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**Health Policy,  
Management  
and Evaluation**

# Is there a quality-efficiency trade-off in Ontario hospitals?

CAHSPR, Calgary

May 12, 2009

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Funded by: Canadian Institutes of Health Research

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# Efficiency Measurement

- Efficiency measurement is essentially about identifying the highest level of output that can be achieved with a given set of inputs (or minimizing inputs to attain a given output).
- Hospital care produces ‘return to health’ with physicians, nurses, and technology
  - ‘Return to health’ is a relatively difficult output to measure.

# Efficiency Measurement

- Hospitals are accountable for patient volumes and must achieve volumes within predetermined global budgets.
- Policy makers are concerned with system sustainability and increased efficiencies from acute hospitals who still comprise substantive portion of health care budget.

# Efficiency Measurement

- Hospitals produce improvements in health via multiple outputs: inpatient and outpatient and emergency care requiring various interventions.
- Hospitals and policy makers tend to have fairly crude assessments of efficiency:
  - e.g. Average Length of Stay; Cost per weighted case
- Crude measurement impairs hospitals' ability to identify areas of inefficiency and areas for improvement.

# Quality Measurement

- Past studies of efficiency have tended not to directly measure quality thereby assuming equivalent quality across organizations.
- But data reported on public websites, identified in legal accountability agreements and pay-for-performance initiatives, and examined in research suggests that quality varies across hospitals.

# Quality Measurement

- Most commonly *mortality* has been used as a clinical outcome to compare hospital quality.
- Demand for more sensitive measures has led to use of *readmission* rates as an indication that the hospital output was not full return to health.
- *Adverse events* and nursing-sensitive complications within hospitals represent a further refinement of clinical quality measurement.

# Efficiency - Quality Trade-off

- Economic theory holds that a higher quality product requires a greater amount of input.  
... a higher cost curve for higher quality care.
- Thus if poor quality (e.g. more deaths, higher adverse events, more readmissions) are due to under-provision of care then we expect to find an empirical trade-off between efficiency and quality.

On the other hand...e.g.

- Adverse events leading to complications may require additional resources to manage new problems.

# Efficiency - Quality Trade-off

- Few studies have directly examined quality & efficiency:

## Post-hoc comparison of quality and efficiency

- *Mortality higher in most efficient rural US hospitals*  
(Ferrier & Valdmanis, JPA 1996)
- *Mortality higher in inefficient California acute hospitals*  
(Mobley & Magnussen, JHCF 2002)

## Simultaneous comparison

- *No relation between mortality and efficiency in Turkish Hospitals*  
(Sahin & Ozcan , JMS 2000)
- *Decline in productivity with increased quality (fewer infections)*  
(Sola & Prior, FAM 2001)
- *Higher mortality associated with inefficient production of volume*  
(Clement et al, HCMS 2008)

# Efficiency - Quality Trade-off

## New Contribution:

- First examination of Quality-Efficiency trade-off in Canadian Hospitals
- Examine whether the relationship is the same across various quality measures
- Focus on inputs under management control (e.g. staffing levels)

# Methods: Approach

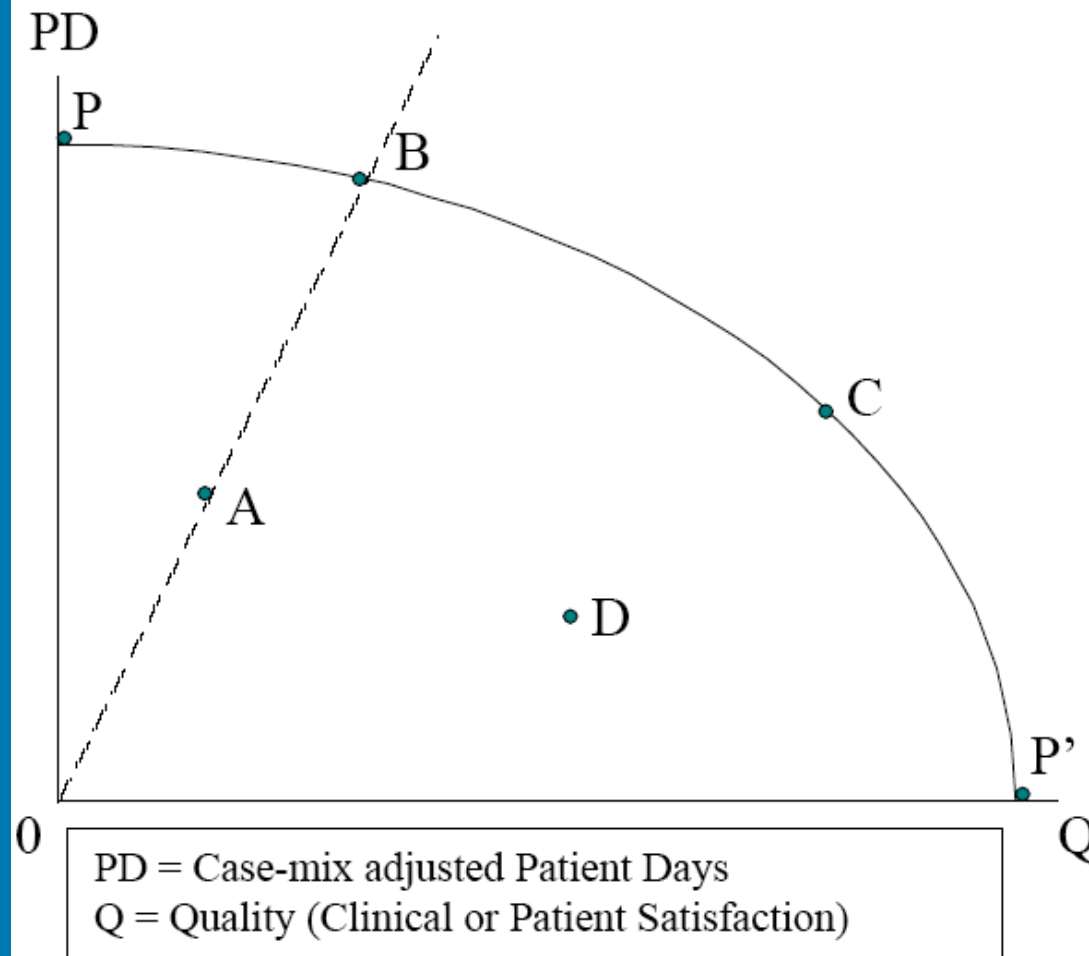
- Data Envelopment Analysis (DEA)
  - Linear programming solution to the problem of maximizing *multiple* outputs with a given set of *multiple* inputs

