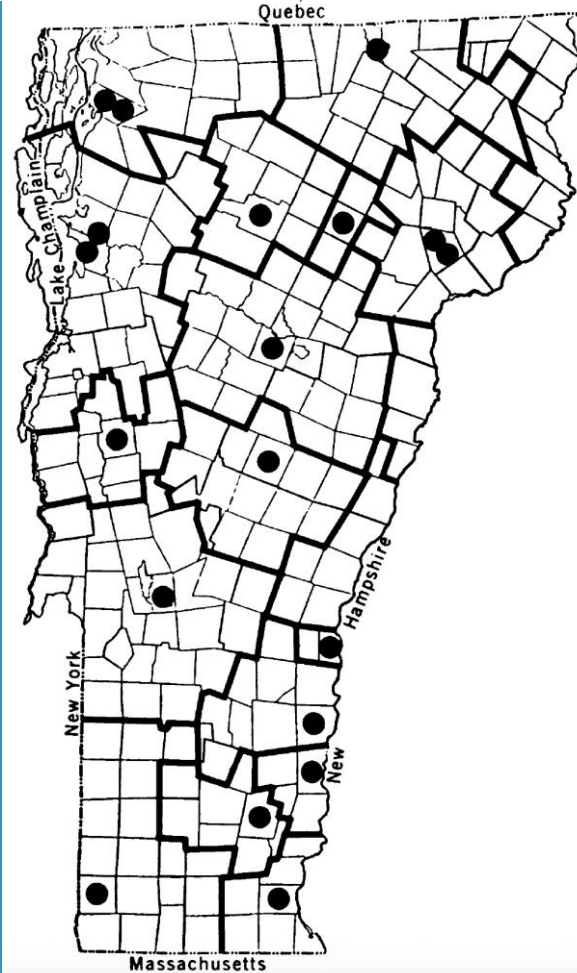


# VARIATIONS IN HEALTH AND HEALTH CARE

HOW CAN UNDERSTANDING VARIATIONS HELP ADDRESS THE CHALLENGES WE ALL FACE?

Elliott Fisher, MD, MPH

Professor of Health Policy,  
Medicine and Community  
and Family Medicine



# WHY ARE WE HERE?

BIOMEDICINE CAN DELIVER MIRACLES

Victoria Gray: first recipient of gene therapy for sickle cell disease

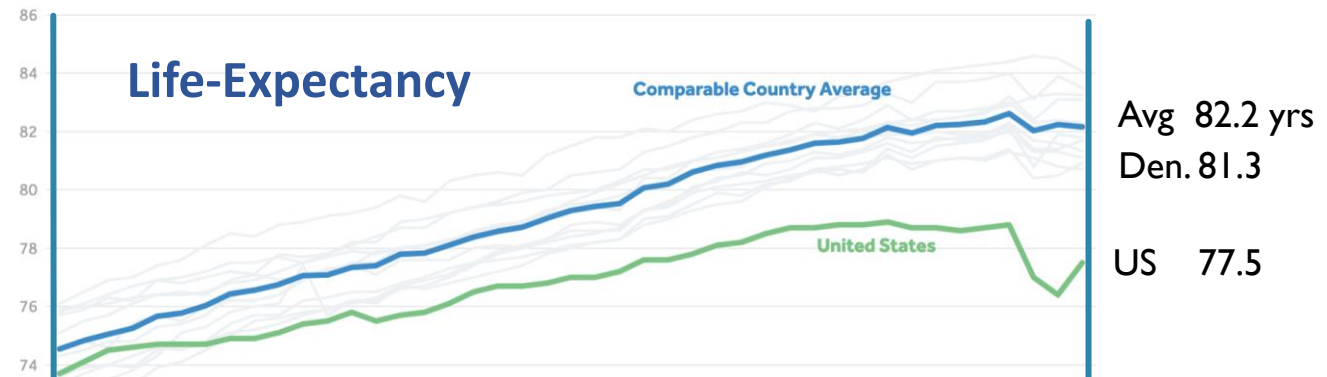


# WHY ARE WE HERE?

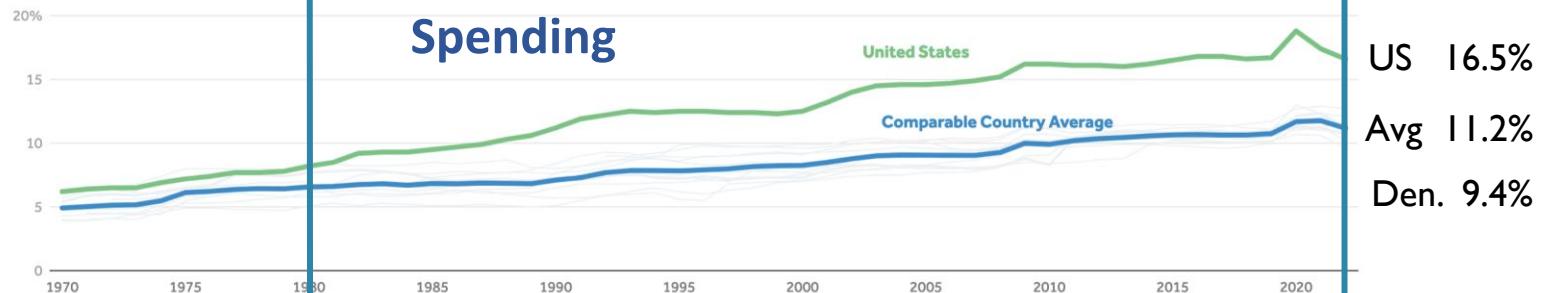
BUT BIOMEDICINE HAS NOT – AND CANNOT – SOLVE THE CHALLENGES WE FACE

- Rising health care costs
- Disparities in life-expectancy
- Aging societies
- Behavioral health crisis
- Health care workforce shortages

Life expectancy at birth, in years, 1980-2022



Health expenditures as percent of GDP, 1970-2022



Notes: Data from 2022 for Australia, Belgium, France, Japan, Switzerland, and the U.S. are estimated. Data from 2022 for Austria, Canada, Germany, the Netherlands, Sweden and the United Kingdom are provisional. Data for Australia is unavailable in 1970. Data for France from before 1990 is not available. Data from Germany prior to 1992 refers to West Germany. Data for Germany is not available for 1991. Data for the Netherlands is unavailable in 1970 and 1971.

Source: KFF analysis of OECD data • Get the data • PNG

Peterson-KFF  
Health System Tracker

1980

2022

# ORIGINS OF THE DARTMOUTH ATLAS OF HEALTH CARE

IT BEGAN IN VERMONT

## Approach

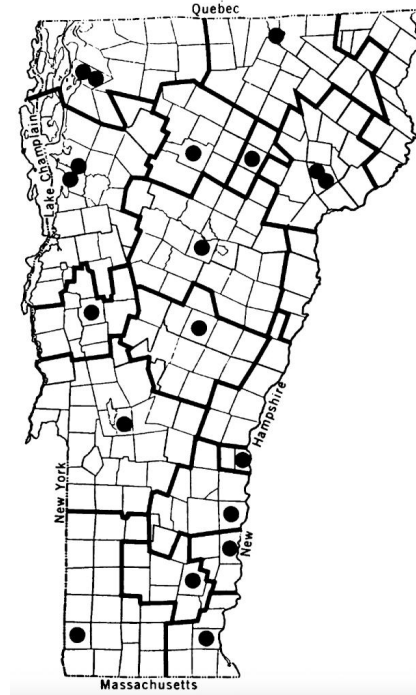
- Define service areas
- Determine use rates for residents
- Adjust for risk (age, sex, income)
- Compare rates

## Findings

Ratio, high to low

Tonsillectomy	11.6
Prostatectomy	3.5
Hospital spending	2.1
Physician spending	3.0

## Vermont Hospital Service Areas

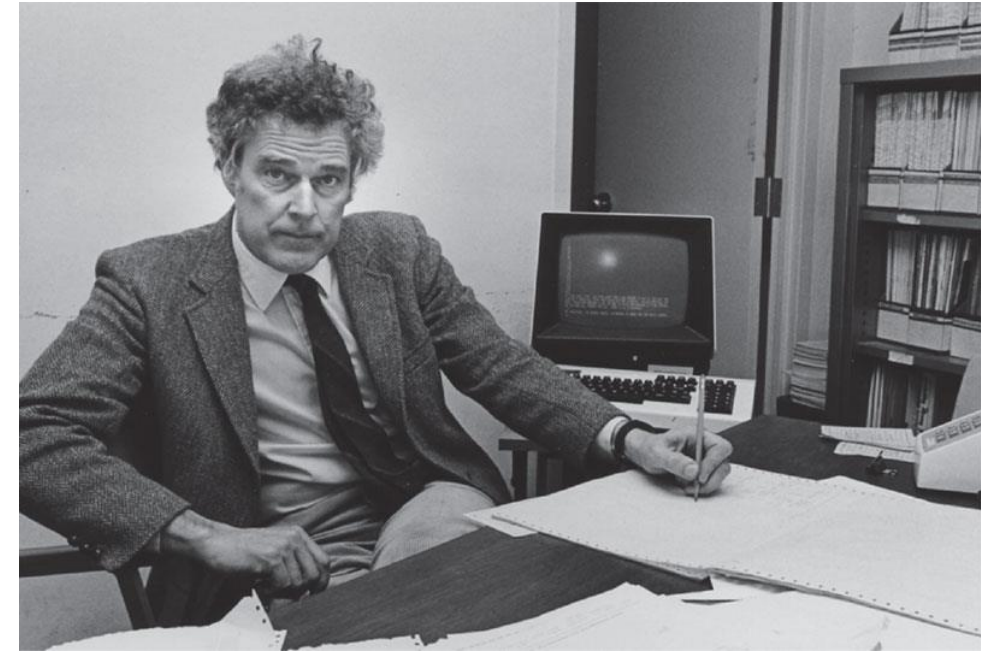


## Small Area Variations in Health Care Delivery <sup>in Vermont</sup> ▲

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

John Wennberg and Alan Gittelsohn

Science, 1973, Volume 182, pp 1102-08



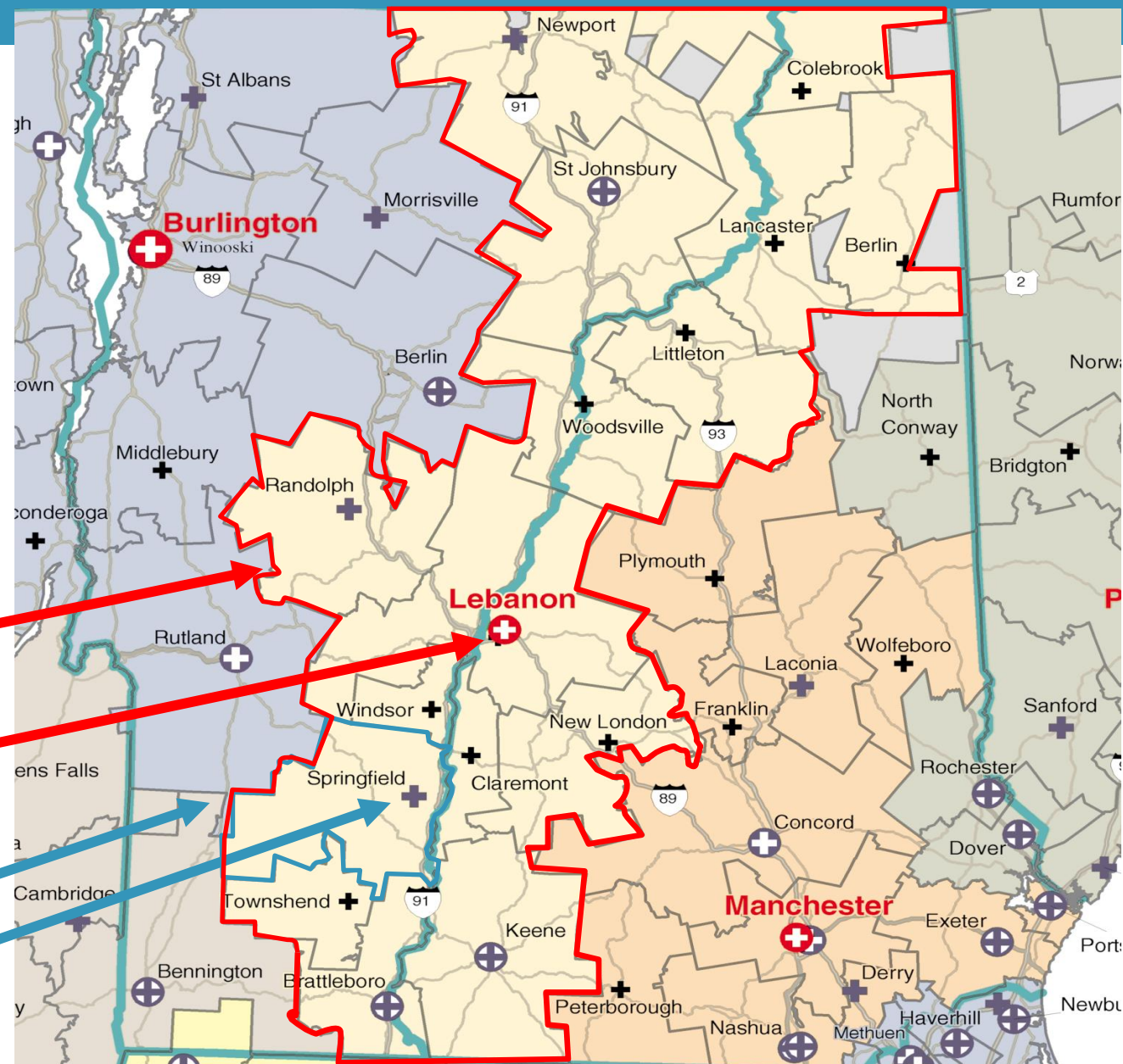
“What Jack found was nonsense.”

