COMED
PUSHING THE BOUNDARIES
OF COST AND OUTCOME ANALYSIS
OF MEDICAL TECHNOLOGIES

Geographic Variation in the Utilization of Medical Devices

Preliminary results from Germany & Italy

Meilin Möllenkamp, Stefan Rabbe, Jonas Schreyögg & COMED project team

Hamburg Center for Health Economics (HCHE), University of Hamburg

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Agenda

1. **Background**
2. **Data and Methods**
3. **Preliminary Results**
4. **Discussion**

Background and Research Question

Demand and supply-side driven variation in healthcare utilization

- A big part of geographic variation is likely to be driven by **demand-side factors** (e.g., Finkelstein et al. 2016; Song et al. 2010; Yip 1998; Sheiner 2014)
- but, there are also strong indications for **supply-driven** differences (e.g., Cutler et al. 2019; Finkelstein et al. 2016; Chandra et al. 2011; Chassin et al. 1987)

Within- and between country variation in healthcare utilization

- Evidence for geographic variation **between countries** (e.g., OECD 2014)
- and between regions **within countries** (e.g., Skinner 2012, Corallo et al. 2014)

Research Question:

Is there demand- and supply-side driven geographic variation in the use of medical devices within and between European countries?

Previous Research

Previous analyses of geographic variation in healthcare utilization

- Within-country variation variation across disease groups (e.g., Dartmouth Atlas of Health Care; Judge et al. 2009)
- Between-country variation using macro-level data in single disease groups
  - Cardiac Implantable Electrical Device Implant Rates in 5 European countries (Torbica et al. 2017)
  - Transcatheter Aortic Valve Replacement in 11 European countries (Mylotte et al. 2013)
- Within- and between-country variation across disease groups using aggregated micro-level data
  - Stroke, AMI and hip fracture in 5 European countries (Häkkinen et al. 2015; Hejink et al. 2015)

So far, variation within and between countries has not been analysed on **patient, provider and regional level** across disease/procedure combinations focusing on medical device use

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Data

Patient-level data, containing each inpatient treatment for the years 2012-2015

Germany

- **Patient data**: Hospital discharge data (InEK)
- **Hospital level data**: Structured quality reports of hospitals (SQB)
- **NUTS3 level data**: Indicators for spatial and urban development (INKAR)

401 NUTS3 regions

1,768 hospitals

79,216,964 hospitalizations

Italy

- **Patient data**: Hospital Discharge Data (SDO)
- **Hospital level data**: Ministry of Health (Ministero della Salute)
- **NUTS3 level data**: National institute of statistics (Istat)

110 NUTS3 regions

1,161 hospitals

38,932,719 hospitalizations

Case Studies

	Diagnosis	Procedure	Medical device
1	Femur fracture	Reposition of femur fracture	e.g., Bone screws
2	ST-elevation myocardial infarction (STEMI)	Percutaneous transluminal angioplasty (PTA)	Heart catheter (e.g., balloon catheter, catheter with diamond-coated rotating milling head)
3	ST-elevation myocardial infarction (STEMI)	Stenting	Stents (drug-eluting/non-drug eluting stents)
4	Malign neoplasm of the prostate	Radical prostatectomy	Laparoscope
5	Benign neoplasm of the uterus	Hysterectomy	Laparoscope

