Challenges and Opportunities in Applying OR/MS Tools to Improve Healthcare Delivery

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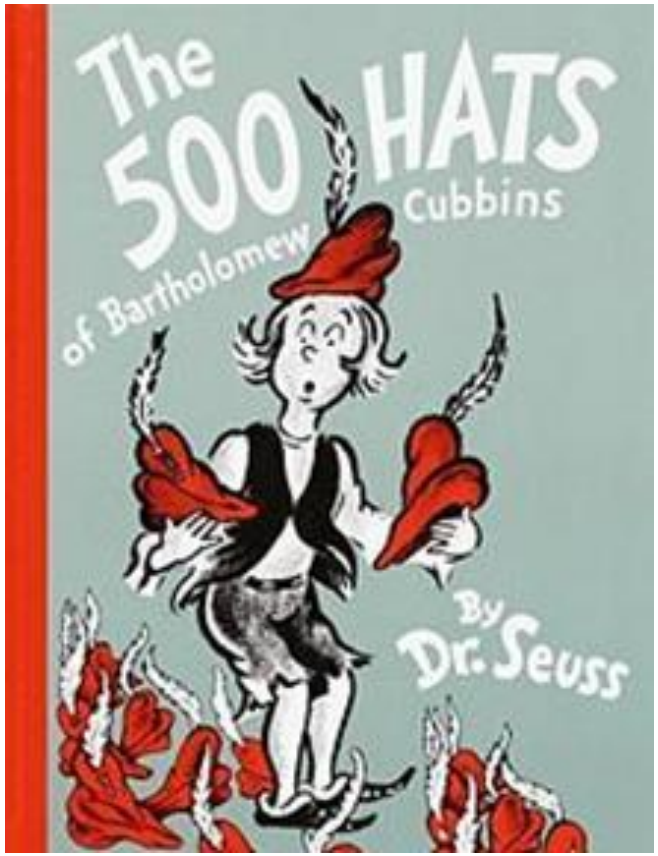
CHEPS Center for Healthcare Engineering & Patient Safety

Background

- My faculty hat
- My Center hat
- My caregiver hat
- My patient hat
- My policy hat