Don Berwick

# THE DARTMOUTH ATLAS OF HEALTH CARE

## APPLYING THE SAME APPROACH NATIONALLY

- Data sources:
  - Enrollment files, insurance claims for US Medicare program
  - Census data
- Define markets based on where people get care:
  - Hospital Service Areas (HSAs, n=3500)
  - Hospital Referral Regions (HRRs, n=306)

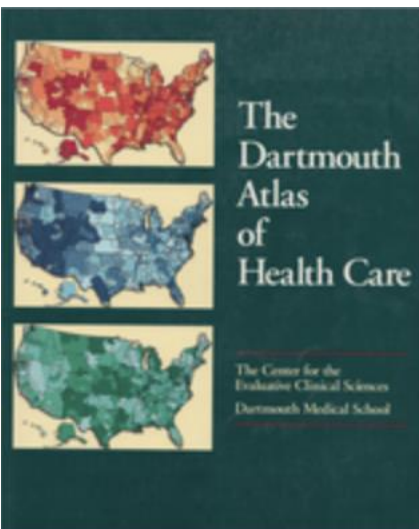


Hospital Referral Region (HRR)

Referral Hospital

Hospital Service Area

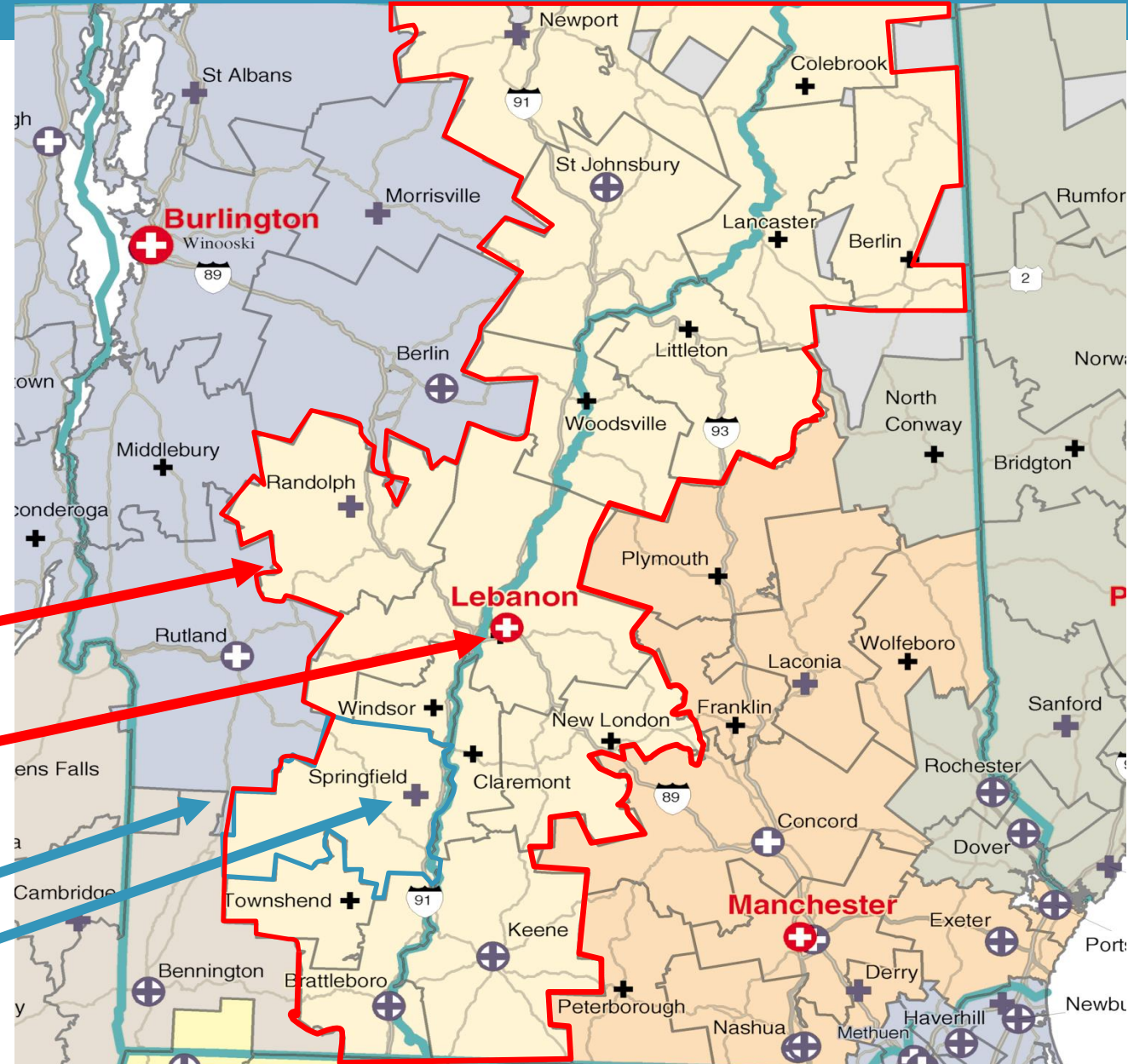
General Hospital



# THE DARTMOUTH ATLAS OF HEALTH CARE

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  - Enrollment files, insurance claims for US Medicare program
  - Census data
- Define markets based on where people get care:
  - Hospital Service Areas (HSAs, n=3500)
  - Hospital Referral Regions (HRRs, n=306)
- Calculate population-based rates

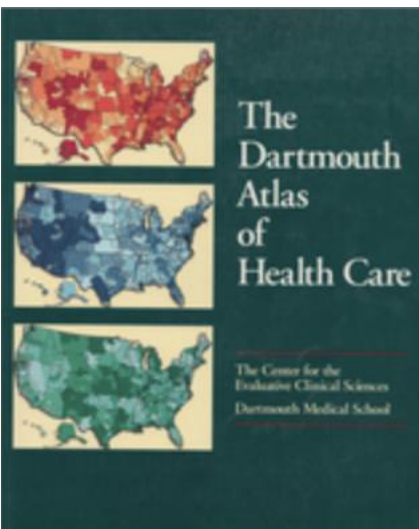


Hospital Referral Region (HRR)

Referral Hospital

Hospital Service Area

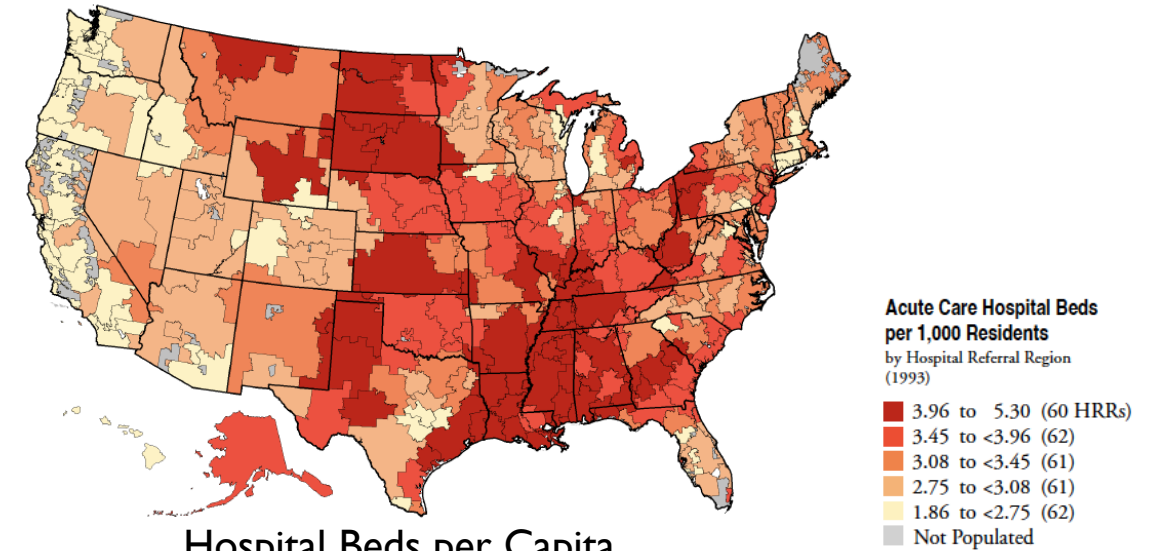
General Hospital



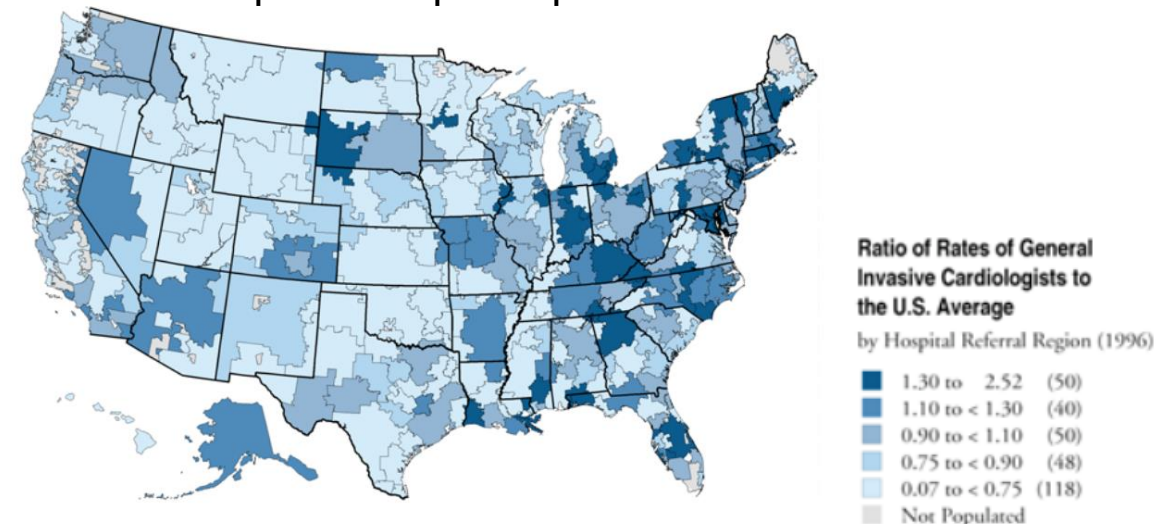
# THE DARTMOUTH ATLAS OF HEALTH CARE

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  - Census data
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  - Hospital Referral Regions (HRRs, n=306)
- Calculate population-based rates
  - **Supply: workforce and hospital beds**



Hospital Beds per Capita

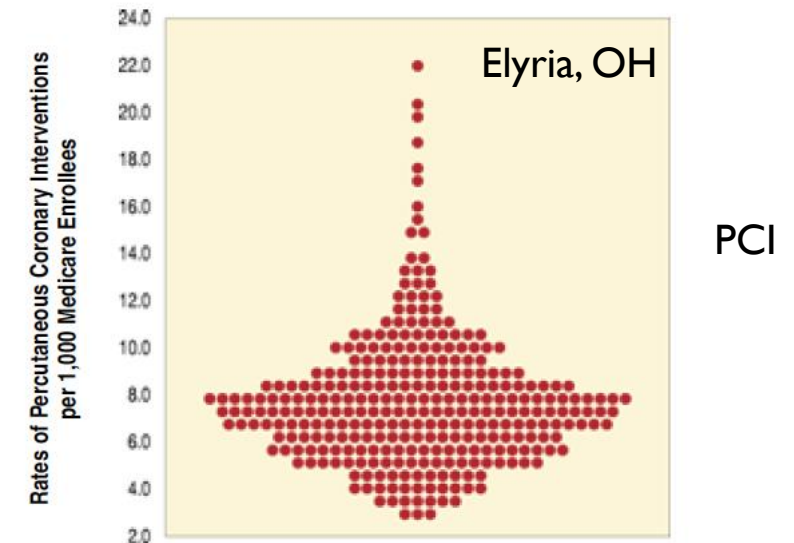
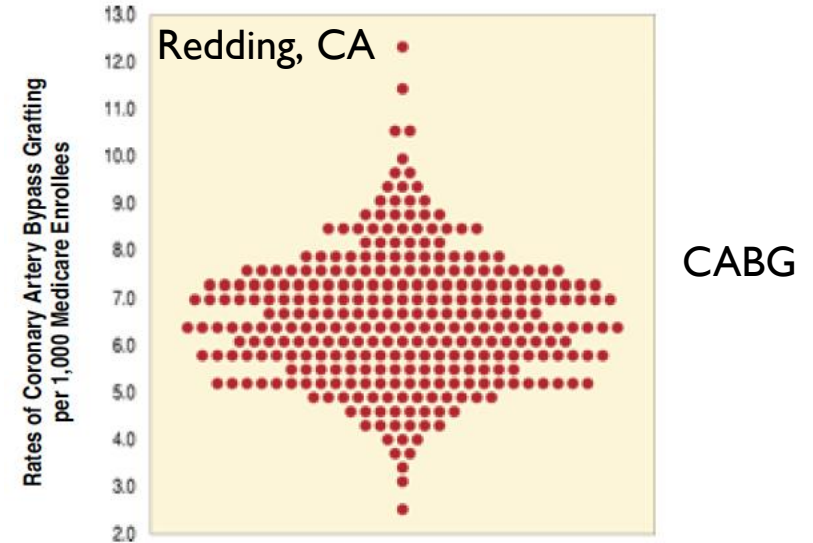


Invasive Cardiologists per Capita

# THE DARTMOUTH ATLAS OF HEALTH CARE

## APPLYING THE SAME APPROACH NATIONALLY

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  - Hospital Referral Regions (HRRs, n=306)
- Calculate population-based rates
  - Supply: workforce and hospital beds
  - **Rates of surgical procedures**





# THE DARTMOUTH ATLAS OF HEALTH CARE

## APPLYING THE SAME APPROACH NATIONALLY

- Data sources:
  - Enrollment files, insurance claims for US Medicare program
  - Census data
- Define markets based on where people get care:
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  - Hospital Referral Regions (HRRs, n=306)
- Calculate population-based rates
  - Supply: workforce and hospital beds
  - Rates of surgical procedures
  - **Quality**

### Breast Cancer Screening

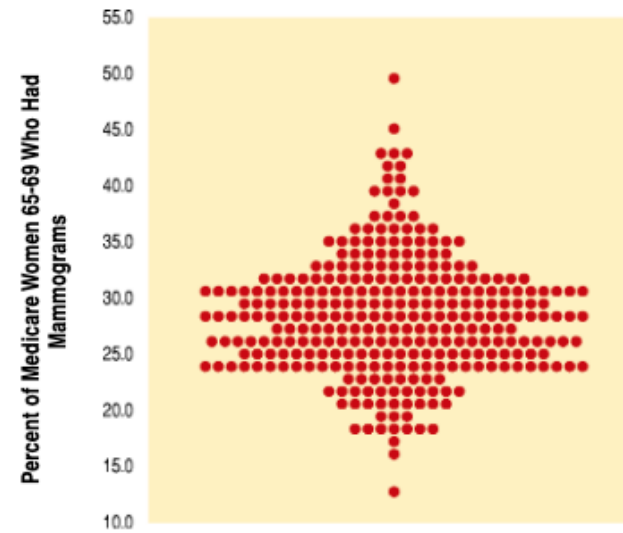


Figure 4.2. Percent of Medicare Women Age 65-69 Who Had Mammograms at Least Once in a Two-Year Period (1995-96)

### Colorectal Cancer Screening

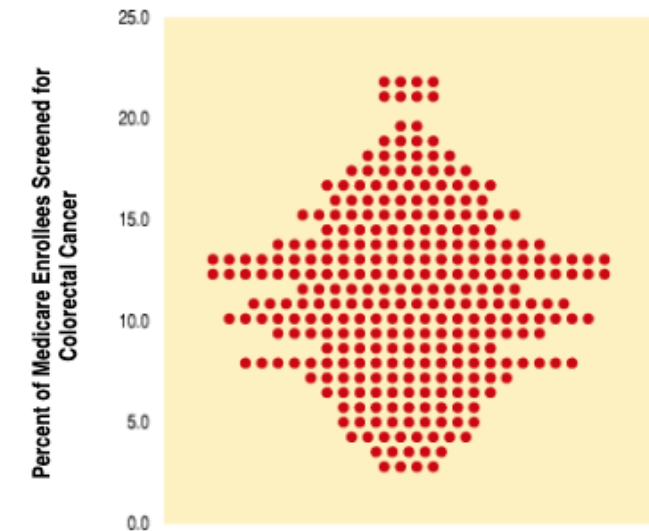
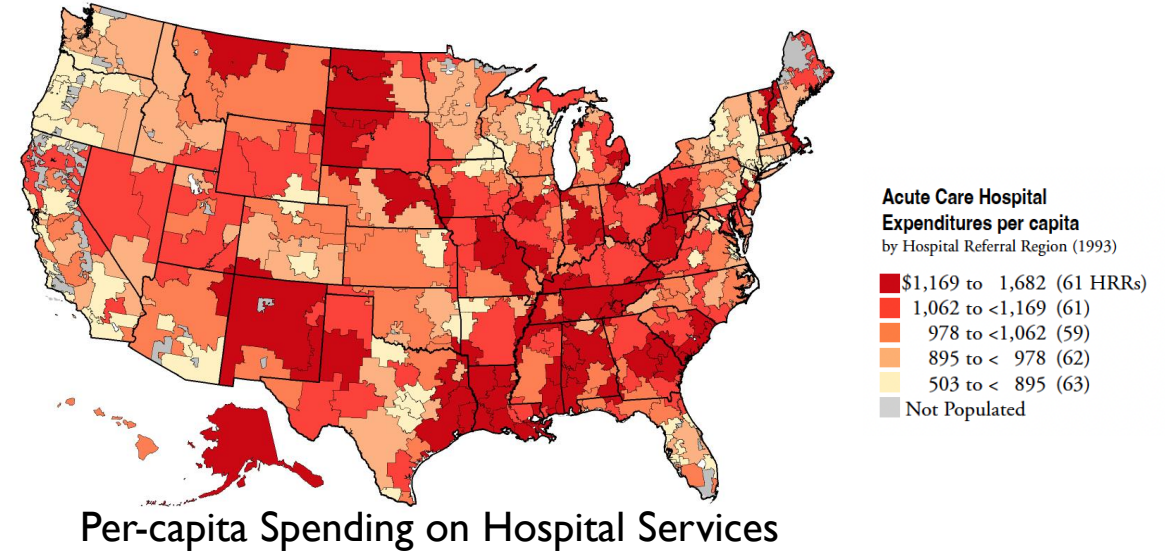