Methods

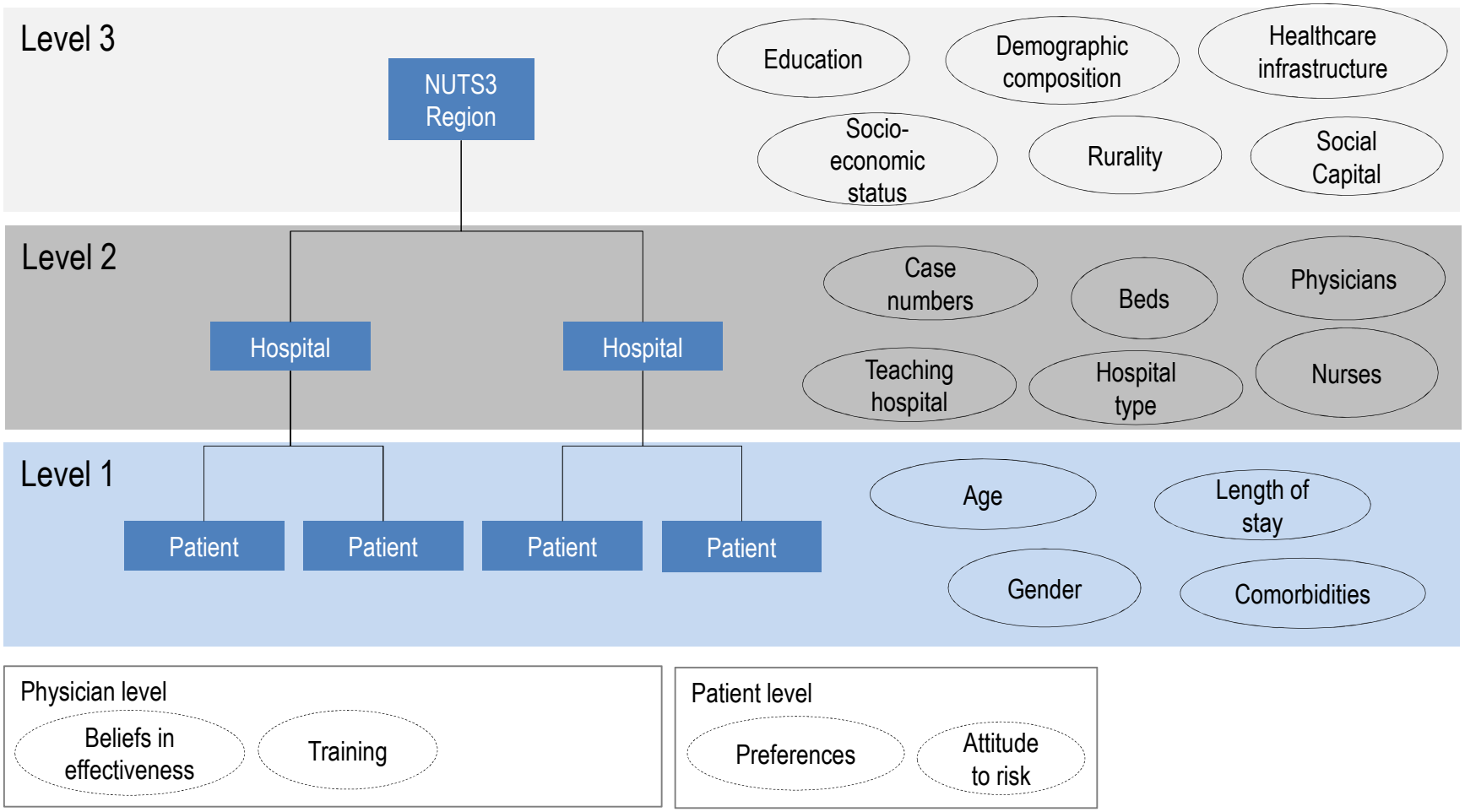
Hypothesis:
Individual characteristics, hospital characteristics, and county characteristics influence whether a patient with a certain diagnosis receives a certain treatment.

Three-level random intercept logistic regression model with fixed effects for years (2012-2015):

$$y_{cjk} = \beta_0 + \beta_1 Pat_{cjk} + \beta_2 Hosp_{jk} + \beta_3 NUTS3_k + u_{jk} + u_k + \eta year_{cjk} + \varepsilon_{ijk}$$

with c: case level; j: hospital level; k: county level
β_0 = mean of the population
y_{ijk} = log of the odds of a patient with a certain diagnosis receiving a certain treatment (y=1)
Pat_{ijk} = patient-level covariates
$Hosp_{jk}$ = hospital-level covariates
$NUTS3_k$ = NUTS3-level covariates
u_{jk} = a hospital‘s deviation from its county‘s mean
u_k = a NUTS3 region‘s deviation from the overall mean of y
$year_{cjk}$ = fixed effects for years
ε_{cjk} = patient-level residual

