

A multilevel approach to explain variation in costs and quality of hospitals in different settings

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Jonas Schreyögg, Oliver Tiemann, Tom Stargardt

*Dept. Health Care Management, Faculty of Economics and Management, Berlin University of Technology, Germany/
Center for Primary Care and Outcomes Research, Stanford University, USA*

Background

- Provision of high quality care at low costs has become the major objective in most health care systems of the world
- Hospitals and health care systems are increasingly benchmarked according to a number of criteria (e.g. WHO 2000 report)
- Drawbacks of many studies:
 - High level of aggregation (precludes adequate control of case-mix)
 - Detailed individual level cost data rarely available
 - Often no indicators for quality included

Objective

1) to explain variation in **costs** and

2) to explain variation in **hospital mortality as a measure of clinical quality**

between hospitals in different settings with individual level data

-> to explore new ways in comparing health care systems

Research approach

- To adequately control for case-mix we select Acute Myocardial Infarction (AMI) as a major care episode
- A number of studies have measured hospital performance based on AMI
- Advantages of AMI over other care episodes:
 - Requires immediate medical attention -> no patient selection
 - High incidence and leading cause of death in the elderly
 - Quality of care provided by hospitals can substantially avoid mortality
 - Reflects level of technology utilization

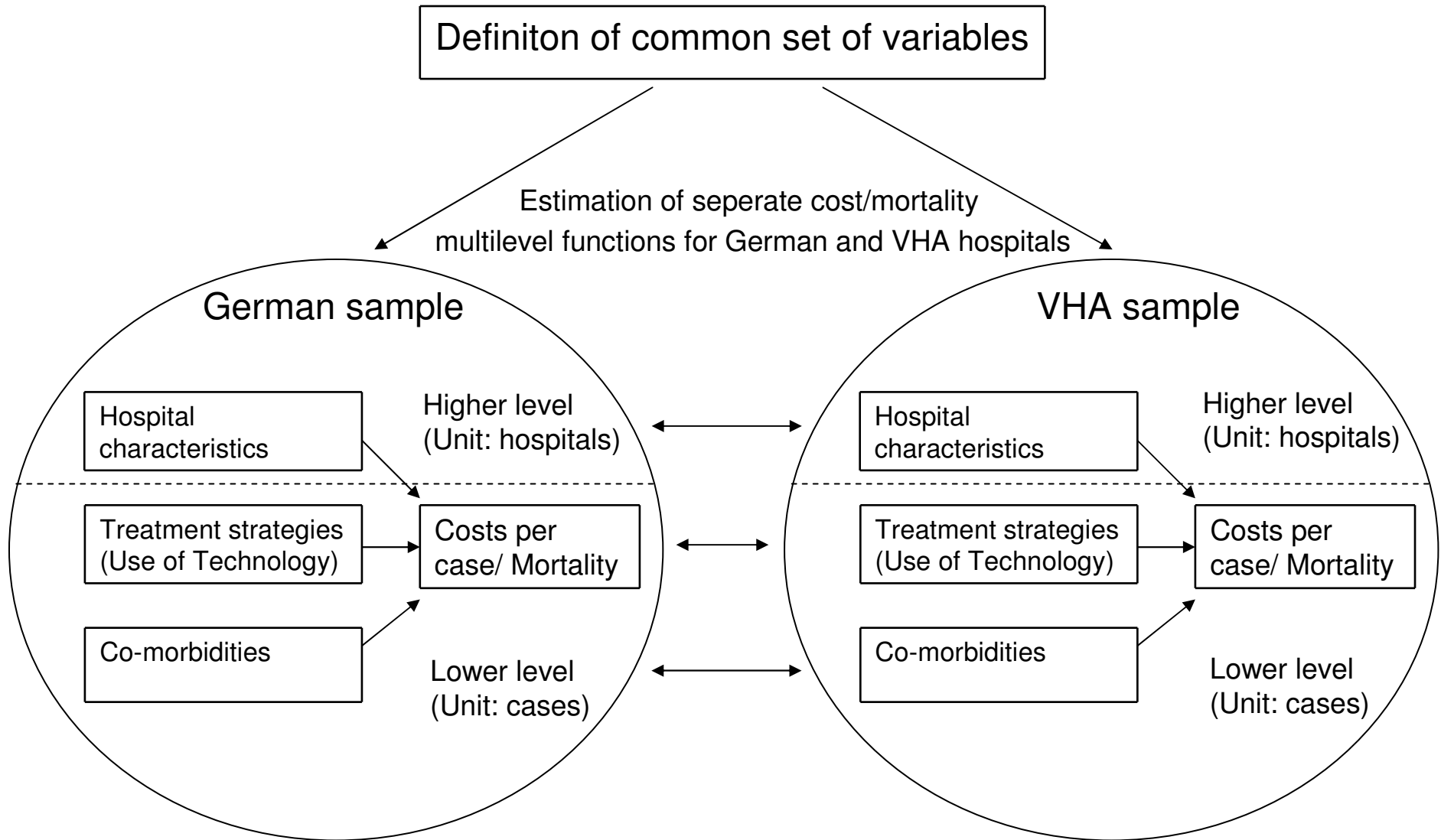
Data

- Data for year 2005 were obtained from the German national cost data study and the administrative databases of the VA
 - both settings have a very similar data structure and follow a similar cost accounting approach
 - modular accounting approach allowed us to separate costs according to diagnostic services, laboratory, drugs, ward costs, and overhead costs
 - patients classified as having severe complications and who had undergone coronary artery bypass graft surgery were excluded
- > 130 VA hospitals with 6,598 patients and 18 German hospitals with 585 patients remained in the two samples