Figure 4.3. Percent of Medicare Enrollees Receiving Annual Screening for Colorectal Cancer (1995-96)

# THE DARTMOUTH ATLAS OF HEALTH CARE

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  - Supply: workforce and hospital beds
  - Rates of surgical procedures
  - Quality
  - **Use of the hospital**



# THE DARTMOUTH ATLAS OF HEALTH CARE

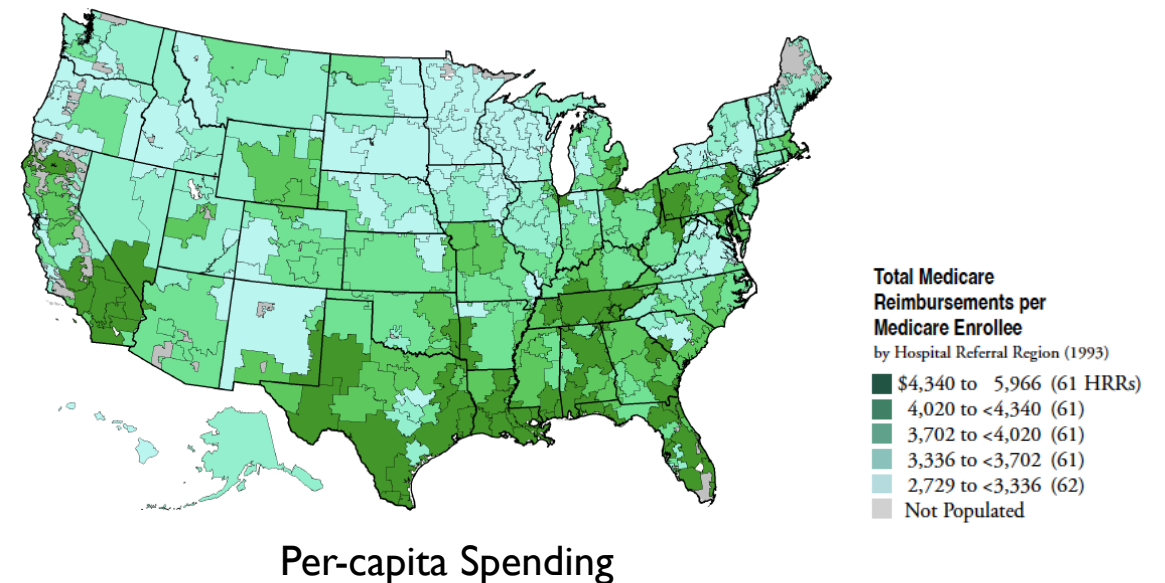
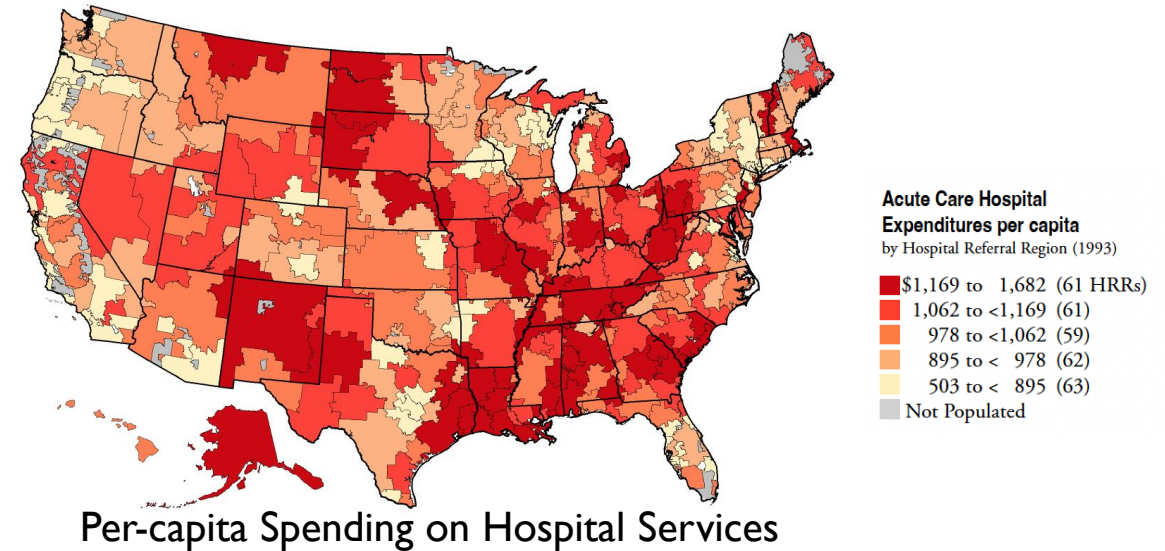
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- Calculate population-based rates
  - Supply: workforce and hospital beds
  - Rates of surgical procedures
  - Quality
  - Use of the hospital
  - **Spending**

And -- ask good questions

Why the variations?

Which are warranted? Which “unwarranted”?

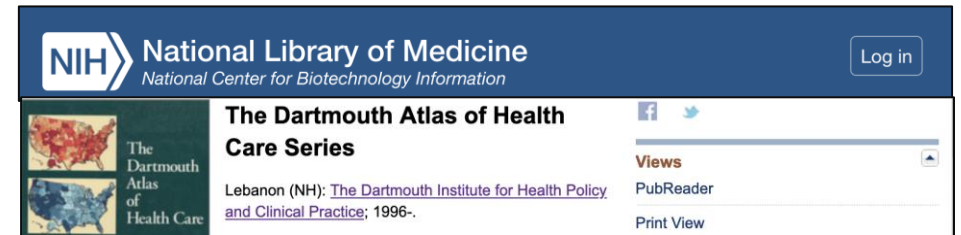


# THE BIGGER FRAMEWORK

USING DATA, SCIENCE, PUBLIC ENGAGEMENT AND POLICY DEVELOPMENT TO MAKE A DIFFERENCE

**The Atlas:**  
use data to ask  
good questions

Atlases and Reports: 69 (1996 – 2024)



The screenshot shows the National Library of Medicine (NIH) website interface. At the top, the NIH logo and the text "National Library of Medicine" and "National Center for Biotechnology Information" are visible, along with a "Log in" button. Below this, the "The Dartmouth Atlas of Health Care Series" is featured. The main title is "The Dartmouth Atlas of Health Care Series". Below the title, there is a sub-title "Lebanon (NH): The Dartmouth Institute for Health Policy and Clinical Practice; 1996-". To the right of the title, there are social media icons for Facebook and Twitter, and a "Views" section with a "PubReader" link and a "Print View" link. The background of the page is dark blue.

# THE BIGGER FRAMEWORK

USING DATA, SCIENCE, PUBLIC ENGAGEMENT AND POLICY DEVELOPMENT TO MAKE A DIFFERENCE

**The Atlas:**  
use data to ask  
good questions



**Research:**  
provide  
evidence to  
inform policy  
and practice

Atlases and Reports: 69 (1996 – 2024)

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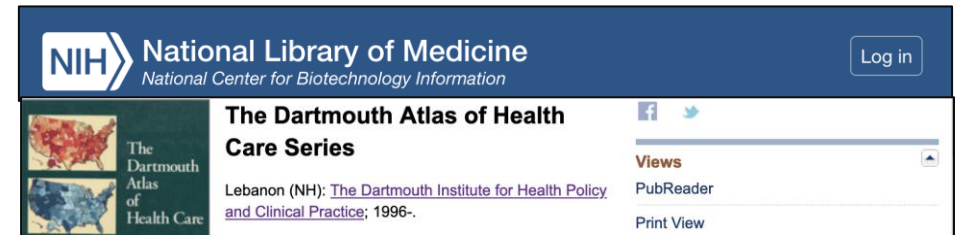
Research: 250+ articles over first 20 years

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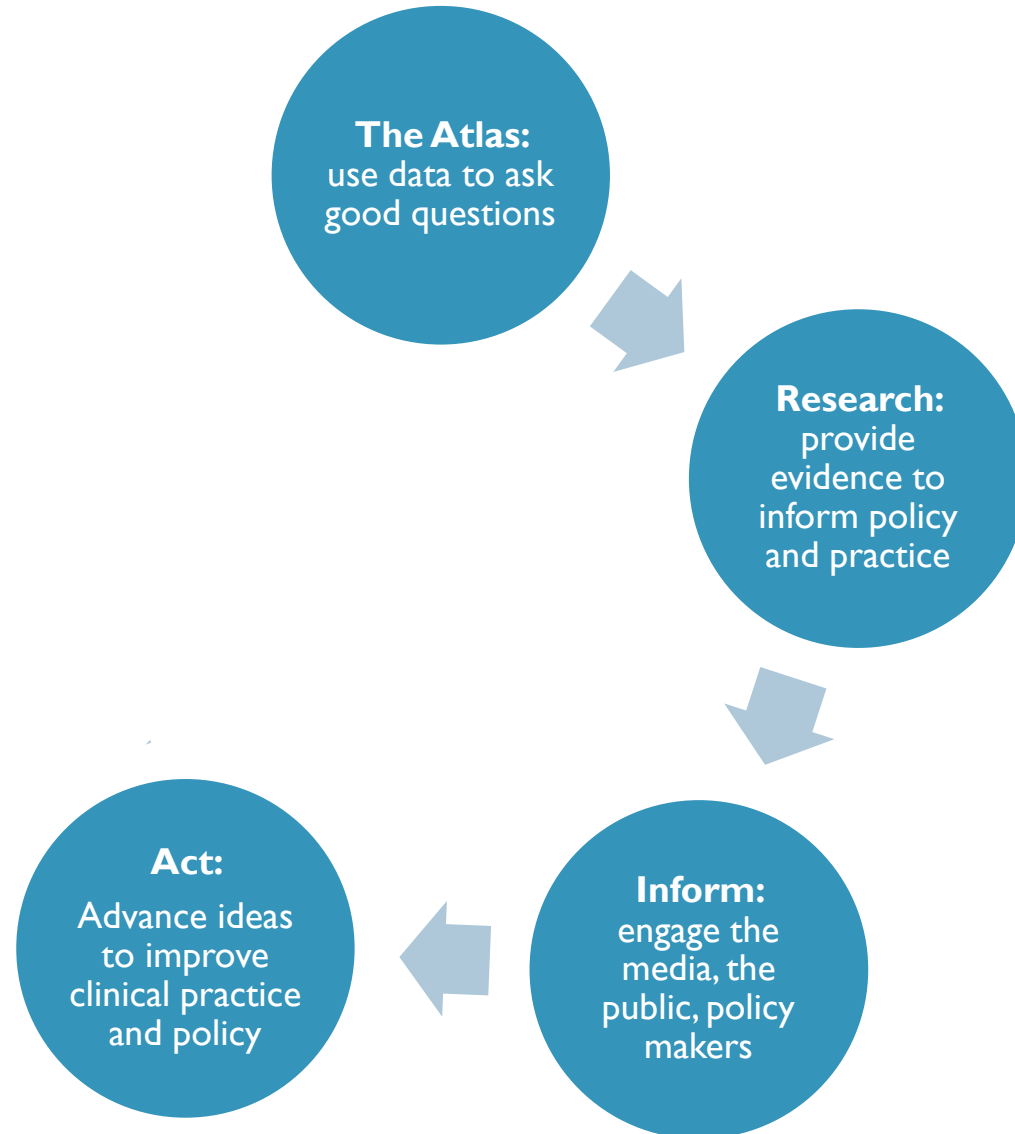


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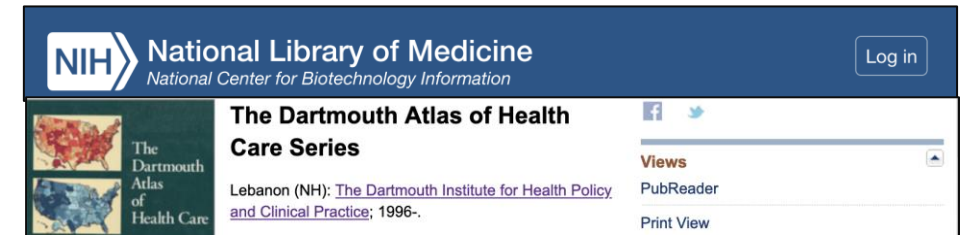
Media: Well-funded  
Policy-makers: Frequent briefings

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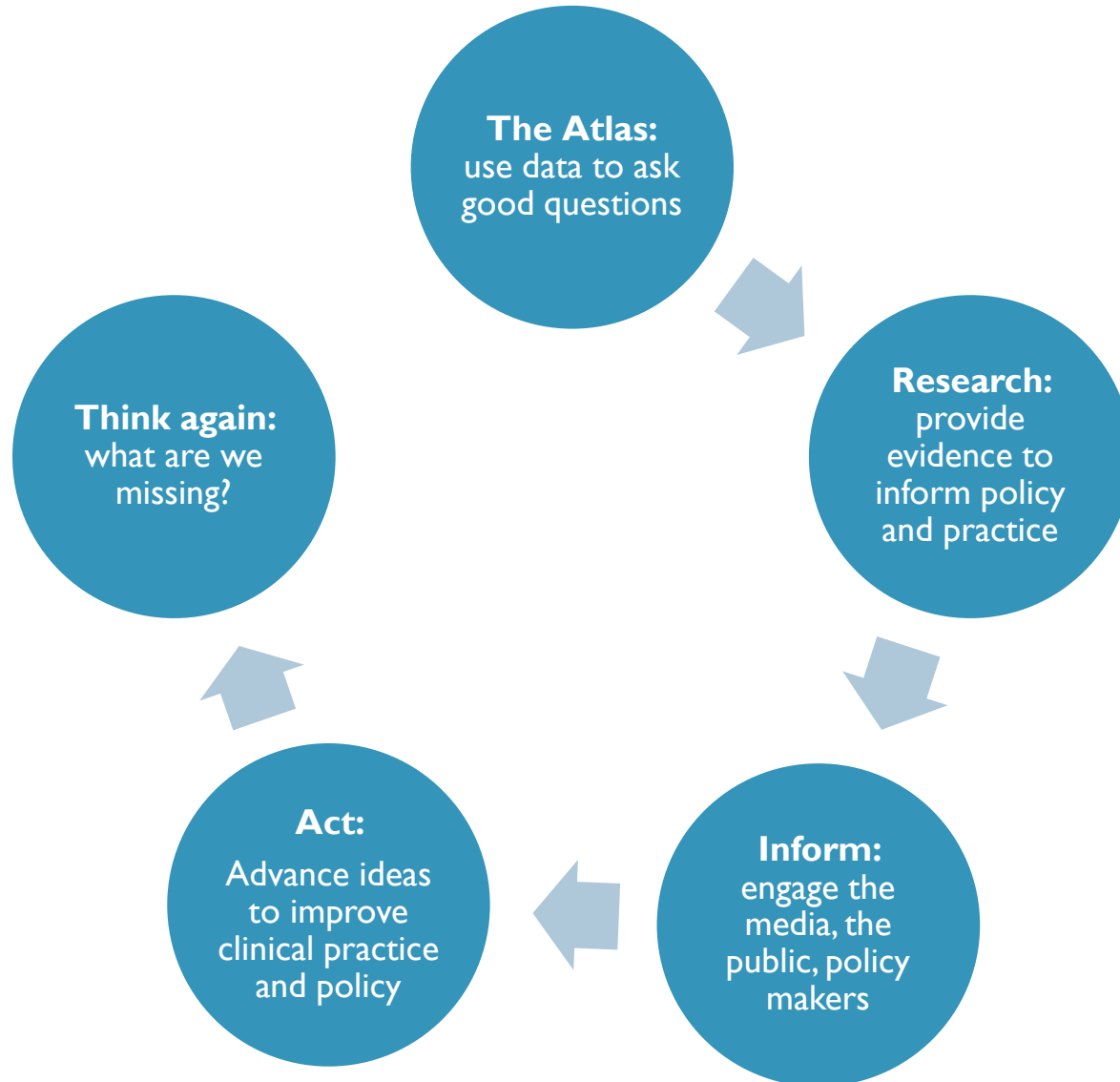
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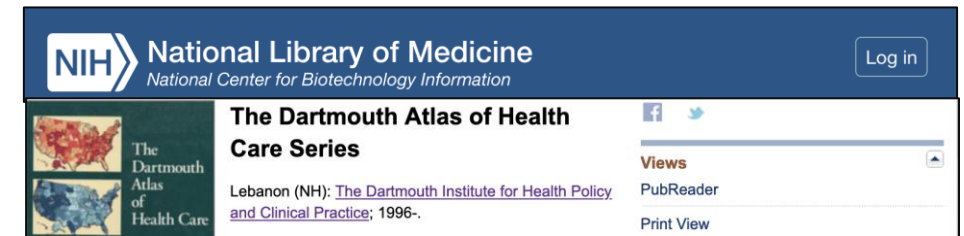
Legislation: Helped launch AHRQ  
Section of 2003 MMA  
Used to justify ACA  
Section 3022 of ACA. (ACOs)