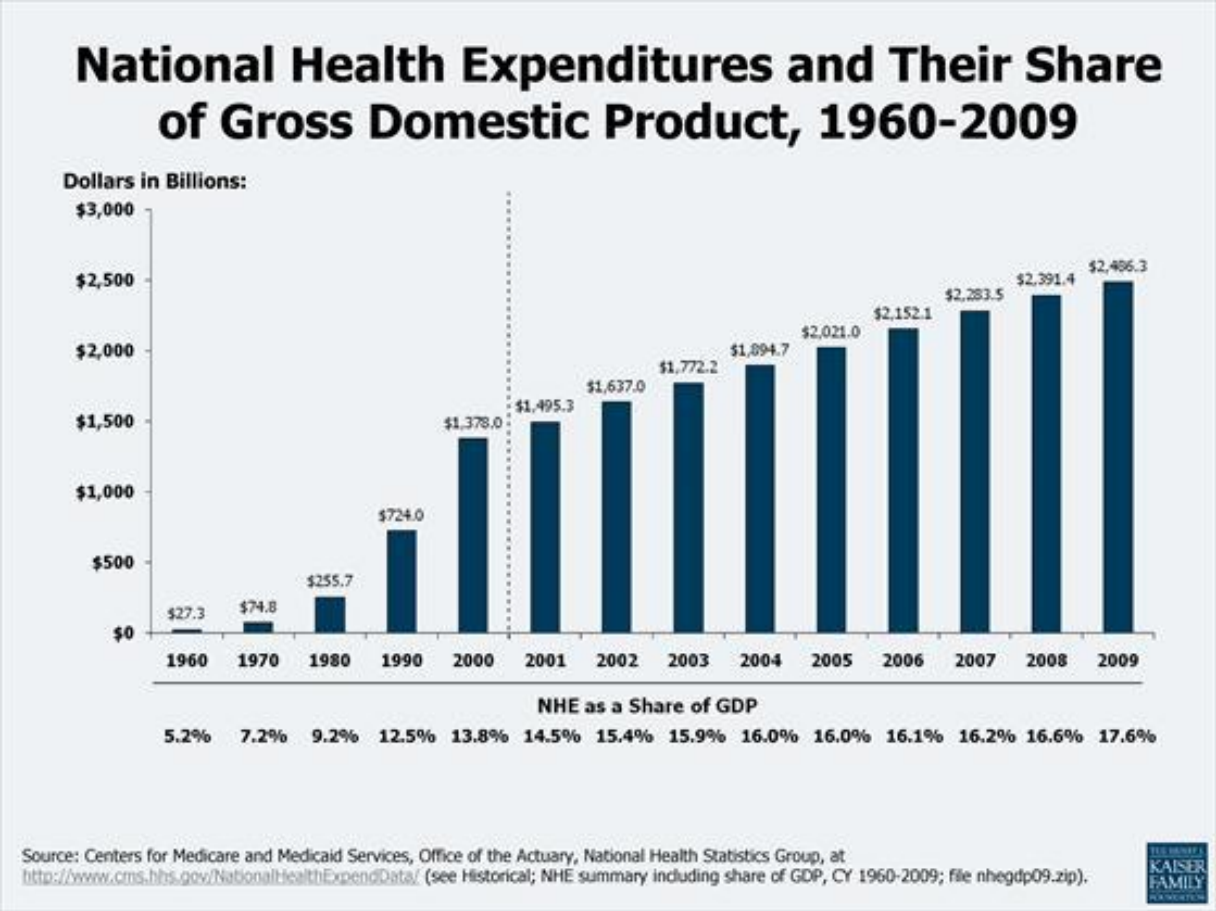


Landscape of Opportunities

- From many different perspectives, working at the interface of engineering and healthcare
  - What are the opportunities for healthcare?
  - What are the opportunities for engineering?
  - What are the opportunities for education?

