidemiologic Research

- **Observational Studies**
  - Cross-sectional
  - Retrospective (case control)
  - Prospective (cohort studies)
  - Ecologic Studies



- **Intervention Studies**
  - Quasi-experimental studies
  - Controlled intervention studies
    - Clinical
    - Health Service
    - Community
  - Cost-effectiveness studies




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### Main Categories of Surveillance Indicators Used In U.S. System

- **Measures of Disease Burden**
  - Clear impact on quality of life, health status, or economics
  - Examples: (prevalence, incidence, complications).
- **Modifiable Risk Factors for Diabetes**
  - Based on controlled trials or consistent cohort studies.
  - Examples: (HbA1c levels, physical activity levels)
- **Effective Interventions**
  - Based on controlled trials, meta-analyses, strong clinical consensus.
  - Examples (HbA1c test, structured lifestyle programs)




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### Key Attributes of Surveillance Indicators

- Predictive value positive –  $Pr: D | T$
- Sensitivity –  $Pr: T | D$
- Predictability – high magnitude of association with outcomes.
- Simplicity – to facilitate sustainability and internal consistency.
- Flexibility – Capacity to adapt to without great resources.
- Acceptability – Willingness of workers/health institutions to support the functioning of the system.
- Representative – of the population of interest.




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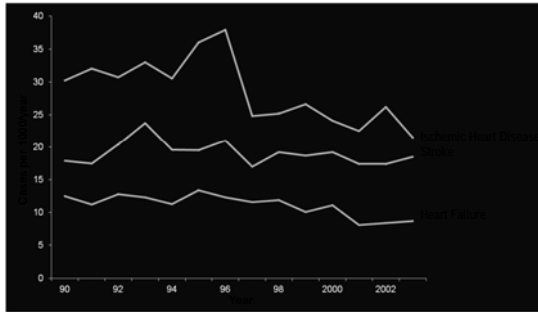
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**Trends in the Incidence of Complications among Persons with Diabetes in the U.S., 1990 – 2003**



www.cdc.gov/diabetes




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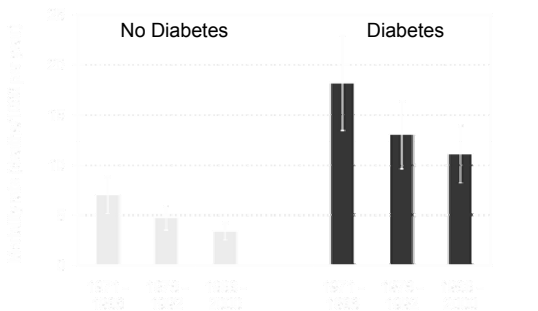
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**Trends in CVD Mortality Rates among the U.S. Population with and without Diabetes**



Gregg et al., Ann Intern Med, 2007




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**Key Sources of Bias in Surveillance Systems**

- Selection bias
  - Non-representative sentinel populations
  - Non-representative survey samples
- Information bias
  - Incomplete reporting (passive vs active surveillance)
  - Differences/changes in case definition




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### Common Metrics in Surveillance

- Prevalence
- Incidence
- Distributions
- Measures of Central Tendency




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### Cause-of-Death Section of the Standard Death Certificate

<b>27. PART I. Enter the immediate cause, or injuries, or complications that caused the death. Do not enter the mode of dying, such as cardiac or respiratory arrest, shock, or heart failure. List only one cause on each line.</b>		<b>Approximate Interval Between Onset and Death</b>
<b>IMMEDIATE CAUSE (final disease or condition resulting in death)</b>	a. Rupture of myocardium b. Acute myocardial infarction c. Coronary artery thrombosis d. Atherosclerotic coronary heart disease	Minutes 6 days 5 years 7 years
<b>28. PART II. Other significant conditions contributing to death but not resulting in the underlying cause given in Part I.</b> Diabetes, chronic obstructive pulmonary disease, smoking		<b>29. WAS AN AUTOPSY PERFORMED?</b> (Yes or no) <b>30. WERE AUTOPSY FINDINGS AVAILABLE PRIOR TO COMPLETION OF CAUSE OF DEATH?</b> (Yes or no)
<b>29. MANNER OF DEATH</b> <input type="checkbox"/> Natural <input type="checkbox"/> Pending <input type="checkbox"/> Accident <input type="checkbox"/> Investigation <input type="checkbox"/> Suicide <input type="checkbox"/> Could not be determined <input type="checkbox"/> Homicide	<b>30a. DATE OF INJURY</b> (Month, Day, Year) <b>30b. TIME OF INJURY</b> (M) <b>30c. INJURY AT WORK?</b> (Yes or no) <b>30d. DESCRIBE HOW INJURY OCCURRED</b>	<b>30e. PLACE OF INJURY—At home, farm, street, factory, office, building, etc. Specify.</b> <b>30f. LOCATION (Street and Number or Rural Route Number, City or Town, State)</b>