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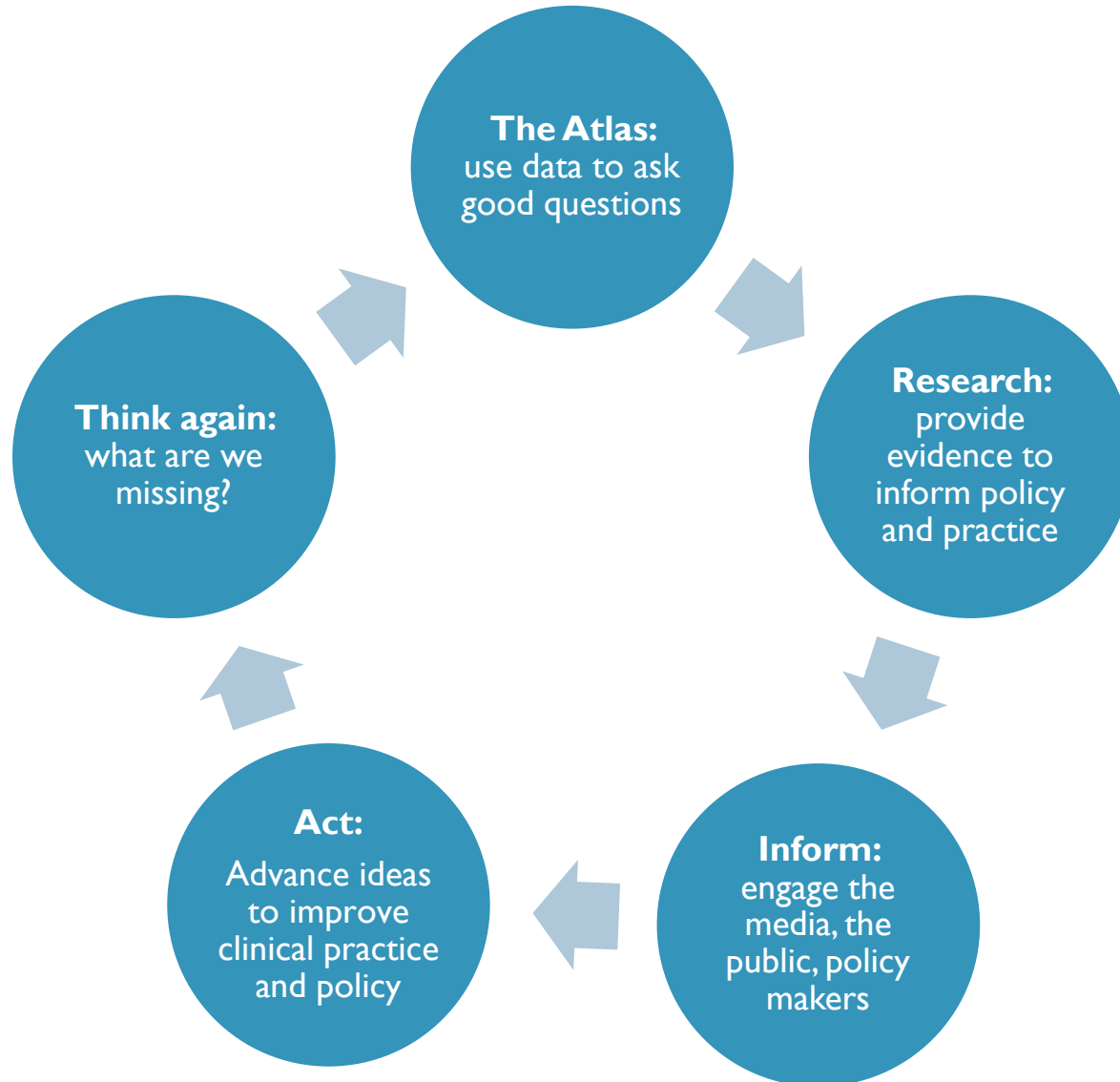
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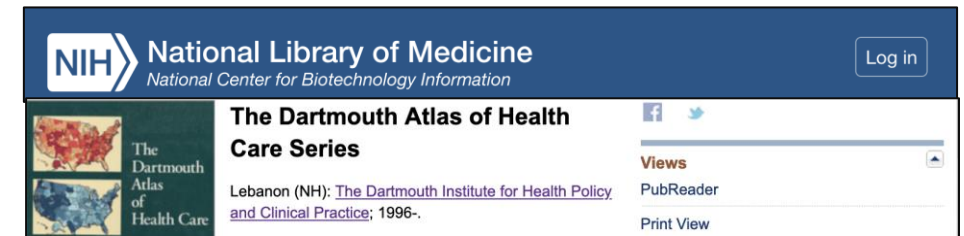


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# EARLY RESEARCH AND THE DARTMOUTH ATLAS

QUESTIONING THE ASSUMPTIONS UNDERLYING MEDICAL CARE

**Four stories**

# EFFECTIVE CARE

## VARIATIONS IN SPECIFIC TREATMENTS

Extending the Vermont work on variations

Prostatectomy -- 4 fold variation  
(Tonsils and uterus – 6 fold)

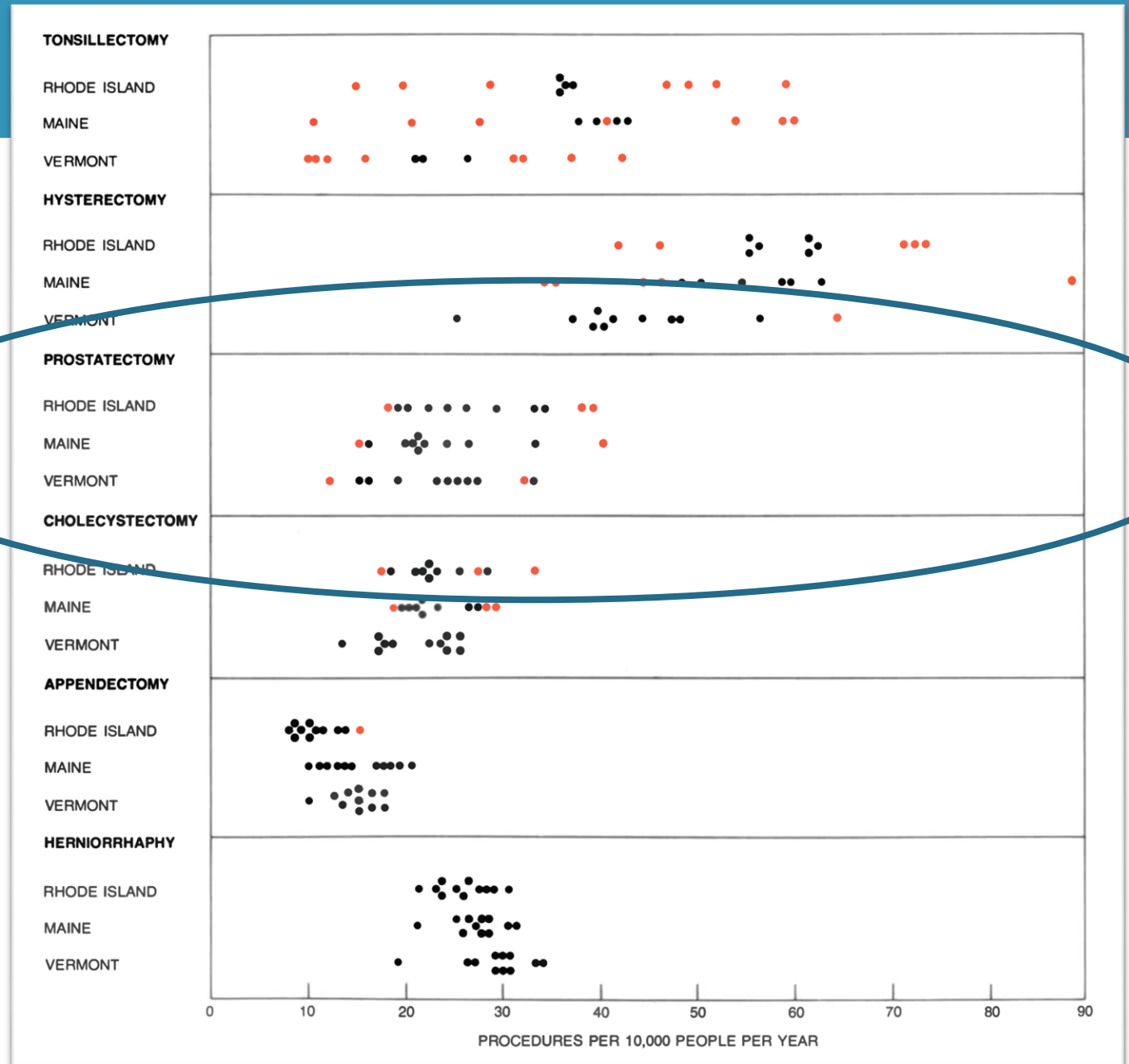
Why choose prostatectomy?

**SCIENTIFIC  
AMERICAN**

Variations in Medical Care among Small Areas

Author(s): John Wennberg and Alan Gittelsohn

Source: *Scientific American*, Vol. 246, No. 4 (April 1982), pp. 120-135



# WHY DO RATES OF SURGERY VARY?

## VARIATIONS IN RATES OF PROSTATECTOMY

May 27, 1988

### **Watchful Waiting vs Immediate Transurethral Resection for Symptomatic Prostatism** The Importance of Patients' Preferences

Michael J. Barry, MD; Albert G. Mulley Jr, MD, MPP; Floyd J. Fowler, PhD; [et al](#)

» [Author Affiliations](#)

JAMA. 1988;259(20):3010-3017. doi:10.1001/jama.1988.03720200032029

May 27, 1988

### **Symptom Status and Quality of Life Following Prostatectomy**

Floyd J. Fowler Jr, PhD; John E. Wennberg, MD; Robert P. Timothy, MD; [et al](#)

» [Author Affiliations](#)

JAMA. 1988;259(20):3018-3022. doi:10.1001/jama.1988.03720200040030

May 27, 1988

### **An Assessment of Prostatectomy for Benign Urinary Tract Obstruction** Geographic Variations and the Evaluation of Medical Care Outcomes

John E. Wennberg, MD; Albert G. Mulley Jr, MD, MPP; Daniel Hanley, MD; [et al](#)

» [Author Affiliations](#)

JAMA. 1988;259(20):3027-3030. doi:10.1001/jama.1988.03720200049032

### **Engage clinicians: what are the theories?**

Urologists engaged to explore causes

Two theories emerged: prevention vs quality of life

Agreed to help test hypotheses.

### **Decision models:**

Prevention? Early operation increased risk of death

Quality of life? Impact of operation on symptoms was the key variable

### **Cohort Study:**

Pre-operative symptoms varied dramatically

Many men undergoing surgery had mild or moderate symptoms

Men with mild symptoms did not improve

Among men with similar symptoms, degree of bother differed

Men also differed in attitudes toward risks

### **Implication:**

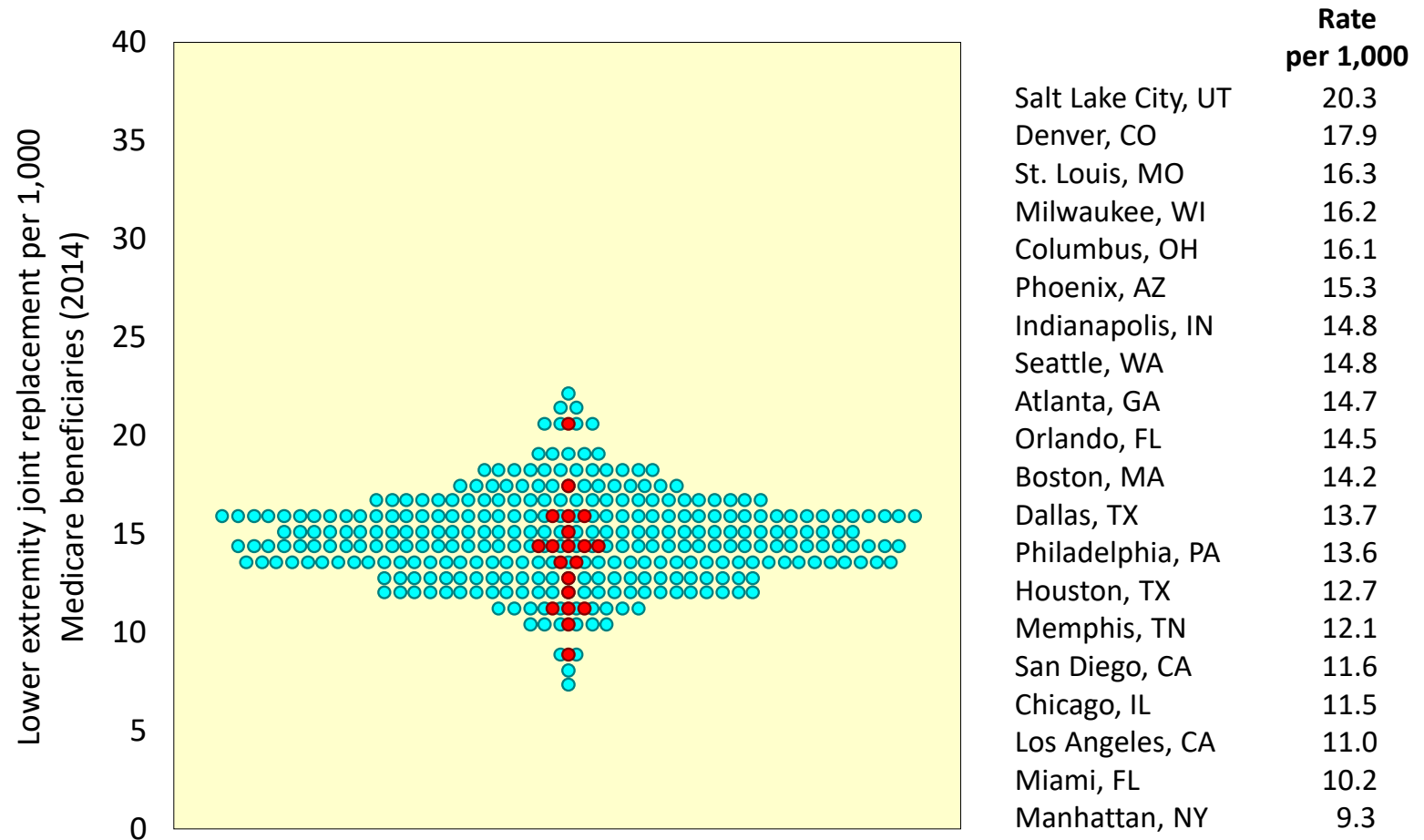
“Right” treatment depended on patient’s preferences