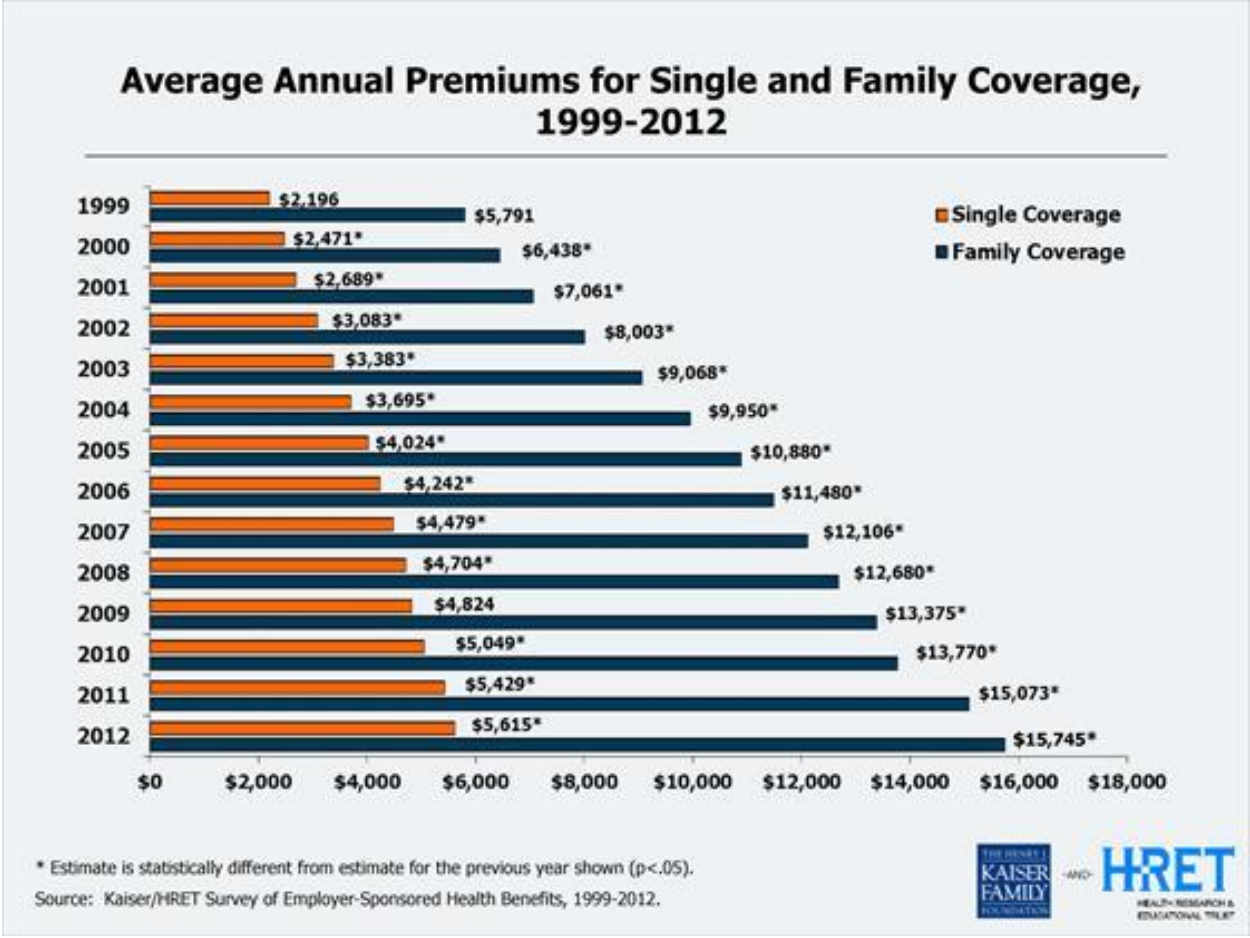
Scope and Scale of the Problem

- 17% of US GDP



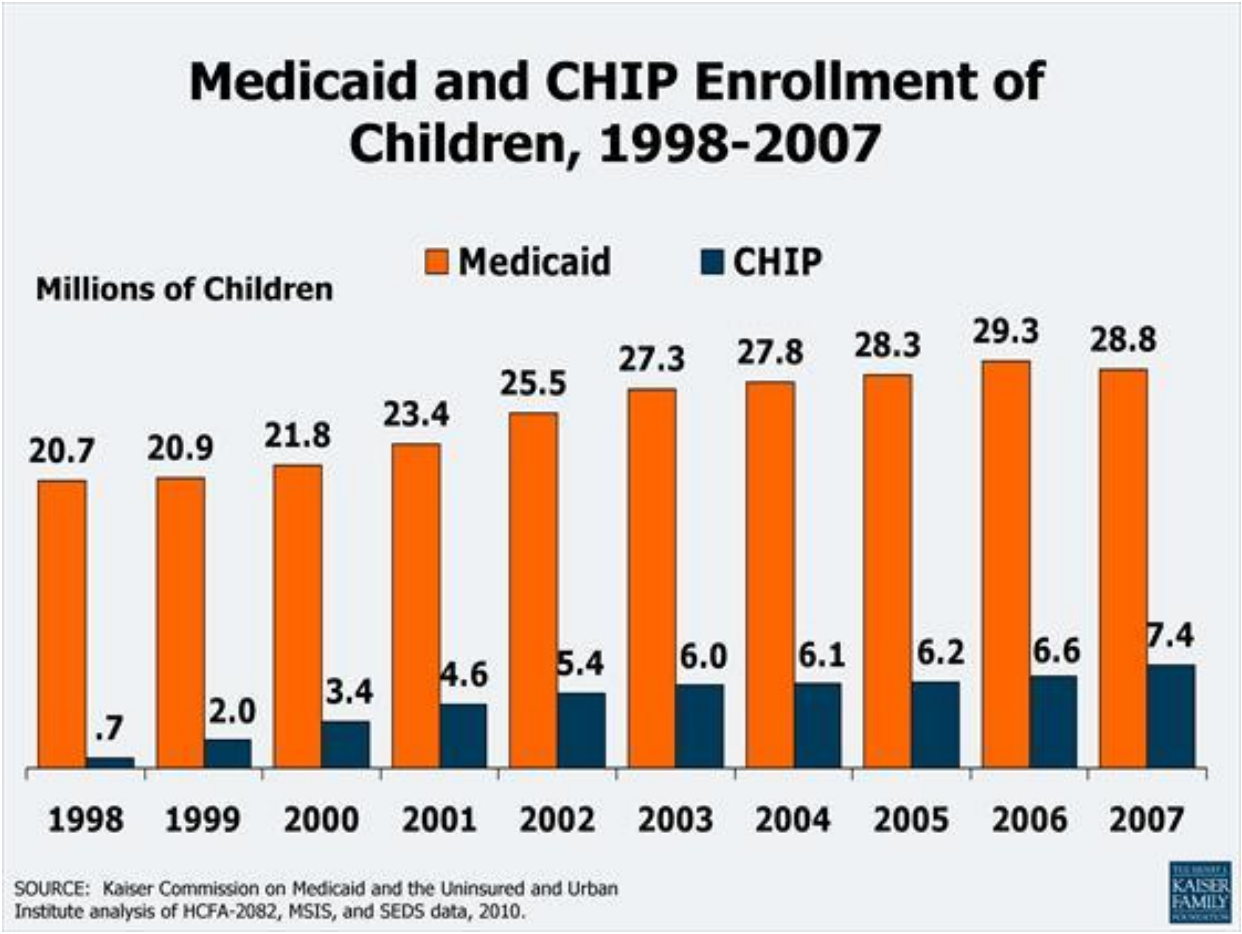
Scope and Scale of the Problem