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### Limitations in cause-of-death data

- Physician variation in interpreting causal sequence
- Changing perceptions of causal role of diseases
- Selection of single cause may not adequately describe the cause
- Etiologic sequence of diseases may be unclear
- Only about 10% of decedents with diabetes who die have recorded on death certificate as underlying cause
- Only 40%-60% of decedents with diabetes who die have it recorded as an underlying or contributing cause (any listed)




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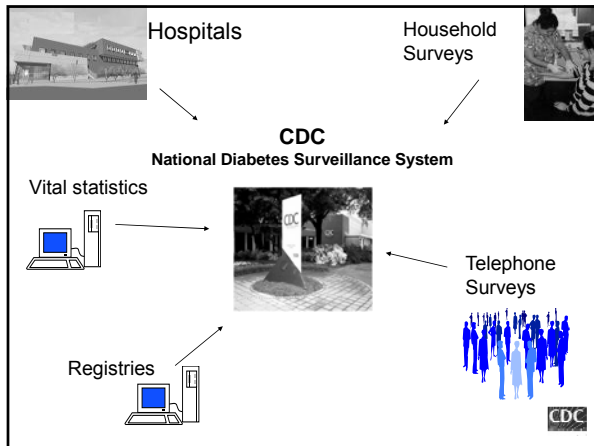
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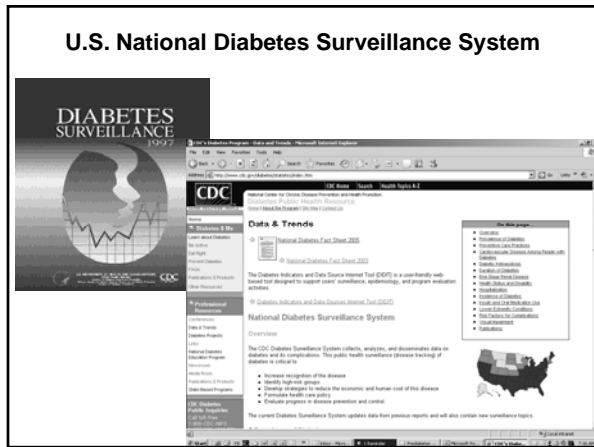
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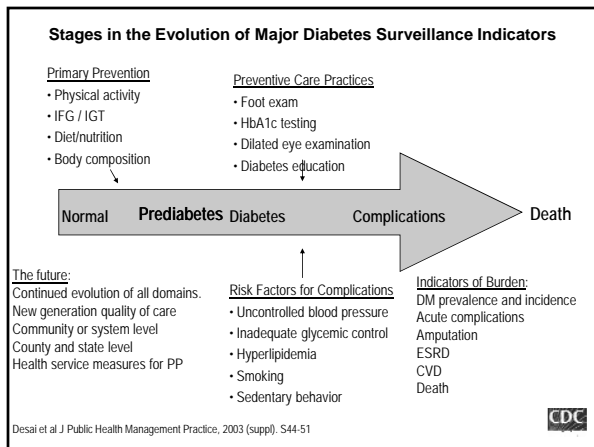
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## Examples and Lessons from the US National Diabetes Surveillance System




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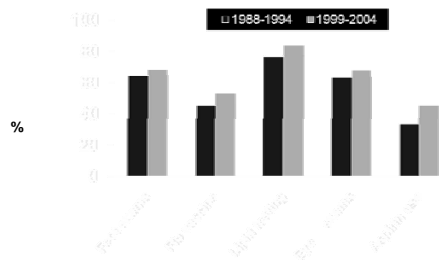
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### Secular Changes in Quality Measures of Diabetes Care Between 1988-1994 and 1999-2004