Multilevel Model: Independent Variables



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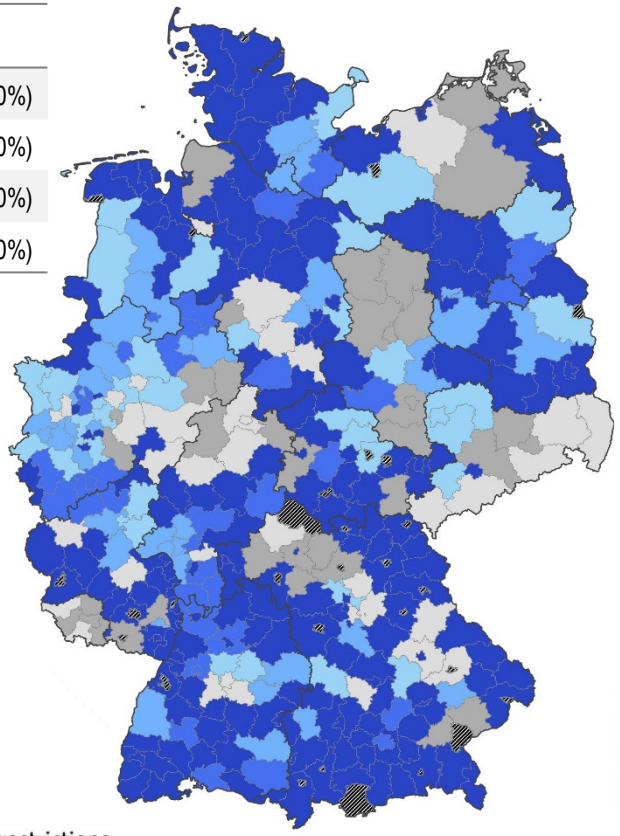
Descriptive Statistics – Stent utilization

		Germany		Italy	
Level	Variable	Mean	SD	Mean	SD
Patient level	Stent utilization	0.766	0.417	0.709	0.454
	Age	64.560	13.050	64.936	12.674
	Gender	0.716	0.451	0.247	0.431
	Length of Stay	8.435	8.413	7.791	6.894
Hospital level	Hospital type	2.335	0.757	0.131	0.337
	Full-inpatient cases	32,169.000	29,410	18,111.81	10,875.83
	Day patient cases	1,169.000	2,319	5,483.621	5,434.095
	Outpatient cases	83,778.000	161,764	–	–
	Nurses per bed	0.670	0.239	–	–
	Doctors per bed	0.349	0.148	–	–
	Teaching hospital	0.847	0.360	0.188	0.391
NUTS3 level	Secondary education	27.27	5.352	8.877	1.722
	School leavers	5.862	2.327	15.224	4.586
	Life expectancy	80.430	1.060	82.242	0.881
	Unemployment rate	6.893	3.006	12.384	5.708
	Share of voters	70.420	3.908	75.323	6.228
	Population density	208.900	233.9	521.727	668.789
	Share of foreigners	8.857	5.328	8.144	3.770
	Median income	3,016	0.465	1,788.604	195.562
	General practioners	158.500	46.880	89.502	11.013
	Internal specialists	24.040	8.571	–	–
	Inhabitants under 6	5.101	0.464	5.441	0.494
	Inhabitants between 50 and 65	21.950	2.324	19.831	0.746
	Inhabitants between 65 and 75	10.580	1.149	10.694	1.041
	Inhabitants older than 75	10.530	1.396	10.789	1.742

Utilization rates for Drug-Eluting Stents (avg. 2012-2015)