- Personal costs are rising rapidly



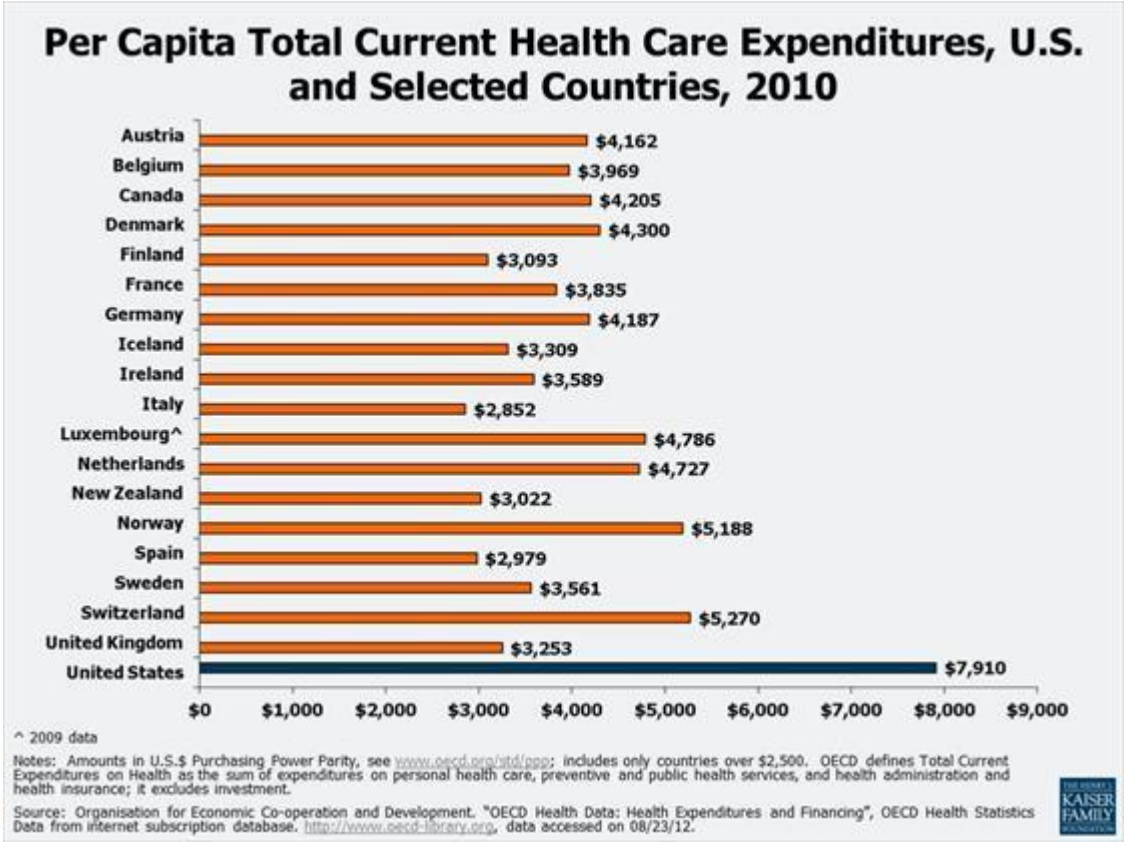
Scope and Scale of the Problem

- Children a particularly vulnerable population

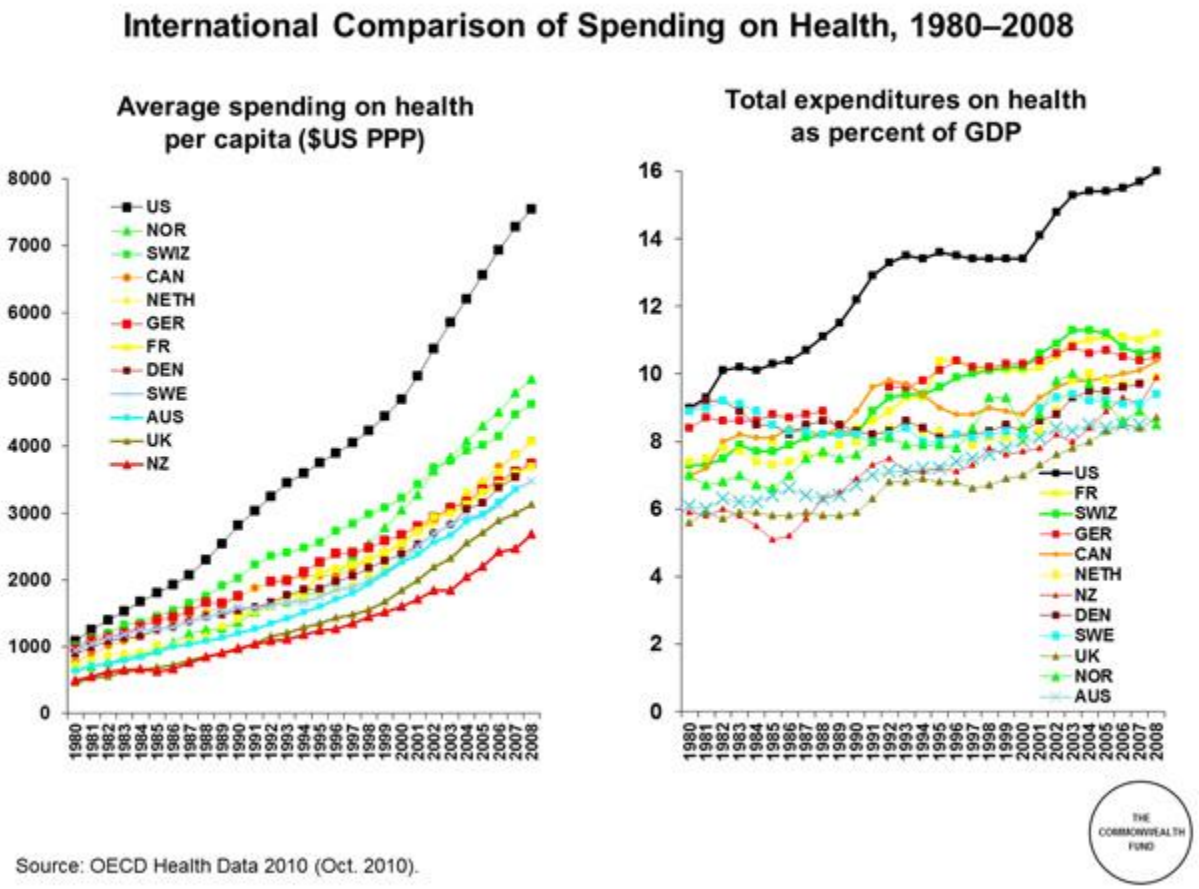


Scope and Scale of the Problem

- We spend more than any other developed nation



Scope and Scale of the Problem



Source: OECD Health Data 2010 (Oct. 2010).

