Geography is Destiny:
The Epidemiology of Health Care

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Cholera Epidemics
Farr and Snow, London, 1840

"Death's Dispensary": through history deadly illnesses were sometimes spread by drinking water.
The School Medical Service - England
The English School Medical Service

- Enlarged adenoids and tonsils were a common condition.
- Tonsillectomy rates began to increase.
- In 1924, *Committee on Enlarged Adenoids and Tonsils* was established.
- In 1931:
  - 6% of students were diagnosed with “adenoids and enlarged tonsils”
  - 84,000 tonsillectomies and adenoidectomies were performed.
  - Thought to be ¾ of all procedures in England.
Glover Tonsillectomy Annual Incidence (1936)
5 - 14 years

“A study of the geographic distribution in elementary school children discloses no correlation between...any other factor, such as overcrowding, poverty, bad housing, or climate.

In fact it defies any explanation, save that of variation of medical opinion on the indications for operation.”
Small Area Variations in Health Care Delivery

A population-based health information system can guide planning and regulatory decision-making.

John Wennberg and Alan Gittelsohn

Recent legislation has extended planning and regulatory authority in the health field to a number of important areas. The 1972 amendments to the Social Security Act provide authority for regulating the construction of facilities and establish Professional Standard Review Organizations (PSROs), which are accountable for setting standards and evaluating professional performance. Phase 3 of the Wage and Stabilization Act of 1970 and state insurance commissions provide authority for regulating dollar flow by controlling impact of regulatory decisions on the equality of distribution of resources and dollars and the effectiveness of medical care services.

For technical and organizational reasons, documentation of the health care experience of populations has been restricted to large political jurisdictions such as counties, states, or nations. Studies at this level of aggregation have used indicators that support direct comparisons among areas. Relationships between the supply of manpower, facilities, and expenditures and the rate of service have not been examined in sufficient detail to explore causes of variation.

In 1969, there was implemented in the state of Vermont a data system that monitors aspects of health care delivery in each of the 251 towns of the state. When the population of the state is grouped into 13 geographically distinct hospital catchment, or service, areas, variations in health care are often more apparent than they are when the population is divided into fewer, larger areas. Population rates can be used to make direct statistical comparisons between each of the 13 hospital service areas. Since the medical care in each area is delivered predominantly by local physicians, variations tend to reflect differences in the way particular individuals and groups practice medicine. The specificity of the information in Vermont's data system makes it possible to appraise the impact that decisions controlling facility construction, price of insurance, and the rate of service have on the

### TABLE III

**Annual Rate of Tonsillectomy in 13 Vermont Hospital Service Areas (Rates per 10,000 Children, 14 Years of Age and Less, 1969-1973)**

<table>
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<td>196*</td>
<td>232*</td>
<td>167*</td>
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<td>137</td>
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<tr>
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<td>98*</td>
<td>86*</td>
<td>59*</td>
<td>51*</td>
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<td>11</td>
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<td>44*</td>
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<td>37*</td>
<td>40†</td>
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<td>33*</td>
<td>57*</td>
<td>33*</td>
<td>67</td>
<td>27†</td>
<td>.930</td>
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**Summary Statistics**
Today, we have a problem with financing:

Medicare Funding as % of Gross Domestic Product

Part A is "exhausted"; Part B and D premiums soar.
Today, we have problems with outcomes

Singleton Low Birth Weight Rates Across 246 U.S. Low Birth Weight Regions, 1998
Unwarranted variation in health care is variation that cannot be explained by:

- Patient illness
- Dictates of evidence-based medicine
- Patient preference

Unwarranted variation is caused by differences in the effectiveness and efficiency of health care delivery systems.
Small area analysis reveals the regional variation in health care delivery

- Reveals variation in medical resources, utilization, and outcomes
- Often attributable to a system of care
- Offers:
  - specific information about health systems – high and low performing health care systems
  - generalizable information about the functioning of our health care system:
    - Are resources found in areas with greater need?
    - Is more better?
    - Is care aligned with patient (and family) preferences?
Primary Care Service Areas - v2 (N = 6,542)
Counties provide coarse measures of primary care physician supply:
"They're harmless when they're alone, but get a bunch of them together with a research grant and watch out."
Tracking the Care of Patients with Severe Chronic Illness

The Dartmouth Atlas of Health Care 2008

www.dartmouthatlas.org

Elliott Fisher, MD MPH
David Goodman, MD MS
John Wennberg, MD MPH
Jonathan Skinner, PhD
The Dartmouth Atlas of Healthcare reports on unwarranted variation

First 6 months 2009:
118 million media impressions
About 2,000 unique media markets
Variation in Per-Capita Medicare Spending Across Hospital Referral Regions (N=306) (2006)
Types of Unwarranted Variation

Unwarranted Variation in:

Effective Care
Preference Sensitive Care
Supply Sensitive Care
## New York City
### Acute Myocardial Infarction Care