# A CAUTIONARY TALE: TOTAL JOINT REPLACEMENT

THE MOST COMMON MAJOR ELECTIVE PROCEDURE IN THE US

## Dartmouth Atlas of Health Care

Total Joint Replacement for Arthritis



# A CAUTIONARY TALE: TOTAL JOINT REPLACEMENT

THE MOST COMMON MAJOR ELECTIVE PROCEDURE IN THE US

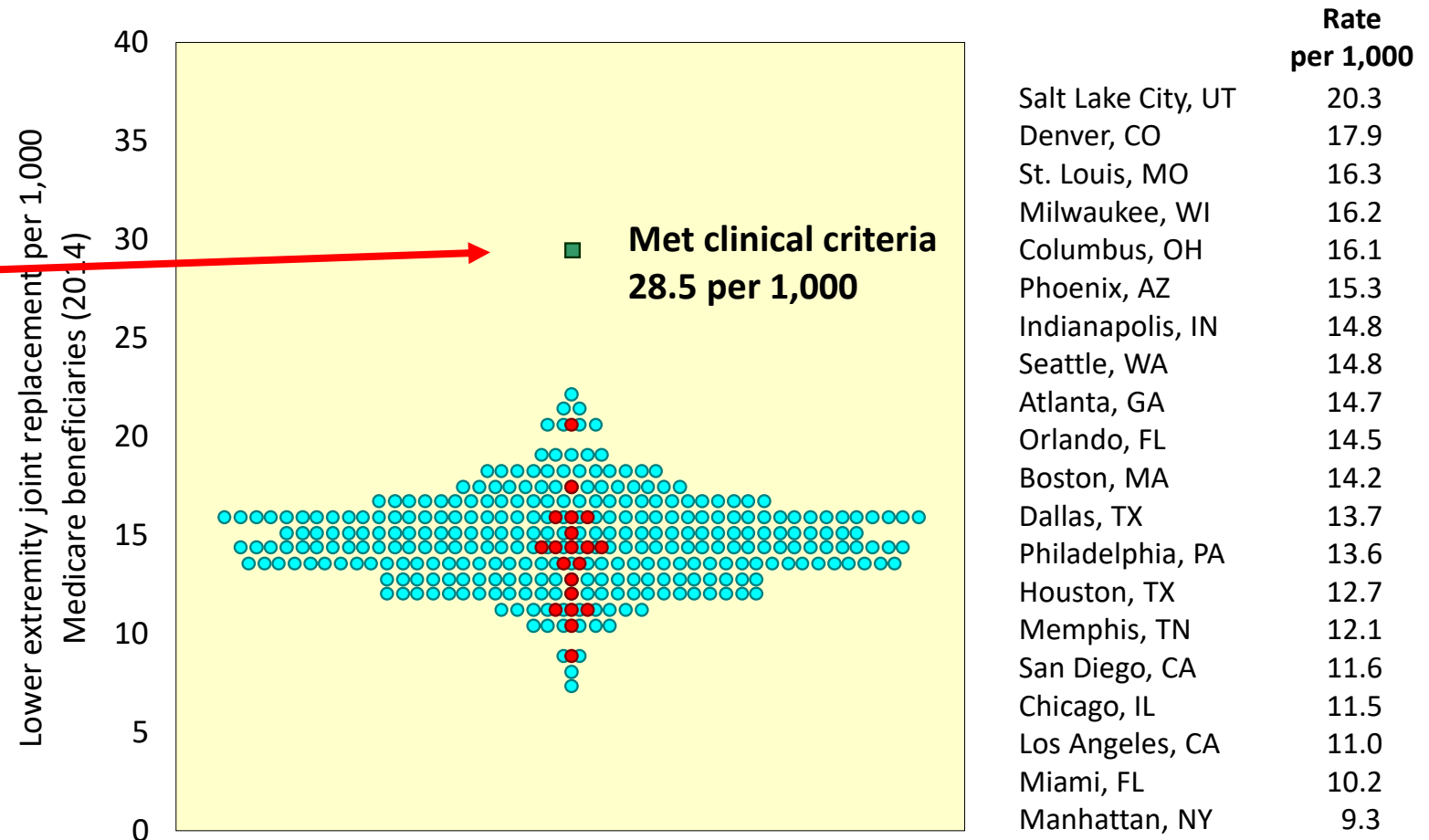
## Ontario study:

(1) identified population-based samples of patients eligible for surgery;

Hawker et al. Determining the need for hip and knee replacement, Hawker et al. Medical Care 2001, 39: 206-16

## Dartmouth Atlas of Health Care

Total Joint Replacement for Arthritis



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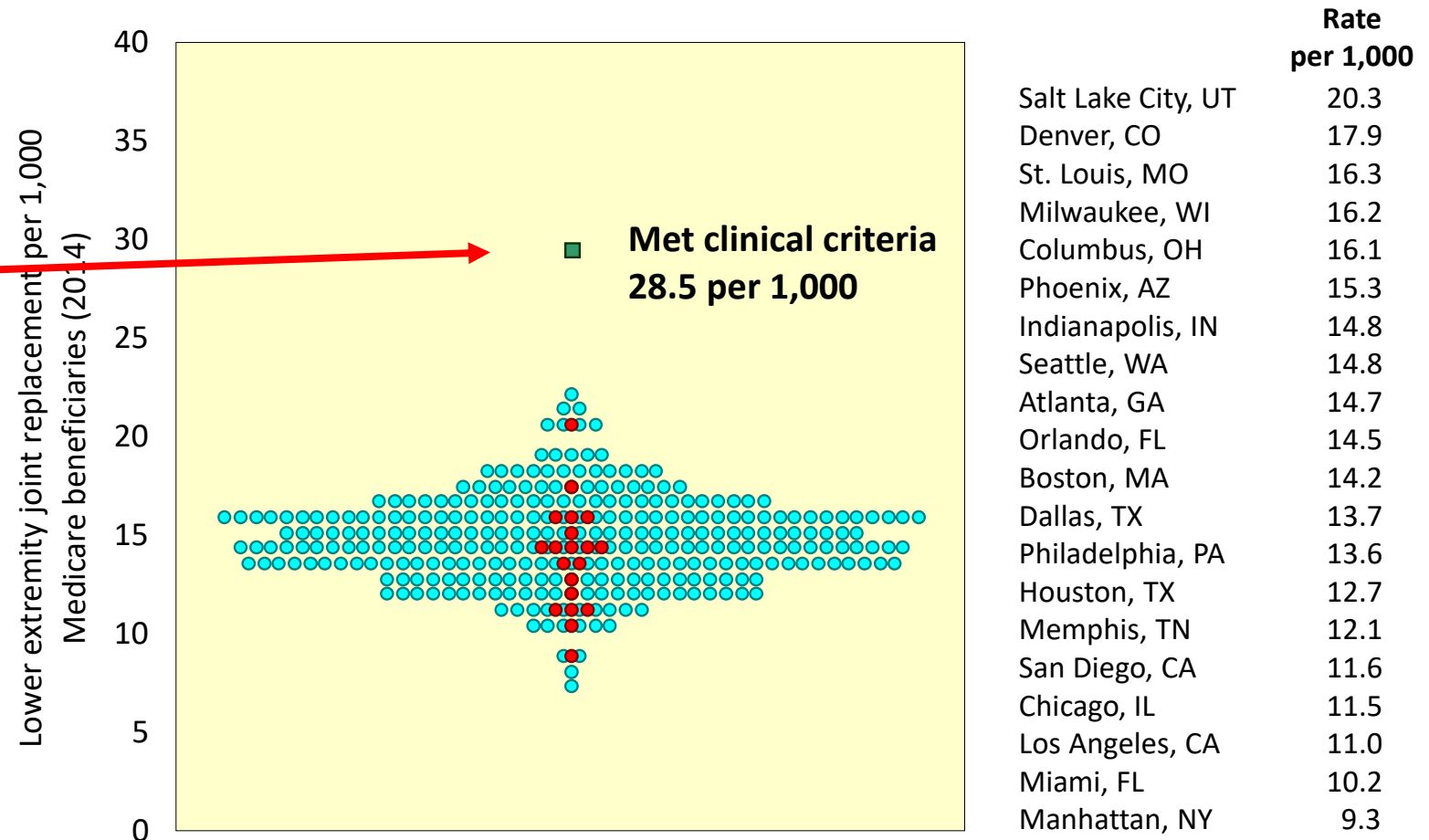
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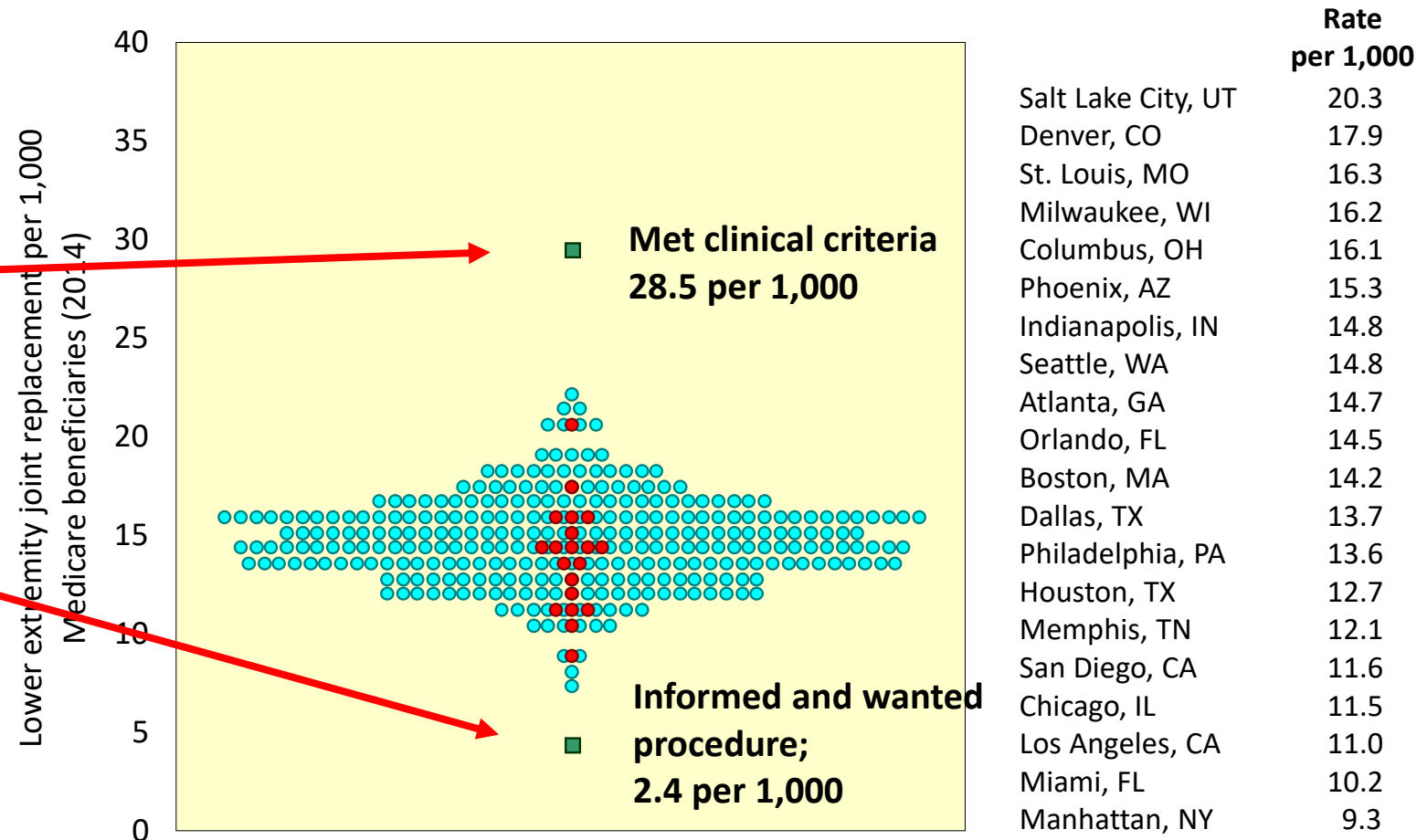
## Ontario study:

- (1) identified population-based samples of patients eligible for surgery;
- (2) Shared decision making based on risks, benefits, alternatives;
- (3) Asked, did they want surgery?

Hawker et al. Determining the need for hip and knee replacement, Hawker et al. Medical Care 2001, 39: 206-16

## Dartmouth Atlas of Health Care

Total Joint Replacement for Arthritis





# WIDELY HELD MENTAL MODELS – AND BETTER ALTERNATIVES

VARIATIONS IN SPECIFIC TREATMENTS. (EFFECTIVE CARE)

Widely held	Uncomfortable Truth	More useful
The scientific basis of medicine is sound.	Evidence is often weak.	We need better evidence.
Patients should defer to their physicians because they are the experts in biomedicine.	Preferences often vary. Misdiagnoses of preferences are common.	Patients' goals and preferences matter. Shared decision making is an ethical imperative.

## **Beyond research:**

Findings used to establish Agency for Healthcare Research and Quality Patient-Outcome Research Teams (PORTs) advanced the science  
Shared decision-making established as a national policy in the Affordable Care Act

# THE NORTHERN NEW ENGLAND CARDIOVASCULAR DISEASE STUDY GROUP

## VARIATIONS IN THE OUTCOMES OF TREATMENT (SAFETY – ALSO -- EFFECTIVE CARE)

Letter from government: “Dr. Plume, your CABG mortality rates are higher than expected” (based on claims data)

Gerry O’Connor, epidemiologist, agrees to help organize the study group, using clinical registry

Three years later.... initial results: 2-fold risk adjusted differences in mortality across centers, 4-fold across surgeons

Acrimonious meeting; close to disbanding; an idea emerged: cardiologists failed to read the angiograms correctly.

The results were unchanged: *something they were doing* was causing the differences.

They decided to try to improve outcomes. Don Berwick agreed to help.