Scope and Scale of the Problem

- Quality trailing all other developed nation

Overall Ranking

Country Rankings	
	1.00–2.33
	2.34–4.66
	4.67–7.00

	AUS	CAN	GER	NETH	NZ	UK	US
OVERALL RANKING (2010)	3	6	4	1	5	2	7
Quality Care	4	7	5	2	1	3	6
Effective Care	2	7	6	3	5	1	4
Safe Care	6	5	3	1	4	2	7
Coordinated Care	4	5	7	2	1	3	6
Patient-Centered Care	2	5	3	6	1	7	4
Access	6.5	5	3	1	4	2	6.5
Cost-Related Problem	6	3.5	3.5	2	5	1	7
Timeliness of Care	6	7	2	1	3	4	5
Efficiency	2	6	5	3	4	1	7
Equity	4	5	3	1	6	2	7
Long, Healthy, Productive Lives	1	2	3	4	5	6	7
Health Expenditures/Capita, 2007	$3,357	$3,895	$3,588	$3,837*	$2,454	$2,992	$7,290

Note: * Estimate. Expenditures shown in $US PPP (purchasing power parity).
Source: Calculated by The Commonwealth Fund based on 2007 International Health Policy Survey; 2008 International Health Policy Survey of Sicker Adults; 2009 International Health Policy Survey of Primary Care Physicians; Commonwealth Fund Commission on a High Performance Health System National Scorecard; and Organization for Economic Cooperation and Development, *OECD Health Data, 2009* (Paris: OECD, Nov. 2009).

THE COMMONWEALTH FUND

CHEPS Center for Healthcare Engineering & Patient Safety

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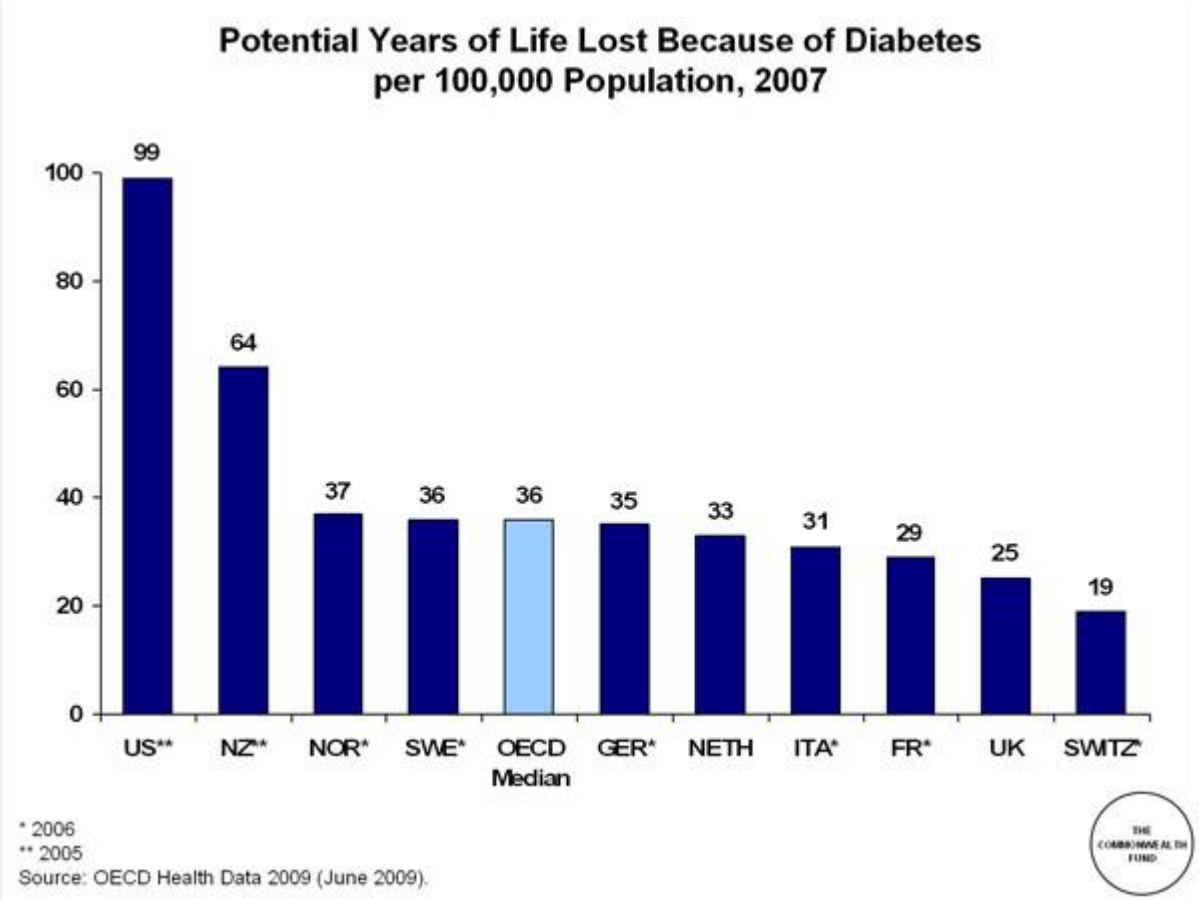