Source: Saaddine et al. *Annals of Internal Medicine*, 2006




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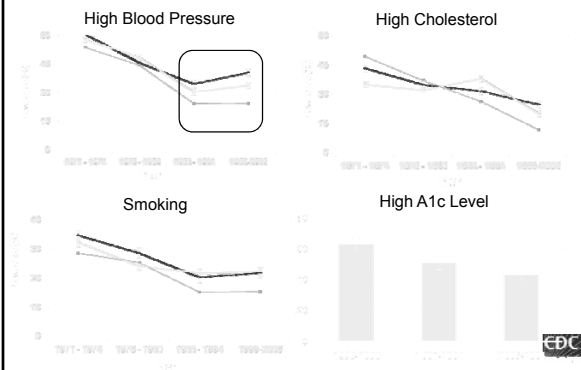
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### Prevalence of CVD risk factors among U.S. adults with diabetes aged 20-74, according to income group, 1971 to 2006

(\* red=low income; green=middle income; yellow=high income)




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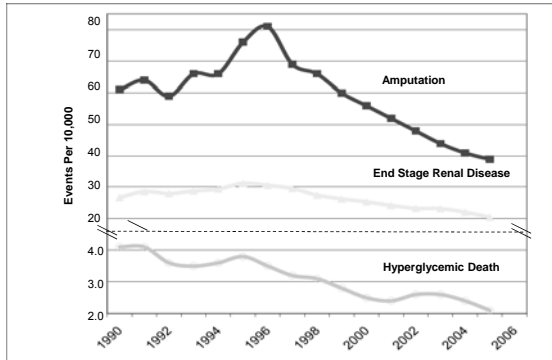
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**Incidence of lower extremity amputation, end stage renal disease, and hyperglycemic death in the U.S. diabetic population, 1990-2006.**



Gregg and Albright, *JAMA*, 2009

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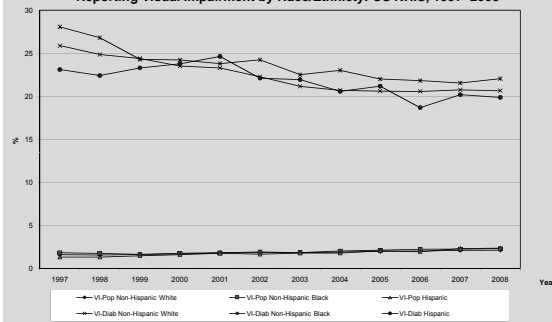
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**Crude Percentage of Adults aged 18 and older with Diabetes Reporting Visual Impairment by Race/Ethnicity: US NHIS, 1997-2008**



Note: Rates were based on 3-year moving averages.

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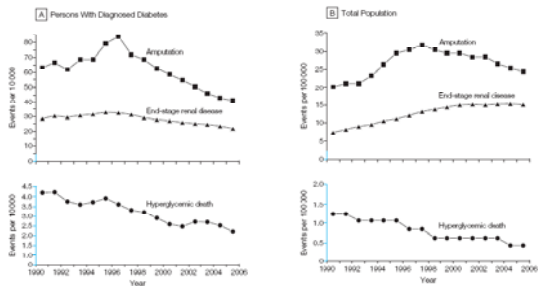
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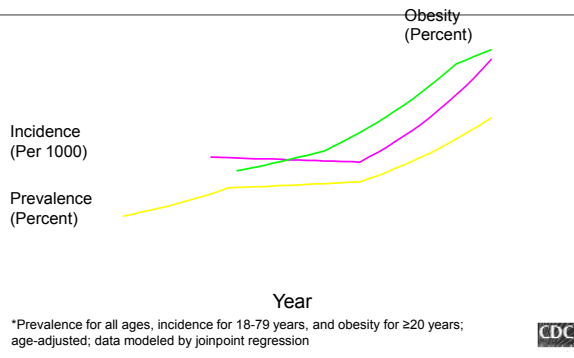
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**Long Term Trends in the Prevalence and Incidence of Diagnosed Diabetes and in the Prevalence of Obesity \* - Geiss et al.**




