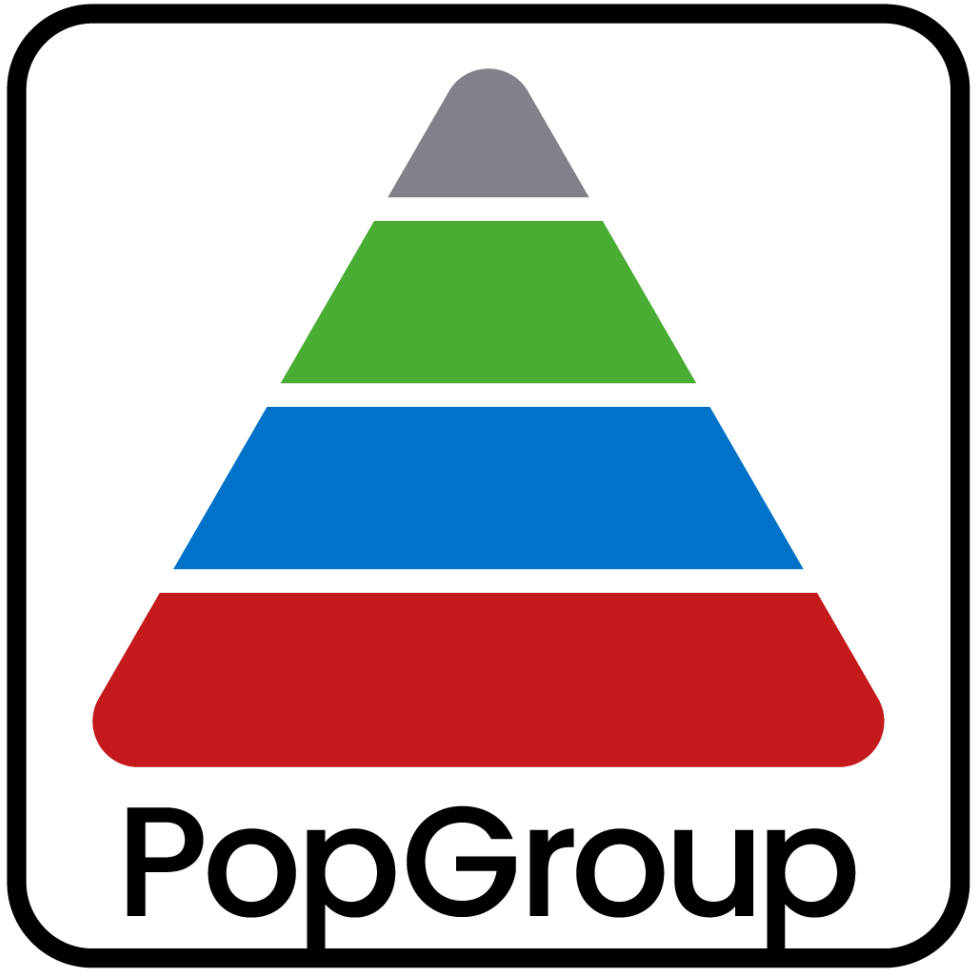


# **Analyzing regional variation in health care utilization in Germany:** Initial results using a new population-based classification system (PopGrouper)

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# Problem & Background

Significant variations in medical practice and outcomes have been documented internationally

Health Policy 114 (2014) 5–14

Contents lists available at ScienceDirect

Health Policy

journal homepage: www.elsevier.com/locate/healthpol

A systematic review of medical practice variation in OECD countries

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ARTICLE INFO

*Article history:*
Received 23 April 2012
Received in revised form 24 May 2013
Accepted 2 August 2013

*Keywords:*
Variations
Physician practice patterns
Small area analysis
Health policy
Diagnostic techniques and procedures
Systematic review
OECD