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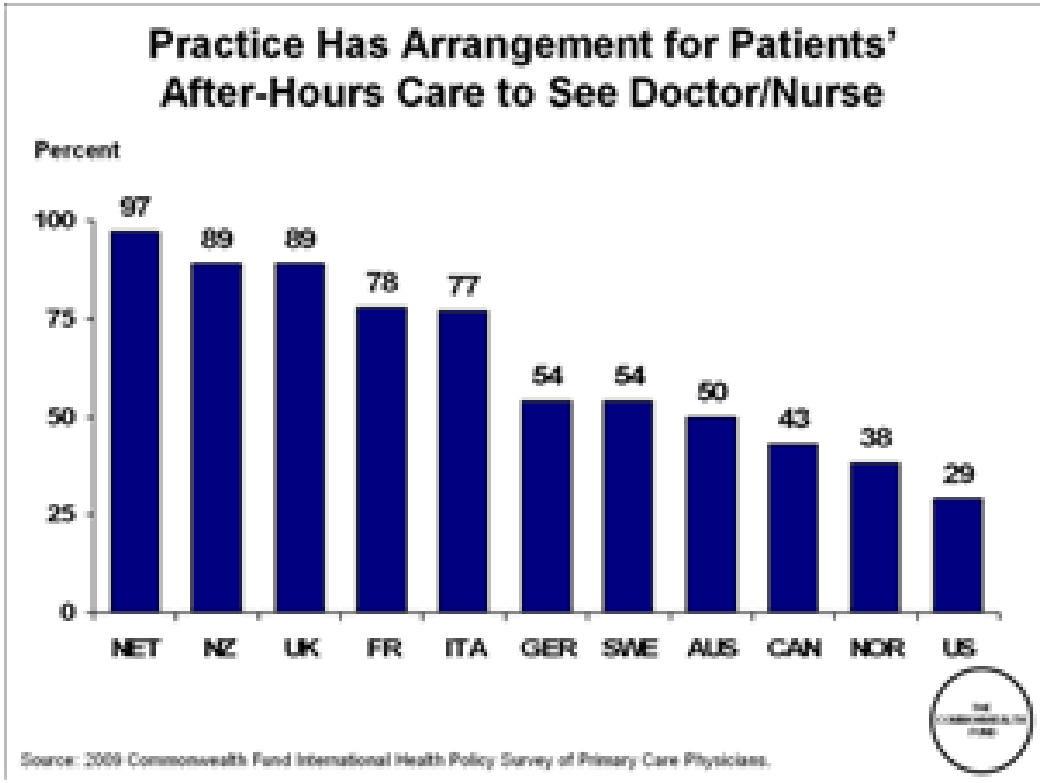