<table>
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<tr>
<th></th>
<th>ACE Inhibitors</th>
<th>PCI &lt; 90 minutes</th>
<th>Smoking cessation</th>
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<td>98%</td>
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<td>97%</td>
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<tr>
<td>Montefiore Medical Center</td>
<td>82%</td>
<td>83%</td>
<td>100%</td>
</tr>
<tr>
<td>Mount Sinai Hospital</td>
<td>97%</td>
<td>88%</td>
<td>99%</td>
</tr>
<tr>
<td>New York-Presbyterian</td>
<td>87%</td>
<td>64%</td>
<td>95%</td>
</tr>
<tr>
<td>NYU Medical Center</td>
<td>83%</td>
<td>75%</td>
<td>85%</td>
</tr>
<tr>
<td>U.S. Average</td>
<td>90%</td>
<td>73%</td>
<td>94%</td>
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Source: CMS, Hospital Compare, 10/06 - 9/07
Domains of Effective Care

- Nearly completely implemented
- Partially implemented
- Proven effective
- Possibly efficacious
- Basic science knowledge
Domains of Effective Care

- Basic Science Knowledge
- Possibly Efficacious
- Proven Efficacious
- Partially Implemented

Health, Disease, and Treatments Unknowns
Supply Sensitive Care

- Care strongly correlates with resource supply (i.e. capacity of hospital beds & doctors.)

- Generally provided in the absence of specific clinical theories governing the “right rate.”

- Generally, the care is one of many options.

- Medical evidence weak or nonexistent.

- Responsible for a high proportion of variation in costs.
Neonatologists per 1,000 Live Births
(Neonatal Intensive Care Regions)

Neonatologists per 1,000 Live Births
8.57 to 25.64 (50)
6.39 to 8.57 (49)
4.88 to 6.39 (51)
3.55 to 4.88 (46)
0.56 to 3.55 (51)
Health Care Capacity is not Located Where Needs are Greater
1995 Neonatal Intensive Care Regions

Are cardiologists located where cardiac needs are greater?  
(306 Hospital Referral Regions, Dartmouth Atlas)

There is virtually no relationship between regional physician supply and cardiovascular risk.

Hospital Beds (1996) vs. Adjusted Discharge Rates for Medical Conditions (1995-96)

$R^2 = 0.56$
Variation in Per-Capita Medicare Spending Is Mostly Caused by Supply Sensitive Care

- $8,800 to 16,352 (61)
- 8,100 to < 8,800 (61)
- 7,550 to < 8,100 (60)
- 6,900 to < 7,550 (62)
- 5,310 to < 6,900 (62)
- Not Populated

Map showing the variation in per-capita Medicare spending across the United States.
Is more spending
(Hospital Days, ICU Days, CT Scans, MRI Scans)
necessarily better?
Lessons from Regional Variation:

- Marked regional variation in capacity, utilization, and spending.
- More spending is not better (i.e. quality and outcomes).
- High spending associated with discretionary services (physician visits, hospital days, tests).
- Implication: low spending regions are more efficient.

Total Medicare Spending per Decedent During the Last Two Years of Life (2001-05)

UCLA Medical Center 93,842
New York-Presbyterian 91,113
Brigham and Women's 87,721
Johns Hopkins Hospital 85,729
Hospital of the U of PA 80,727
Massachusetts General 78,666
UCSF Medical Center 78,046
U of WA Medical Center 70,245
Duke University Hospital 57,411
Cleveland Clinic 55,333
Mayo Clinic (St. Mary's) 53,432
Average Number of Hospital Days per Decedent During the Last Six Months of Life (2001-05)

- New York-Presbyterian: 22.7
- UCLA Medical Center: 18.5
- Hospital of the U of PA: 17.6
- Massachusetts General: 17.3
- Johns Hopkins Hospital: 16.5
- Brigham and Women's: 16.1
- Cleveland Clinic: 14.8
- Duke University Hospital: 13.8
- UCSF Medical Center: 13.5
- U of WA Medical Center: 13.2
- Mayo Clinic (St. Mary's): 12.0
Average Number of Days in ICU per Decedent During the Last Six Months of Life (1999-2003)

- UCLA Medical Center: 11.4
- New York-Presbyterian: 5.0
- Barnes-Jewish: 4.5
- Johns Hopkins: 4.3
- Mayo Clinic (St. Mary's): 3.9
- Cleveland Clinic: 3.5
- Duke University Hosp.: 3.3
- UCSF Medical Center: 3.3
- Univ. of Washington: 3.2
- Mass. General: 2.8
<table>
<thead>
<tr>
<th>Medical Services</th>
<th>Physician FTEs per 1,000 end-of-life Medicare beneficiaries</th>
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<tbody>
<tr>
<td><strong>NYU Medical Center</strong></td>
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<tr>
<td>Total</td>
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<td>28.3 FTEs</td>
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<td><strong>Mayo Clinic</strong></td>
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<tr>
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<td>8.9 FTEs</td>
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</table>

Source: Goodman, Health Affairs, March/April 2006.
“What will we ever think about now that the genome project is almost complete?”

Think about the science and geography of health care delivery!