Stephen Plume



Gerry O’Connor

# NNE EXPERIENCE

ONE OF THE FIRST QUALITY IMPROVEMENT INITIATIVES

## Adjusted In-hospital Mortality Rates

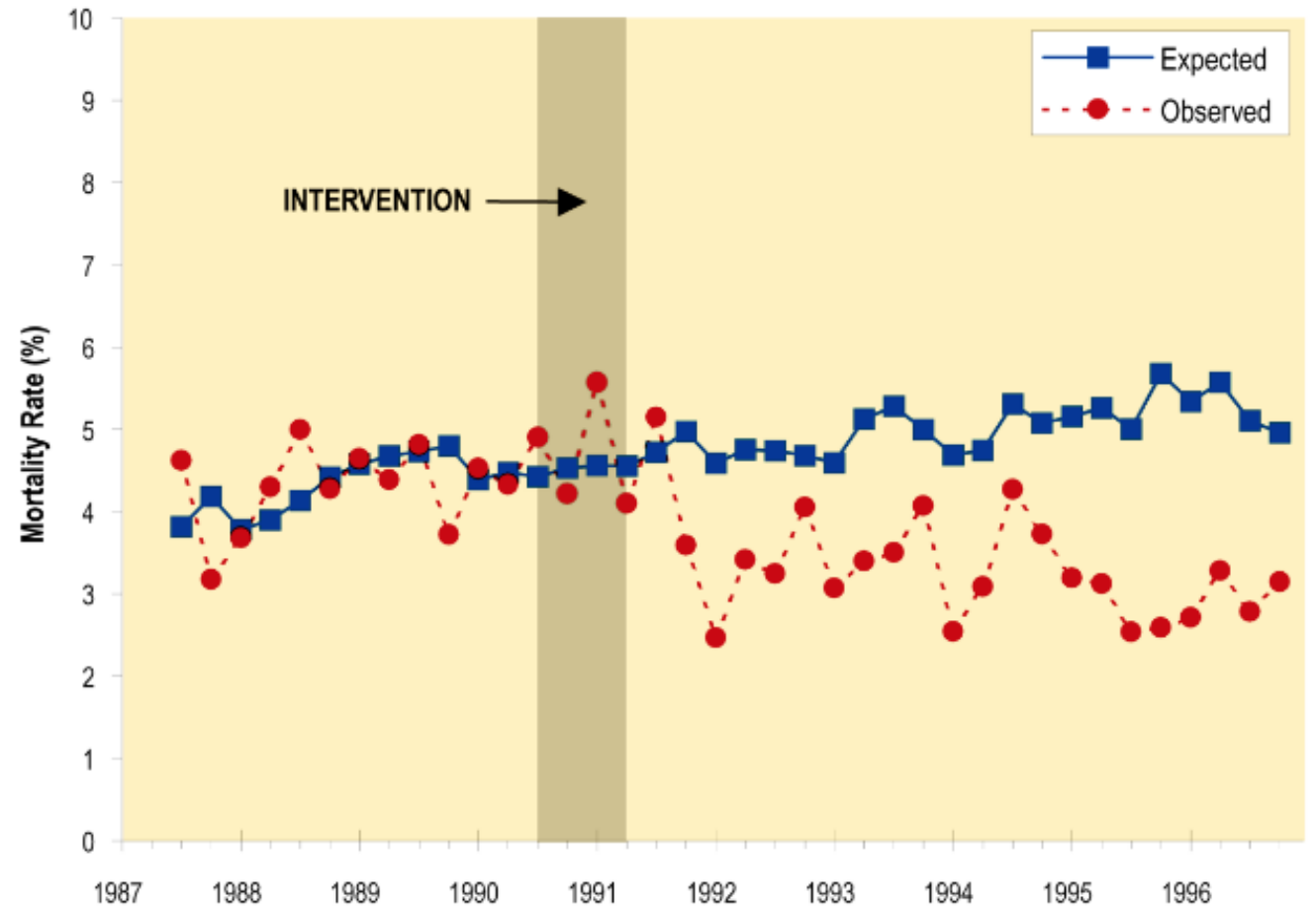
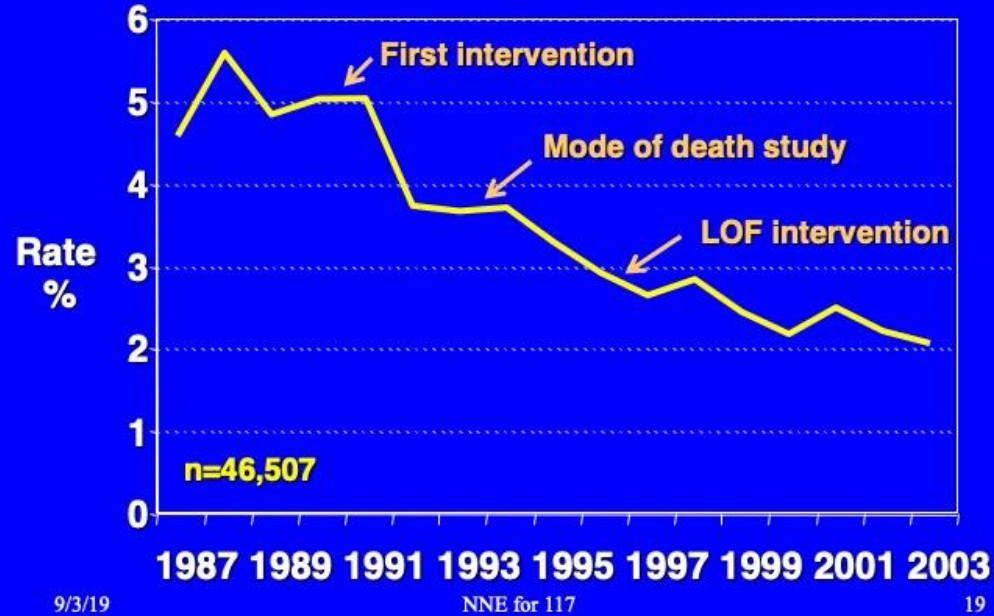
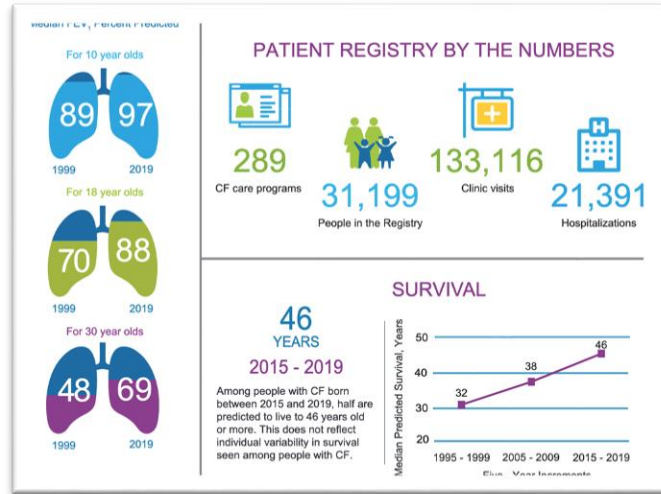


Figure 5.14. In-Hospital Mortality Rates Before and After Implementation of Quality Improvement Intervention (1987-1996)

# ..AND U.S. OFFSPRING – AND NORDIC COUSINS

## Cystic Fibrosis National Registry



## Michigan Surgical Quality Collaborative

**MSQC** Michigan Surgical Quality Collaborative

MSQC is a collaborative of Michigan hospitals dedicated to overall surgical quality improvement, including better patient care and lower costs. Our goal is simple: we work to make Michigan the best place for surgery in the country.

**What We Do**

MSQC is a collaborative of Michigan Hospitals dedicated to overall surgical quality improvement, including better patient care and lower costs. We are multidisciplinary and inclusive as we work together to transform surgical quality and deliver care that is cost effective.

<b>120</b> CLINICAL NURSE REVIEWS	<b>2500</b> SURGEONS
--------------------------------------	-------------------------

## GUIDE FOR INTERNATIONAL RESEARCH ON PATIENT QUALITY REGISTRIES IN THE NORDIC COUNTRIES

- KRISTINA (TINA) LIDÉN MASCHER, SWEDEN
- GUNILLA JACOBSSON EKMAN, SWEDEN
- PAUL D. BARTELS, DENMARK
- MICHAEL BORRE, DENMARK
- ARTO VUORI, FINLAND
- UNTO HÄKINEN, FINLAND
- HALLA SIGRÚN ARNARDÓTTIR, ICELAND
- EVA STENSLAND, NORWAY



NATIONELLA KVALITETSREGISTERET



regionernes kliniske kvalitetsudviklingsprogram



NATIONAL INSTITUTE FOR HEALTH AND WELFARE  
FINLAND



NASJONALT SERVICEMILJØ FOR MEDISINSKE KVALITETSREGISTRE



# WIDELY HELD MENTAL MODELS – AND BETTER ALTERNATIVES

## VARIATIONS IN THE OUTCOMES OF TREATMENT

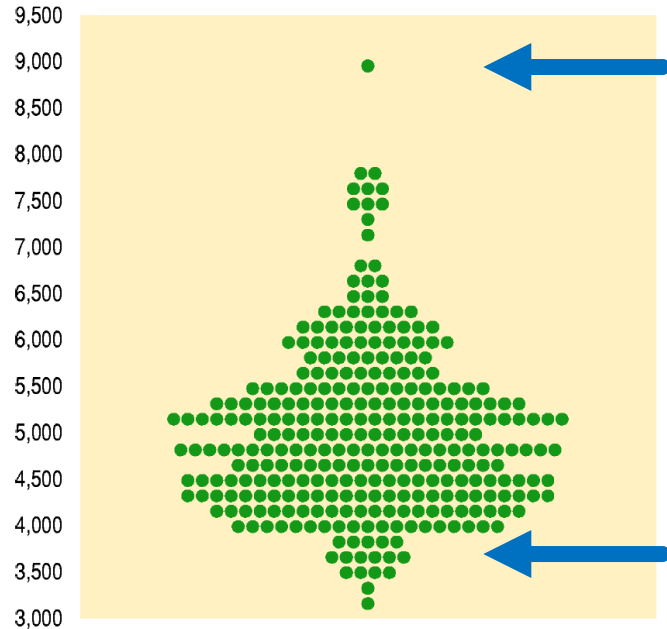
Widely held	Uncomfortable Truth	More useful
<p>The scientific basis of medicine is sound.</p> <p>Patients should defer to their physicians because they are the experts in biomedicine.</p>	<p>Evidence is often weak.</p> <p>Physician beliefs (and biases) drive many decisions. Patient preferences vary..</p>	<p>We need much better evidence.</p> <p>Patients' goals and preferences matter. Shared decision making is an ethical imperative.</p>
<p>The United States provides the best medical care in the world.</p> <p>Bad care is due to bad apples.</p>	<p>Outcomes vary dramatically and are a consequence of how care is delivered.</p>	<p>Quality is a system attribute. We need systems that support learning and improvement.</p>

### **Beyond research:**

VA Surgical Quality Improvement Collaborative  
National Surgical Quality Improvement Collaborative  
Swedish Rheumatology Register  
...and all of your work

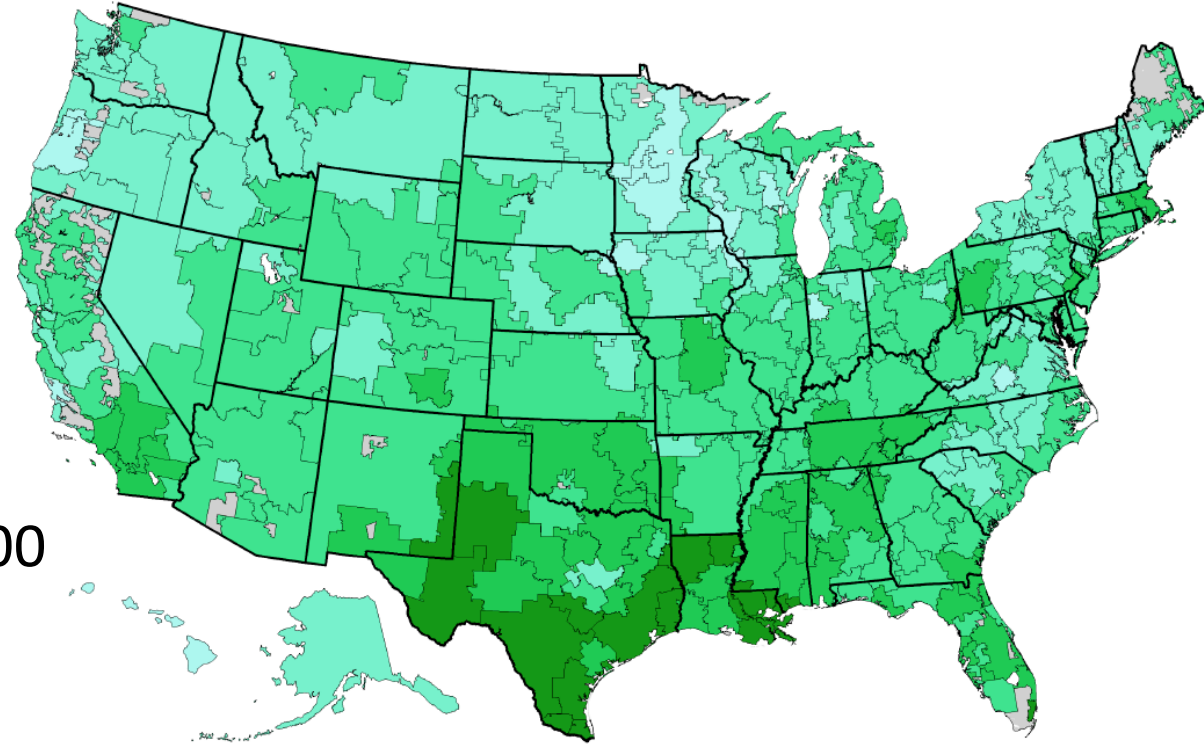
# HEALTH CARE SPENDING

DARTMOUTH ATLAS OF HEALTHCARE, 1999



Miami: \$7,783

Minneapolis: \$3,700



Ratio of Rates of Price Adjusted Reimbursements for Noncapitated Medicare to the U.S. Average by Hospital Referral Region (1996)

- 1.30 to 1.81 (17)
- 1.10 to < 1.30 (54)
- 0.90 to < 1.10 (142)
- 0.75 to < 0.90 (81)
- 0.61 to < 0.75 (12)
- Not Populated

Figure 1.1. Age, Sex, Race, Illness and Price Adjusted Reimbursements for Noncapitated Medicare Among Hospital Referral Regions (1996)



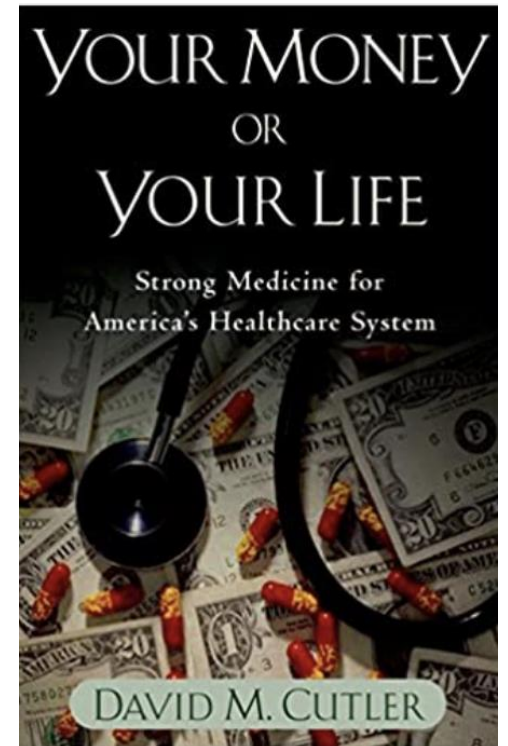
“HOW CAN THE BEST MEDICAL CARE IN THE WORLD COST TWICE AS MUCH AS THE BEST MEDICAL CARE IN THE WORLD?”

Uwe Reinhardt

# THE COMMON WISDOM

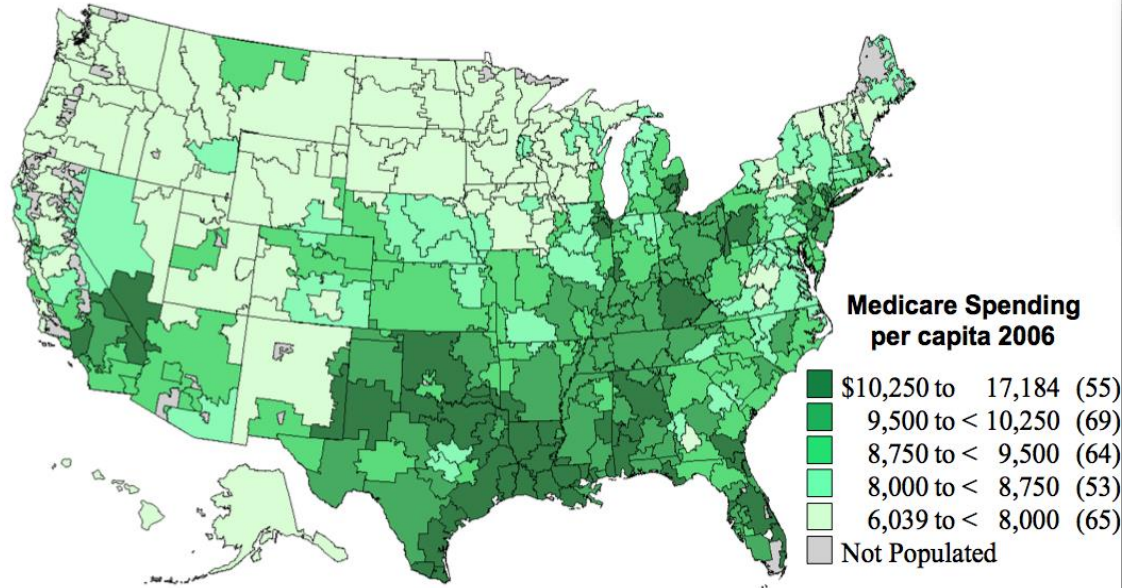
CIRCA 2000 (AND STILL WIDELY BELIEVED)

“All medical care offers benefits.”