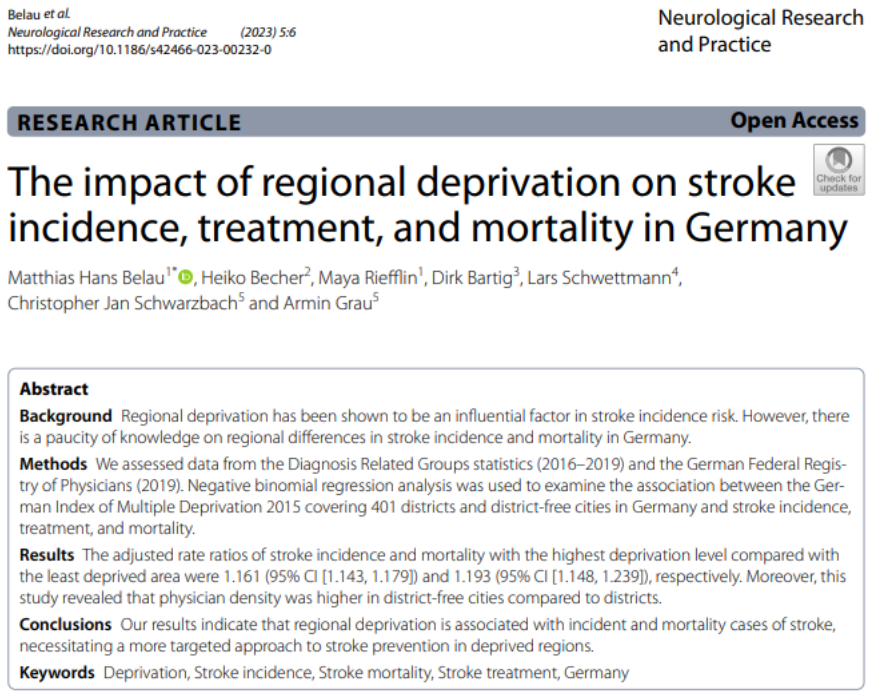
ABSTRACT

*Background:* Major variations in medical practice have been documented internationally. Variations raise questions about the quality, equity, and efficiency of resource allocation and use, and have important implications for health care and health policy.
*Objective:* To perform a systematic review of the peer-reviewed literature on medical practice variations in OECD countries.
*Methods:* We searched MEDLINE to find publications on medical practice variations in OECD countries published between 2000 and 2011. We present an overview of the characteristics of published studies as well as the magnitude of variations for select high impact conditions.
*Results:* A total of 836 studies were included. Consistent with the gray literature, there were large variations across regions, hospitals and physician practices for almost every condition and procedure studied. Many studies focused on high-impact conditions, but very few looked at the causes or outcomes of medical practice variations.
*Conclusion:* While there were an overwhelming number of publications on medical practice variations the coverage was broad and not often based on a theoretical construct. Future studies should focus on conditions and procedures that are clinically important, policy relevant, resource intensive, and have high levels of public awareness. Further study of the causes and consequences of variations is important.



Corallo et al. 2014

Example: Stroke in Germany



Belau *et al.*
*Neurological Research and Practice* (2023) 5:6
https://doi.org/10.1186/s42466-023-00232-0

Neurological Research and Practice

RESEARCH ARTICLE Open Access

The impact of regional deprivation on stroke incidence, treatment, and mortality in Germany

Matthias Hans Belau[1*], Heiko Becher[2], Maya Riefflin[1], Dirk Bartig[3], Lars Schwettmann[4], Christopher Jan Schwarzbach[5] and Armin Grau[5]

**Abstract**

**Background** Regional deprivation has been shown to be an influential factor in stroke incidence risk. However, there is a paucity of knowledge on regional differences in stroke incidence and mortality in Germany.

**Methods** We assessed data from the Diagnosis Related Groups statistics (2016–2019) and the German Federal Registry of Physicians (2019). Negative binomial regression analysis was used to examine the association between the German Index of Multiple Deprivation 2015 covering 401 districts and district-free cities in Germany and stroke incidence, treatment, and mortality.

**Results** The adjusted rate ratios of stroke incidence and mortality with the highest deprivation level compared with the least deprived area were 1.161 (95% CI [1.143, 1.179]) and 1.193 (95% CI [1.148, 1.239]), respectively. Moreover, this study revealed that physician density was higher in district-free cities compared to districts.

**Conclusions** Our results indicate that regional deprivation is associated with incident and mortality cases of stroke, necessitating a more targeted approach to stroke prevention in deprived regions.