$$F_i(y^j, x^j | C, S) = \min_{\theta, \lambda} \theta \quad (1)$$

$$\text{subject to : } y^j \leq \lambda Y, \theta x^j \geq \lambda X, \lambda \in \mathfrak{R}_+^J$$

# DEA Model of Production

Production Possibility Frontier (PPF)



# Setting

## Ontario Acute Care Hospitals

156 Acute Hospitals in 2006/07

– 31 specialty hospitals (mental health, ambulatory etc)

n = 125

# Data Sources

## Financial and Statistical Data

- Ontario Hospital Reporting System (CIHI-MIS)

## Clinical Quality Data

- CIHI Discharge Abstract Database (CIHI-DAD)

# Input Measurement

Labour Hours (Professional, Regulated, Support)  
Capital (Bed days staffed and in operation)  
Supplies (Diagnostic & Therapeutic, Medical,  
Pharmaceutical Supplies)

# Output Measurement

Resource Intensity Weighted (RIW) x Patient Days  
Equivalency Day Surgery Cases  
Emergency Department Cases

# Quality Measurement

Mortality: Hospital Standardized Mortality Ratio (CIHI HSMR)

Readmission rates (for all medical and surgical procedures as defined by Ontario Hospital Report)

Adverse Events (as defined by Needleman et al, NEJM 2002)

# Methods: Approach

- Quality as a congestion problem
- Consider impact of congestion using DEA
  - Assume all outputs are good (traditional view: strong disposability of output constraint)
  - Consider some outputs interfere with others (congestion view: weak disposability of quality outputs)
  - Compare efficiency under congestion view to efficiency under traditional view
- Measures whether congestion (quality problems) compromise efficiency

# Results

- Overall Efficiency:
  - 1.12 (on average hospitals could produce 12% more output with given sets of input)...no quality adjustment
  - 53 hospitals were efficient (frontier hospitals)
  - 72 hospitals were inefficient
- Quality :Observed/Expected Ratios (s.d.):
  - In-Hospital Standardized Mortality Ratio: 0.78 (0.24)
  - In-Hospital Complication Ratio : 0.76 (0.43)
  - Hospital Readmission Ratio : 1.02 (0.41)

# Results

Observed / Expected Quality Score (s.d.) by Efficiency					
Mortality		Complications		Readmissions	
Ineff.	Effic.	Ineff.	Effic.	Ineff.	Effic.
0.77	0.78	0.83	0.71	1.07	0.98
(0.27)	(0.22)	(0.50)	(0.36)	(0.47)	(0.35)
p = 0.79		p = 0.15		p = 0.23	

- Mortality rates about the same in efficient and non-efficient hospitals
- Quality is (not significantly) worse (higher complications and readmissions) in efficient hospitals

# Results

Mean (s.d.) Congestion Score for Congested Hospitals		
Mortality	Complications	Readmissions
1.03 (0.03)	1.07 (0.10)	1.06 (0.10)

1.00 interpreted as no congestion;  $>1.00$  is congestion

- Results are not significant
- Trend is that there is no trade-off for Mortality
- There is some trade-off for Complications and Readmissions

# Interpretation

- Mortality has little relationship to efficiency in Ontario Acute Hospitals.
- There is a non-significant trend, that complications and readmissions contribute to reduced efficiency in Ontario acute hospitals.
- DEA analysis helps to make assumptions and interpretations more transparent.

# Next Steps:

- Examining temporal trends in efficiency and changes in technical efficiency, technological changes, and production models.
- Integrating and comparing various approaches to efficiency: Stochastic Frontier models and Quantile models.
- Assessing the economic costs of quality (adverse events and readmissions).
- Assessing the impact of technology on hospital quality.

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# Questions & Comments

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