Methodology (1)

1. Multilevel regression is performed
 - > What determines costs and mortality in both systems?
2. Imposing VHA prediction functions on German sample and imposing German prediction functions on the VHA sample
 - > How would VHA hospitals perform with German patients and vica versa?
3. Applying a propensity matching score approach to match VHA and German patients
 - > How do hospitals from both systems perform with the same patient co-morbidities/treatment strategies?

Methodology (2)



Definition of variables

Dependent variables:

- Costs per case: costs incurred during hospitalization for treatment after AMI
 - converted German costs into PPP adjusted US\$
 - transformed by the natural log
- In-Hospital mortality

Explanatory variables:

- Co-morbidities:
 - Ontario AMI prediction rules and Charlson Co-morbidity Index were used
 - ICD-9 for VHA and ICD-10 for Germany – crosswalk tables used
- Treatment strategies: Cardiac catheter, PTCA, Stents
- Hospital characteristics:
 - Number of selected AMI cases
 - Beds as proxy for capital input
 - Urban status: hospitals located in metropolitan area with pop. > 200,000
 - Teaching status: if member of the council of teaching hospitals
 - Nursing ratio: proxy for labor intensity

Sample characteristics

	VA	Gemany	p-value
No. of cases in the sample	6598	585	
No. of hospital in the sample	130	18	
Length of stay	5.5	8.0	<0.0001
Mortality rate	6.3%	1.5%	<0.0001
<i>Treatment Strategies</i>			
No procedure	29%	27%	0,034
Catheterization/NOPCI	17%	14%	0,0046
PTCA received	22%	36%	<0.0001
STENTS received	9%	20%	<0.0001
DRUGSTENTS received	23%	3%	<0.0001
<i>Hospital Characteristics</i>			
Selected AMI cases	48	35.6	0.59
Nurses per bed	2.8	0.59	<0.0001
Physicians per bed	0.7	0.2	<0.0001
Adminstrative staff per bed	2.2	0.1	<0.0001
Number of beds	137.8	503.3	<0.0001
Member of the council of teaching hospitals	35%	50%	0.63
Located in urban area	38%	22%	0.55

Median costs by cost category in US\$

	VHA	Germany
Radiology Laboratory	<i>Factor 3.5 (40% due to wages/ 60% due to nursing ratio)</i>	
Therapy + Ward ^a		
- Nursing Staff	2.549	727
- Physicians and other staff	874	686
- Drugs	555	128
- Overhead	1.736	848
- Total	5.988	2.579
General Overhead ^b	3.646	797
Total costs	11.034	3.650
	<i>Factor 4.6 (higher admin. per bed ratio 2.0- VA/ 0.12-Ger, higher admin. wages -> more documentation, bureaucracy etc.)</i>	

How do VA hospitals perform with German patients and vice versa?

	Predicted mean values based on German function		Predicted mean values based on VHA function	
	VHA	Germany	VHA	Germany
Based on co-morbidities (in \$)				
Total costs (in \$)	3,675	3,953	14,909	15,565
Hospital mortality (in %)	2.5	1.5	6.3	6.4
Based on co-morbidities and treatment strategies				
Total costs (in \$)	3,498	3,953	14,909	15,488
Hospital mortality (in %)	2.0	1.5	6.3	6.0
Based on co-morbidities, treatment strategies and				
Total costs (in \$)	3,748	3,953	14,909	15,638
Hospital mortality (in %)	2.9	1.5	6.3	6.8

How do hospitals from both systems perform with the same co-morbidities/treatment strategies?

	Unmatched samples	Matched on propensity scores for co-morbidities ^a	Matched on propensity scores for co-morbidities and treatment strategies ^b
Ln_cost			
Coefficient for Germany	-1.3513 (0.1344) ^{***}	-1.4967 (0.1554) ^{***}	-1.3434 (0.1649) ^{***}
Hospital Mortality			
Coefficient for Germany	-0.0973 (0.0491) ^{***}	-0.1007 (0.0736) ^{***}	-0.0979 (0.0957) ^{***}

*** P<0.0001

S.E. in parenthesis

^a PSM matched samples for co-morbidities include n = 2840 for VHA and n = 568 for Germany

^b PSM matched samples for co-morbidities and treatment strategies include n = 1592 for VHA and n = 530 for Germany

Conclusion

- The analysis demonstrates the potential of micro-level data for health system comparisons
- Multilevel models in combination with propensity matching score approach can substantially improve comparability of health care systems
- Differences in costs can be explained by a combination of differences in input mix:
 - Utilization: VHA likely to perform a greater number of procedures and to use costly drug-eluting stents instead of bare-metal stents; and had much higher staffing ratios than German hospitals
 - Unit costs: example of nursing costs showed that wages are nearly of equal importance as staffing ratios
- Each country should maintain an accessible representative micro data panel to improve cross-country learning possibilities