# BUT DOES IT?

## THE RESEARCH



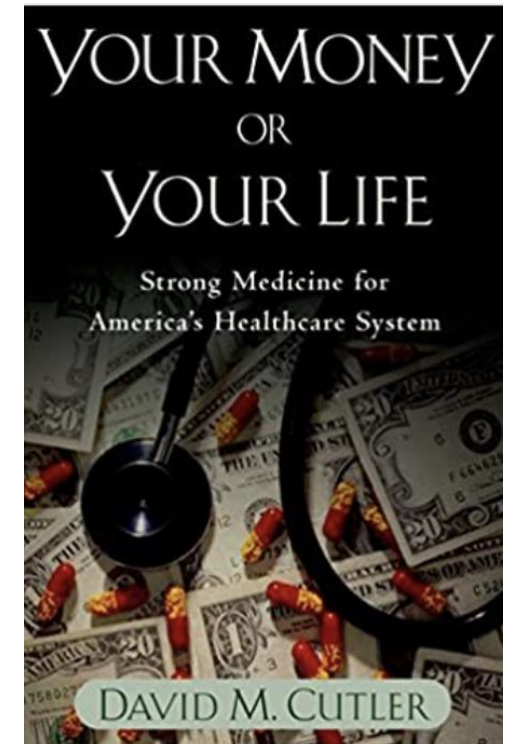
### Average Per-Capita Spending

Ratio – High to Low

**1.61**

### Initial Study

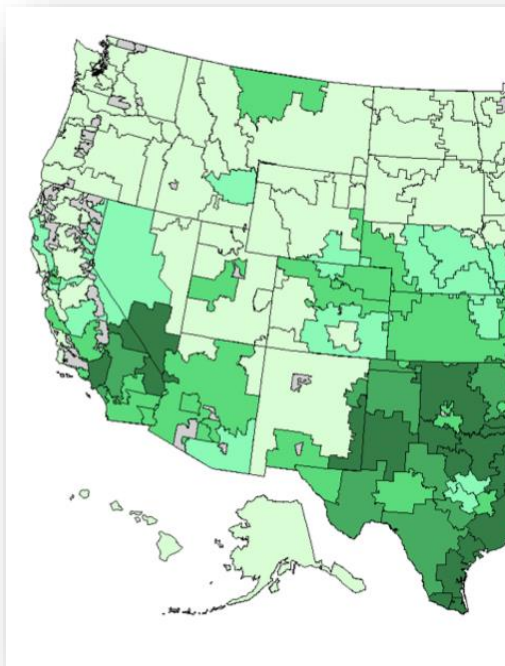
- 1 million Medicare beneficiaries with heart attack, colon cancer, hip fracture
- Followed for up to five years after initial hospitalization
- Compared content, quality and outcomes of care *across regions with 60% differences in per-person spending*





# WHAT IS THE “MORE”?

VARIATIONS IN SPENDING LARGELY DUE TO SUPPLY-SENSITIVE CARE



## Initial Study

- 1 million Medicare beneficiaries
- Followed for up to 5 years
- Compared content of care

### Effective Care: *benefit clear for all*

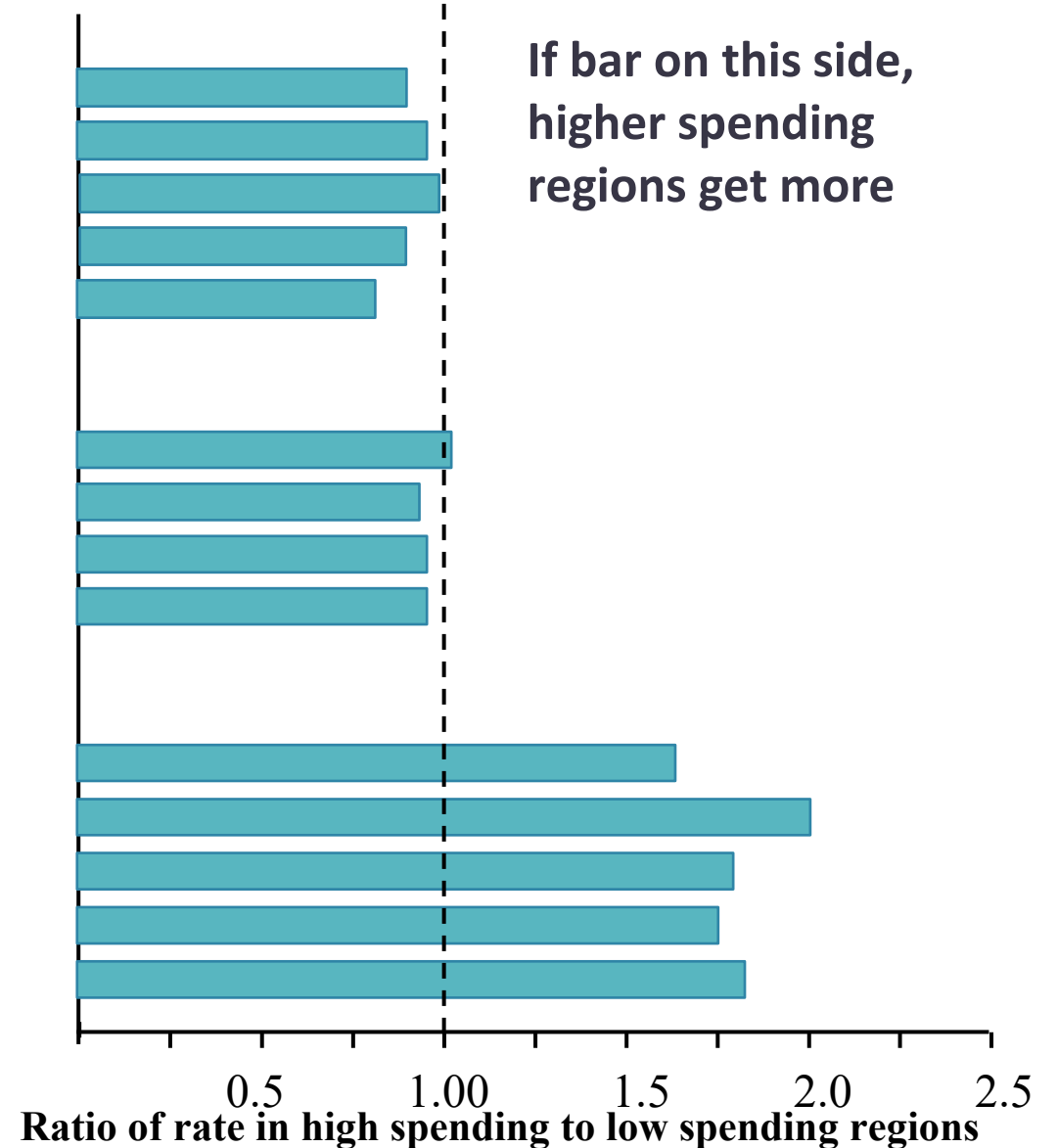
- Reperfusion in 12 hours (Heart attack)
- Aspirin at admission (Heart attack)
- Mammogram, Women 65-69
- Pap Smear, Women 65+
- Pneumococcal Immunization (ever)

### Preference Sensitive: *values matter*

- Total Hip Replacement
- Total Knee Replacement
- Back Surgery
- CABG following heart attack

### Supply sensitive: *often avoidable care*

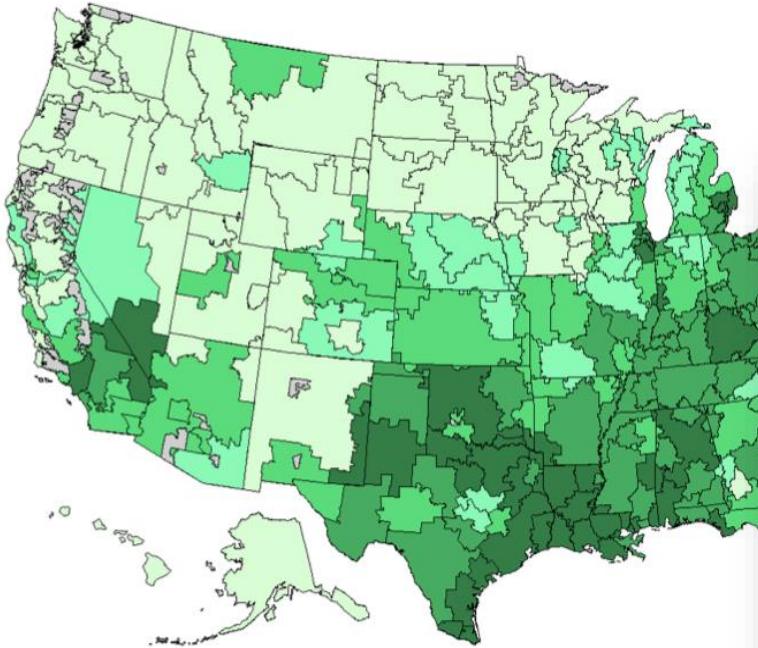
- Total Inpatient Days
- Inpatient Days in ICU or CCU
- Evaluation and Management (visits)
- Imaging
- Diagnostic Tests



If bar on this side, higher spending regions get more

Ratio of rate in high spending to low spending regions

# IS MORE SUPPLY-SENSITIVE CARE BETTER?



## Health Outcomes

No gain in survival

No better function

## Physician's Perceptions

Worse communication

Greater difficulty ensuring coordination

Greater perception of scarcity

## Patient-Perceived Quality

Lower satisfaction with hospital care

Worse access to primary care

No less sense that care is rationed

**Uncomfortable truth: we're wasting 20-30% of health care spending on supply-sensitive care**

Sources: (1) Fisher et al. Ann Intern Med: 2003; 138: 273-298; (2) Baicker et al. Health Affairs web exclusives, October 7, 2004; (3) Fisher et al. Health Affairs, web exclusives, Nov 16, 2005; (4) Skinner et al. Health Affairs web exclusives, Feb 7, 2006; (5) Sirovich et al. Ann Intern Med: 2006; 144: 641-649; (6) Fowler et al. JAMA: 2008; 299: 2406-2412.

# WIDELY HELD MENTAL MODELS – AND BETTER ALTERNATIVES

Widely held	Uncomfortable Truth	More useful
<p>The scientific basis of medicine is sound.</p> <p>Patients should defer to their physicians because they are the experts in biomedicine.</p>	<p>Evidence is often weak.</p> <p>Physician beliefs (and biases) drive many decisions.</p>	<p>We need much better evidence.</p> <p>Patients' goals and preferences matter. Shared decision making is an ethical imperative.</p>
<p>The United States provides the best medical care in the world. Bad care is due to bad apples.</p>	<p>Outcomes vary dramatically and are a consequence of how care is delivered.</p>	<p>Quality is a system attribute. We need systems that support learning and improvement.</p>
<p>All health care services offer benefit. Cutting spending will lead to rationing and harm.</p>	<p>Waste is pervasive: largely due to unnecessary care</p> <p>Supply drives utilization</p>	<p>Redesign is an alternative to rationing – at every level.</p> <p>Create incentives and systems to reduce overuse of avoidable supply-sensitive care</p>

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<p>All health care services offer benefit. Cutting spending will lead to rationing and harm.</p>	<p>Waste is pervasive; largely due to</p> <p><b>Beyond research:</b></p> <p>Findings used to support passage of the Affordable Care Act</p> <p>Atul Gawande wrote “The Cost Conundrum” (New Yorker), revealing magnitude of excess utilization and role of financial incentives.</p> <p>Accountable Care Organizations included in the ACA</p>	<p>Redesign is an alternative to</p>

# A CURRENT CHALLENGE FOR ALL OF US

## VARIATIONS IN LIFE EXPECTANCY

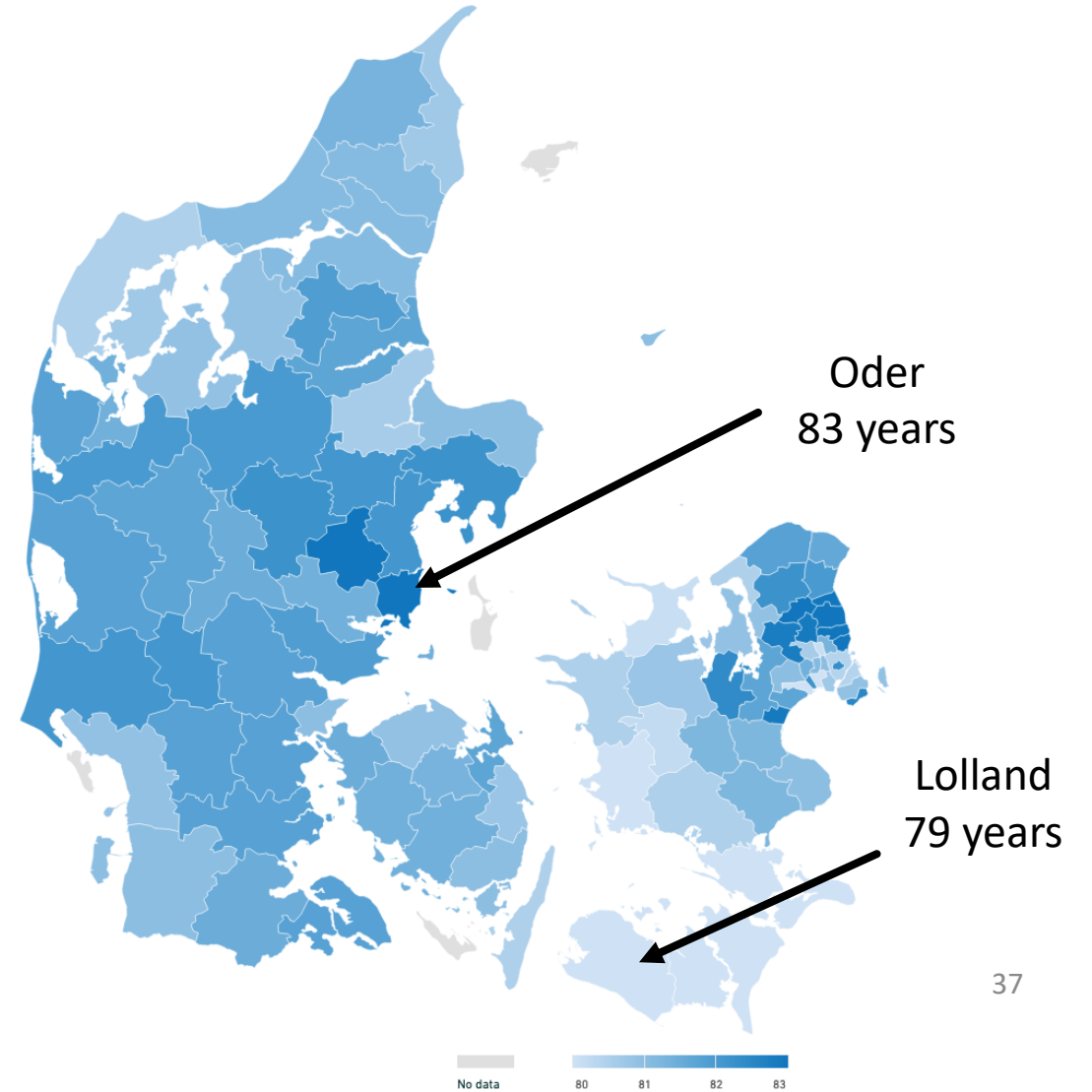
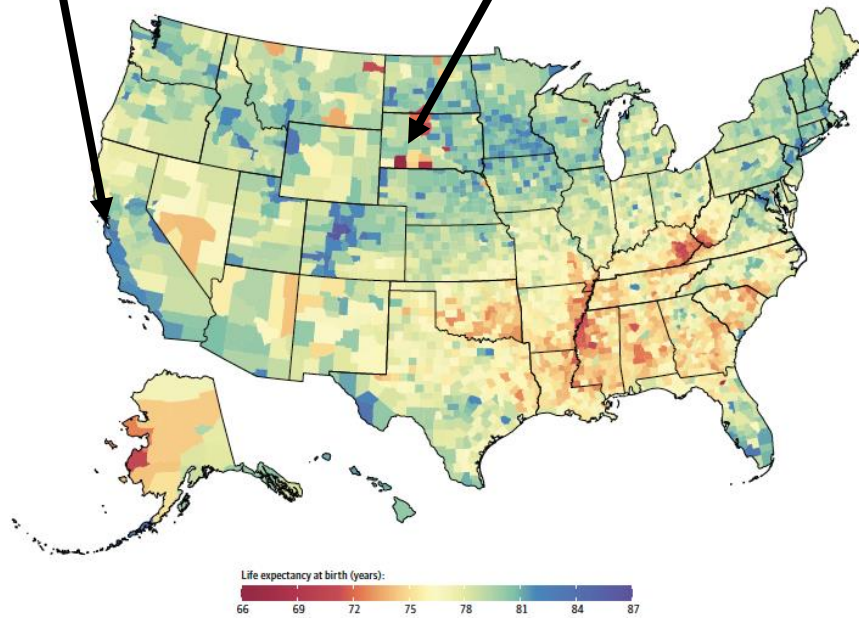
San Mateo County