Germany

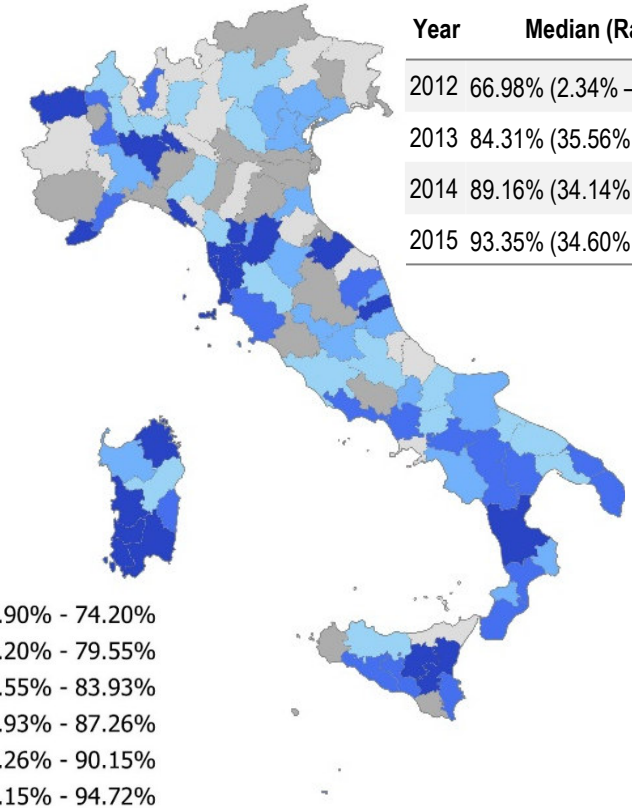
Year	Median (Range)
2012	74.26% (33.57% – 100%)
2013	82.10% (39.96% – 100%)
2014	88.02% (48.25% – 100%)
2015	97.83% (52.23% – 100%)



49.61% - 74.38%
74.38% - 79.17%
79.17% - 82.70%
82.70% - 86.37%
86.37% - 95.38%
95.38% - 100.00%
Missing due to data restrictions

Italy

Year	Median (Range)
2012	66.98% (2.34% – 90.34%)
2013	84.31% (35.56% – 96.59%)
2014	89.16% (34.14% – 98.47%)
2015	93.35% (34.60% – 98.37%)



39.90% - 74.20%
74.20% - 79.55%
79.55% - 83.93%
83.93% - 87.26%
87.26% - 90.15%
90.15% - 94.72%
Missing due to data restrictions

Preliminary Results – Stent utilization

Three-level random intercept logistic regression model with fixed effects for years

Utilization of drug-eluting stents	**Germany**
Variables	Odds Ratio
• *Patient level variables*	
• *Hospital level variables*	
• *NUTS3 level variables*	
NUTS3 level variance	**0.273*****
	(0.079)
Hospital level variance	**1.444*****
	(0.122)
ICC NUTS3	**5.46%**
ICC hospital	**34.30%**
Number of observations	215,165
Number of hospitals included	952
Number of NUTS3 regions included	378

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Preliminary Results – Stent utilization

Two-level random intercept logistic regression model with fixed effects for years

Utilization of drug-eluting stents	**Germany**	**Italy**
Variables	Odds Ratio	Odds Ratio
• *Patient level variables*		
• *Hospital level variables*		
• *NUTS3 level variables*		
Hospital level variance	**1.752*****	**4.847*****
	(0.124)	(0.501)
ICC hospital	**34.75%**	**59.57%**
Number of observations	215,165	127,601
Number of hospitals included	952	475

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

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Discussion

First Insights

- First insights into variation within and between Germany and Italy on patient, provider and regional level for the utilization of drug-eluting stents in patients with a STEMI diagnosis
- For the case of drug-eluting stents supply-driven differences appear to be higher in Italy than in Germany

Limitations

- Different procedure code systems across countries impede comparability
- Cannot account for differences in coding practices between countries
- Data pooling not possible due to data protection restrictions

Outlook & Implications

Outlook

- Inclusion of further control variables (e.g., hospital competition)
- Extension of analyses to further case studies (i.e., disease/procedure combinations)
  - First results for Germany indicate that variation in utilization differs between medical devices
- Inclusion of further European countries (i.e., Switzerland, Hungary and the Netherlands)

Implications

- Contribution to the identification of determinants of regional variation in the utilization of medical devices within and between European countries
- Indications of potential structural deficits and inefficiencies in health care systems (e.g., planning and coordination deficits, misplaced incentives or poor patient involvement)

Thank you!

Meilin Möllenkamp
Stefan Rabbe
Jonas Schreyögg
Hamburg Center for Health Economics
Universität Hamburg
Esplanade 36 · 20354 Hamburg

meilin.moellenkamp@uni-hamburg.de
stefan.rabbe@uni-hamburg.de
jonas.schreyoegg@uni-hamburg.de

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