IOM Goals

- 2005 seminal report issued jointly by IOM and NAE:
- Six major goals for the U.S. healthcare system:
  - Safe
  - Effective
  - Timely
  - Patient-centered
  - Efficient
  - Equitable
- Importance of “a vigorous new partnership” between engineering and healthcare to overcome the challenges that prevent us from reaching these goals

OR/MS Opportunities for Impact

- Why is this partnership important?
  - Systems perspective
  - OR/MS ability to translate complex real-world problems into mathematical models that can be analyzed and optimized
  - Use of data to drive decisions

Broadening the Scope

- Understand problem domain
- Identify specific problem
- Gather data
- Build models
- Build algorithms
- Analyze results
- Implement solutions
- Maintain solutions

Topic 1: Bilingualism

- Communication is important in any applied research/project
- A particular challenge in healthcare
  - Healthcare providers are not engineers!
  - Neither group are famous for their communication skills
  - Culture and hierarchy play a key role

Topic 1: Bilingualism

- Educational need:
  - Not enough to train engineers to present to other engineers
  - Need to train engineers to present to non-engineers
  - Need to train engineers to present to healthcare providers in particular
  - Need to train engineers how to *listen* to healthcare providers!
  - Can we also teach healthcare providers to talk to engineers?

Topic 1: Bilingualism

- Some simple examples of language issues
  - "Optimal"
  - "Stochasticity"
  - Example from BUSM residency scheduling

Topic 2: Understanding and Identification of Critical Challenges

- We teach students to solve problems that are given to them…
- …but where do the problems come from?
- In healthcare, problems aren't posed "the right way" – return to issue of bilingualism
- Need to understand the domain thoroughly to see where opportunities are for improvement
- Need to understand the domain thoroughly to ensure solutions that can be implemented

Topic 2: Understanding and Identification of Critical Challenges

- Need to understand
  - Processes and operations
  - Culture
  - Finance
  - Medicine
  - Terminology
  - Decision makers and constituencies
  - Incentives

Topic 2: Understanding and Identification of Critical Challenges

- We are approaching this through “The Engineer’s Guide…”
  - Transplant
  - Residency scheduling
  - Asthma

Topic 3: Innovative Solutions

- Developing innovative solutions often requires the creation of novel models, algorithms, and simulation-based tools
- This is what we often focus on/teach our students
- Plenty of opportunities
  - And can advance other fields as well
  - E.g. scheduling planned and unplanned events

Topic 3: Innovative Solutions

- But the math is not enough…

Topic 4: Barriers to Implementation

- What are the barriers that limit the implementation of these solutions?
  - Culture
  - Regulatory landscape
  - Privacy issues
  - Uniqueness of each patient
  - Technology / HER

  Data can help overcome these barriers

  Strong partnerships are also key

Topic 5: Multi-Disciplinary Education

- Need for educating both OR/MS practitioners and healthcare providers so as to foster ongoing and widespread successful collaborations
- Educating engineers
  - Seminar series
  - Student research experiences
  - Shadowing
  - HEPS concentration

Topic 5: Multi-Disciplinary Education

- Educating clinicians
  - Multi-disciplinary student research teams
  - Truly collaborative problem solving (not "consulting")
  - Transplant simulator – demo

Conclusion: Education

- Healthcare provides a great opportunity to train engineering/OR students in
  - Multi-disciplinary problem solving
  - Open-ended problem solving
  - Communication skills
- We also have the opportunity to educate healthcare providers about the benefits of systems engineering/analytics-based approaches
  - Best done through hands-on, collaborative projects?

Conclusion: Engineering

- Many advances in OR methodology can be motivated by/advanced through healthcare applications
  - Scheduled/unscheduled use of capacity
- Many applications of engineering don't look like "rocket science"
  - Low hanging fruit
  - Challenges in implementation, acceptance
  - Still advance our field
  - Lay the ground work for more sophisticated OR

Conclusion: Healthcare

- Requires new skills not always taught to engineers in school
- Requires deep collaboration between engineers and healthcare providers
- Requires a heavy up-front and on-going investment in learning the problem domain
- Tremendous opportunity to have impact

Questions and Discussion