83 years

Oglala Lakota County

67 years

Figure 1. Life Expectancy at Birth by County, 2014



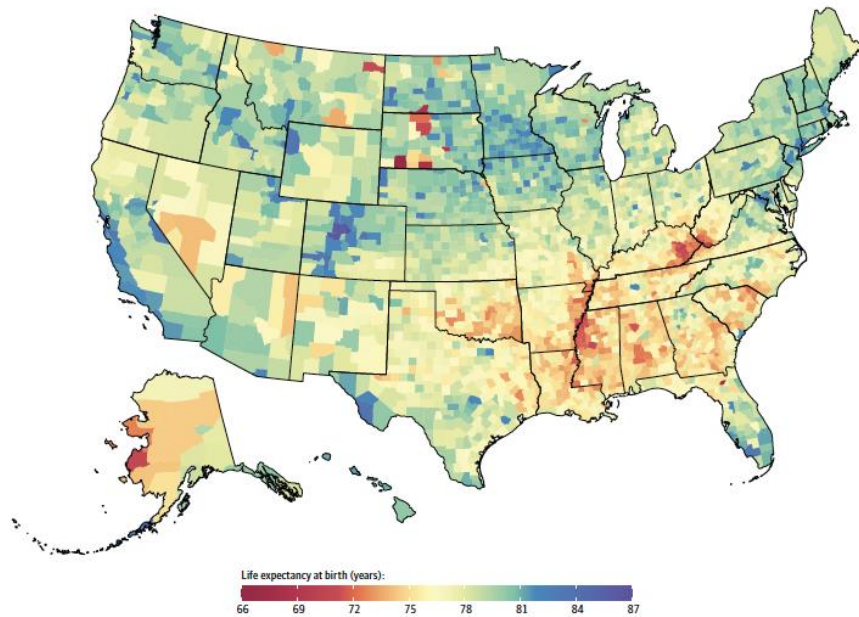
# THE FUTURE?

## ADDRESSING MODIFIABLE RISKS

### In the US

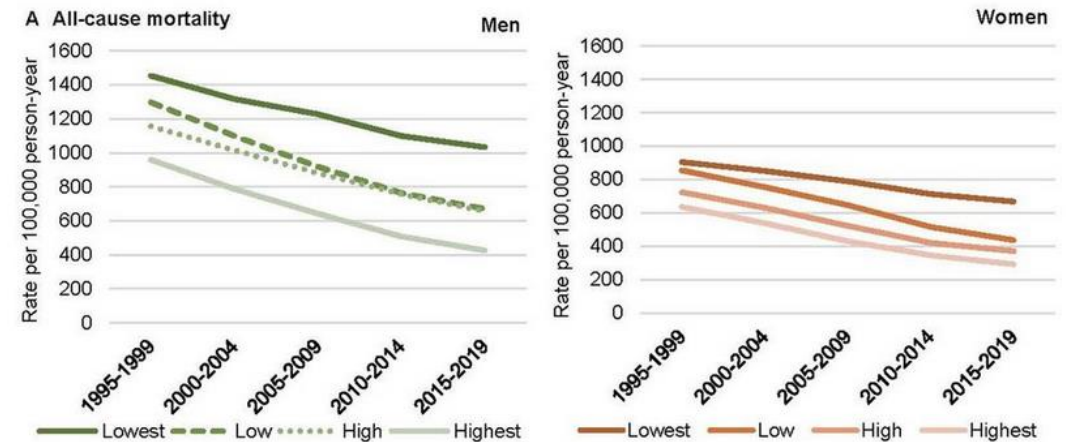
74% of variation explained by behavioral and metabolic risks  
Most of racial and economic variation due to modifiable risks

Figure 1. Life Expectancy at Birth by County, 2014



### In Denmark:

Mortality gap by educational attainment has increased  
60% of disparity due to alcohol and smoking



Original research

Trends in social inequality in mortality in Denmark 1995–2019: the contribution of smoking- and alcohol-related deaths [a](#)


[Heidi Amalie Rosendahl Jensen](#), [Sofie Rossen Møller](#), [Anne Illemann Christensen](#), [Michael Davidsen](#), [Knud Juel](#), [Christina Bjørk Petersen](#)

# THE FUTURE? WORKING TOGETHER TO IMPROVE HEALTH

## UNDERSTANDING AND ADDRESSING THE CAUSES OF PREMATURE MORTALITY

Research | [Open access](#) | Published: 01 October 2015

### Validation of a new predictive risk model: measuring the impact of the major modifiable risks of death for patients and populations

[Stephen S. Lim](#) , [Emily Carnahan](#), [Eugene C. Nelson](#), [Catherine W. Gillespie](#), [Ali H. Mokdad](#), [Christopher J. L. Murray](#) & [Elliott S. Fisher](#)

*Population Health Metrics* **13**, Article number: 27 (2015) | [Cite this article](#)

5825 Accesses | 13 Citations | 6 Altmetric | [Metrics](#)

### Measure: predicted 10 year life expectancy

Estimated based on major metabolic and behavioral risks

### Why (theoretically) useful?

*At point in time:* Help patients prioritize risks; help identify those at highest risk  
*Over time:* because it changes in real time → a measure of health improvement

### Potential Use Cases for “LifeScore”

Clinicians and individuals:

shared decision-making

Practices:

identifying high risk groups

Health systems

Tracking and motivating improvement

Payers

Rewarding improvement

Researchers:

Testing interventions

### Aligning Accountable Care Models With The Goal Of Improving Population Health

[Elliott S. Fisher](#), [Andrew B. Bindman](#), [Michael Kopko](#)

MARCH 11, 2024

10.1377/forefront.20240305.653407



### Where we are now

Launching collaborative

Initial work – proof of concept

Then – expand to registry based improvement approach

Life expectancy	
	Smoking
Male	3.2
Female	2.4

# SUMMARY

<b><i>Category of Care</i></b>	<b><i>Translating theory into action</i></b>
Effective Care / Patient Safety	Registry based improvement Clinical engagement and leadership
Preference Sensitive Care	Improve real-world evidence Shared decision making
Supply-sensitive Care	Apply variation analysis to reveal breadth and magnitude of opportunity for savings
Health Improvement	Measure current modifiable risks to future health – and apply improvement science to reduce them  Invest in the Vital Conditions (social determinants)



# THE FUTURE

## REGISTRY-BASED LEARNING HEALTH SYSTEMS



BMJ 2016;354:i3319 doi: 10.1136/bmj.i3319 (Published 1 July 2016)

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### Patient focused registries can improve health, care, and science

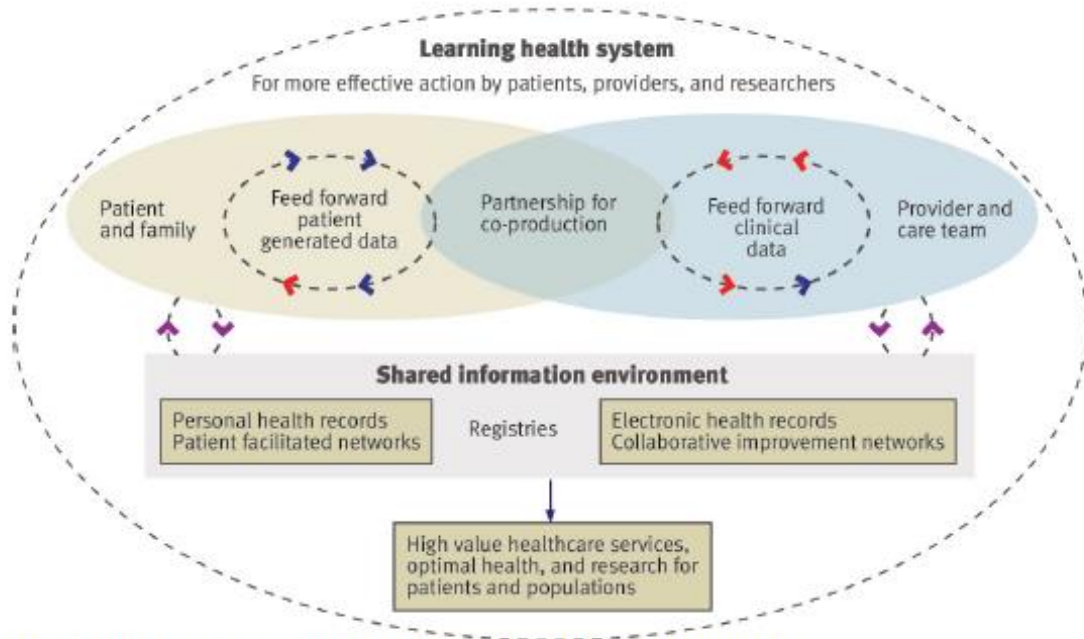
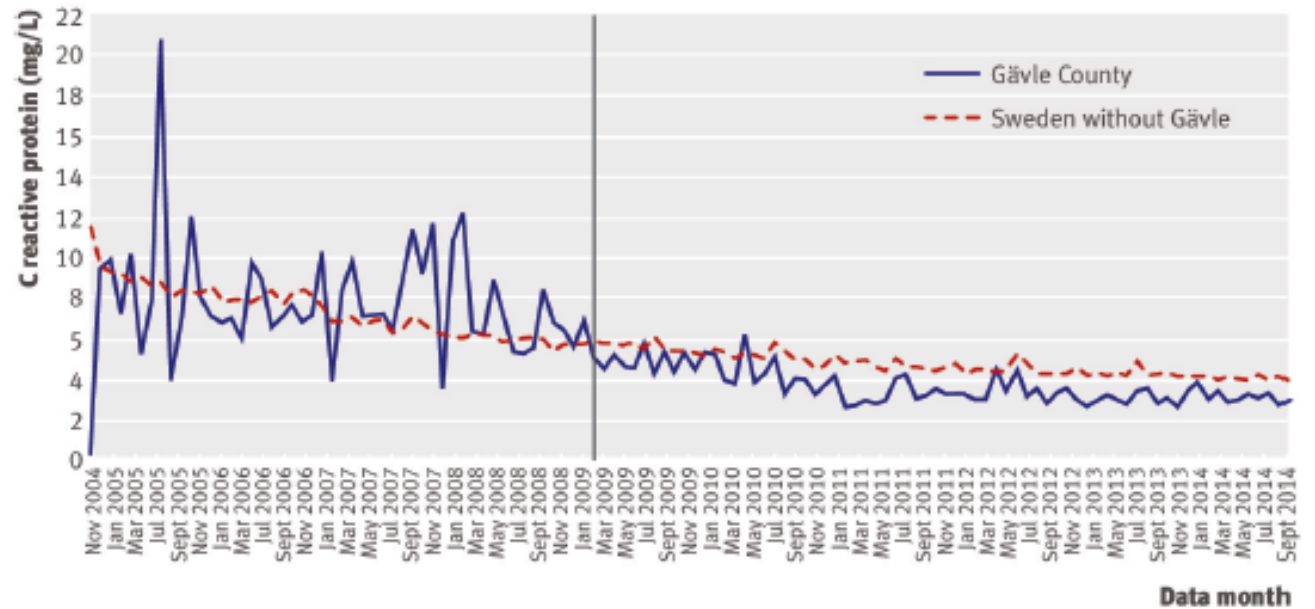


Fig 1 Model of registry enabled care and learning health system

Inflammatory activity (C-reactive protein; CRP) by month for Swedish individuals with rheumatoid arthritis

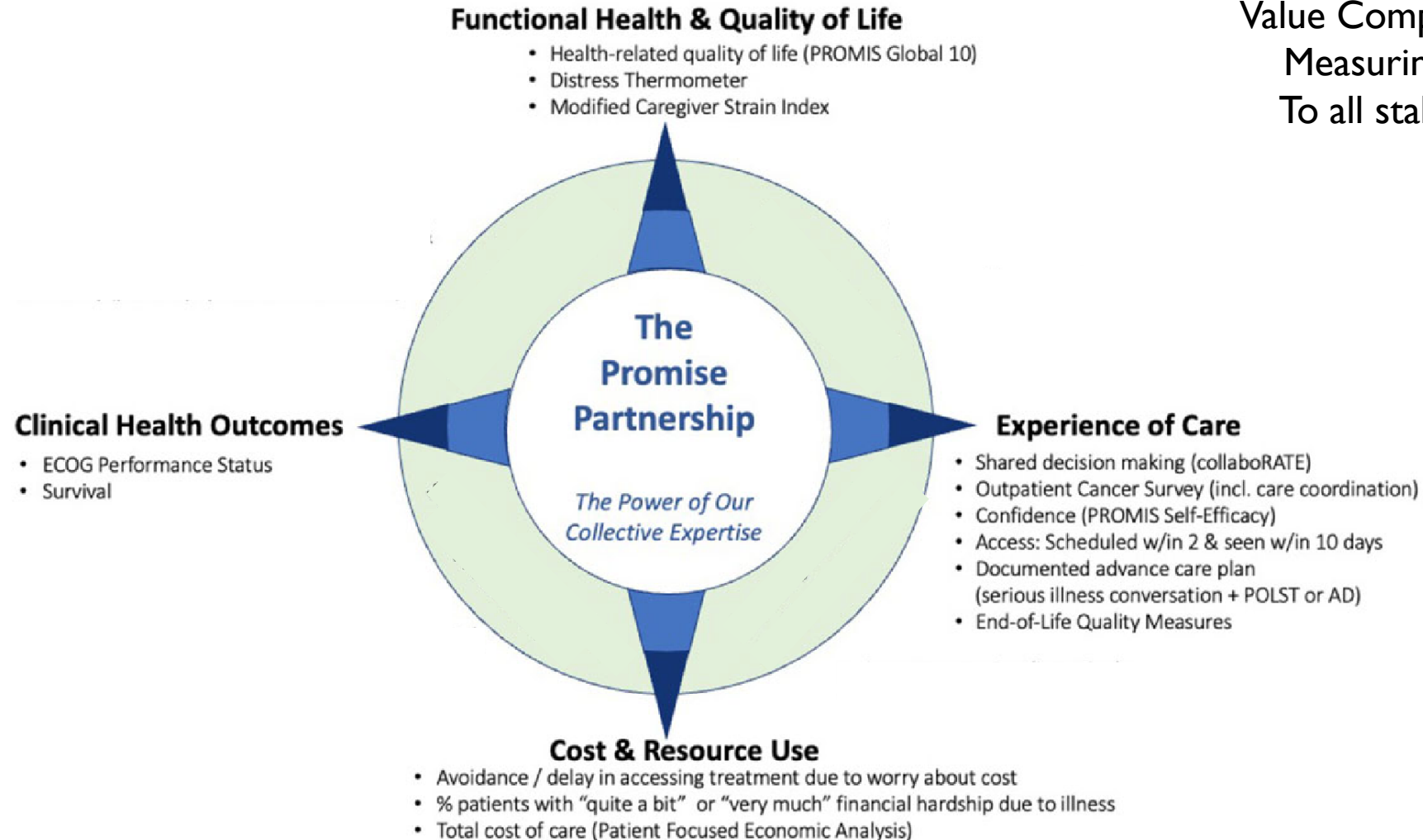


Data month

# WHERE WE ARE NOW

## APPLYING A VALUE COMPASS APPROACH TO IMPROVEMENT

Value Compass  
Measuring what matters  
To all stakeholders



# THE FUTURE

ENGAGING ALL STAKEHOLDERS TO IMPROVE HEALTH, CARE, COSTS AND QUALITY: ATLASES CAN HELP