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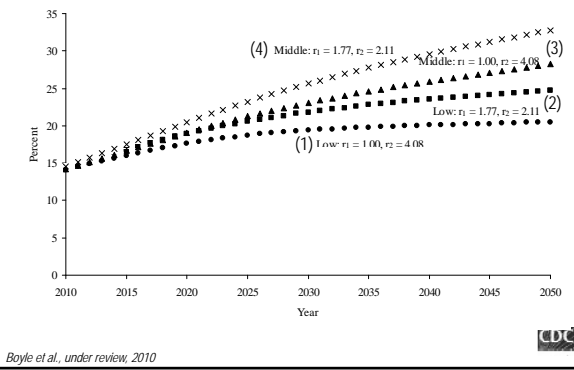
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Projected total diabetes prevalence for 4 scenarios: low incidence and high mortality (1), low incidence and low mortality(2); middle incidence and high mortality (3), and middle incidence and low mortality (4)




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**What has worked in secondary prevention?**

- Health Services:
  - Acute care and major medical interventions
  - Diffusion of new science of risk factor management
  - Emphasis on quality of care
  - Health system adaptation and CQI
- Health Promotion and Health Protection
  - Improved education/awareness of diabetes control.
  - Improved CVD risk factor education and awareness.
  - Reduced Tobacco / tobacco legislation
  - Less directly atherogenic food supply




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### Failures in the Public Health Response to Diabetes

- Levels of care and preventive health behaviors are still suboptimal.
- Improvements in blood pressure may have stalled.
- Disparities remain in renal disease, amputation, acute complications, and costs.
- Major differences in morbidity remain between people with and without diabetes.
- Diabetes is economically disabling for people and their families.
- While the *average person with diagnosed diabetes* has better control and lower risk of complications, the risk of diabetes or a diabetes complication for the *average person in the total population has increased*.




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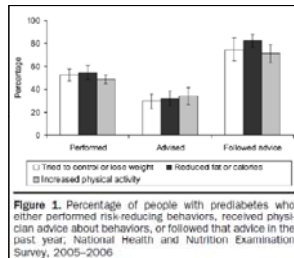
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### Diabetes Risk Reduction Behaviors Among U.S. Adults with Prediabetes

Linda S. Geiss, MA, Cherie James, MSPH, Edward W. Gregg, PhD, Ann Albright, PhD, RD, David F. Williamson, PhD, Catherine C. Cowie, PhD

- 29.6% of adults have pre-diabetes
- 7.3% of people with pre-diabetes are aware.
- 47.7% report testing in past 3 years




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### Applications of Surveillance at the State and Local Level




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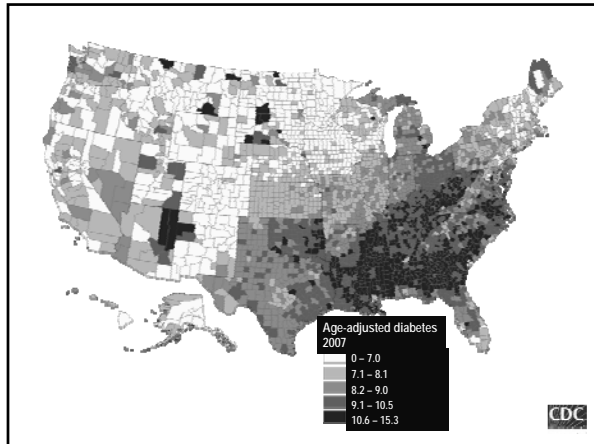
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**Gaps in Measures of Health Status**

- Behavior change
- Pre-diabetes
- Hypoglycemia, risks, adverse events
- Gestational diabetes
- Adverse events of treatment
- Heart disease and stroke incidence
- Microvascular disease incidence
- Accurate cause of death
- Diabetes in youth

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**Additional Conceptual Gaps and Limitations in Design**

- Variation in cost, quality.
- Ability to distinguish people from events.
- Vulnerability to coding biases
- Dependence on external denominators.
- Longitudinal data and linkage to cohorts.

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