**Keywords** Deprivation, Stroke incidence, Stroke mortality, Stroke treatment, Germany

Belau et al. 2023

## Overarching research question

What contribution can a population-based classification system (PopGrouper) make to the analysis of regional variation in health care?

## Initial study objective

To use the PopGrouper to analyze the regional variation in length of stay in hospital and costs for stroke patients in Germany

# Development of the PopGrouper (V0.1)

The PopGrouper is a **population-based classification system** that assigns individuals with similar medical needs and costs to **mutually exclusive PopGroups** based on their diagnoses and characteristics.

The PopGrouper development drew inspiration from the Clinical Risk Groups (CRGs)[1], Adjusted Clinical Groups (ACGs)[2], and Canadian health profile groups[3].

| Macro Base PopGroup | No. of Base PopGroups (N = 410) | No. of PopGroups (N = 1,176) |
|---|---|---|
| **1** Newborns | 13 | 24 |
| **2** Pregnancy, childbirth and puerperium | 12 | 24 |
| **3** Severe, high-cost cases | 29 | 98 |
| **4** Acutely treated malignant tumors | 37 | 121 |
| **5** Severe diseases from 3 or more MDGs* | 47 | 119 |
| **6** Severe diseases from 2 MDGs* | 58 | 149 |
| **7** Severe disease(s) from 1 MDG* | 78 | 246 |
| **8** At least one moderate disease | 53 | 168 |
| **9** At least one minor disease | 52 | 155 |
| **10** At least one very mild disease | 29 | 68 |
| **11** Healthy users | 1 | 3 |
| **12** Non-users | 1 | 1 |

*MDG: Macro Disease Group

1: (3M 2022)
2: (Johns Hopkins University 2015)
3: (CIHI 2023)

# Description of study population

Source: claims data from BARMER sickness fund (approx. 9 million insured) (2019)

Stroke patients (N=21,114):

- Principal diagnosis of cerebral infarction (I63), intracerebral hemorrhage (I61) or unspecified stroke (I64) in 2019
- Age > 30 years
- No hospitalization due to stroke in the previous year

- 226 PopGroups, Top 3 PopGroups:

| PopGroup | PopGroup Name | N | % |
|---|---|---|---|
| **P0707E** | Severe disease(s) from one MDG, including: Cerebral hemorrhage or cerebral infarction – with a care level ≤ 2 and without complex intensive care treatment | 8,821 | 41.78 |
| **P0507D** | Severe diseases from 3 or more MDGs, including: Cerebral hemorrhage or cerebral infarction – with mechanical ventilation ≤ 24 h | 2,869 | 13.59 |
| **P0606E** | Severe diseases from 2 MDGs, including: Cerebral hemorrhage or cerebral infarction – without mechanical ventilation, without central paralysis and without complex intensive care | 2,686 | 12.72 |
| **Total** | | | **68.09** |

**Patient characteristics**

| | N | % |
|---|---|---|
| **Gender** | | |
| Male | 9,612 | 45.52 |
| Female | 11,502 | 54.48 |
| **Type of stroke** | | |
| I61 | 2,108 | 9.98 |
| I63 | 18,873 | 89.39 |
| I64 | 133 | 0.63 |
| **Age category** | | |
| 31-64 | 4,140 | 19.61 |
| 65-74 | 4,276 | 20.25 |
| ≥ 75 | 12,698 | 60.14 |
| **Care level** | | |
| 0 | 11,556 | 54.73 |
| 1 | 819 | 3.88 |
| 2 | 3,036 | 14.38 |
| 3 | 2,747 | 13.01 |
| 4 | 1,847 | 8.75 |
| 5 | 1,109 | 5.25 |

# Description of outcome variables

## Length of stay (LOS, in days)

Cumulative somatic inpatient days over 1 year

| | |
|---|---|
| Mean | 17.5 |
| SD | 21.9 |
| Min | 0 |
| Max | 330 |

## Costs (in EUR)

Total costs (incl. ambulatory, inpatient, rehab, pharmaceutical)

| | |
|---|---|
| Mean | 28,749 |
| SD | 104,025 |
| Min | 0 |
| Max | 6,606,475 |

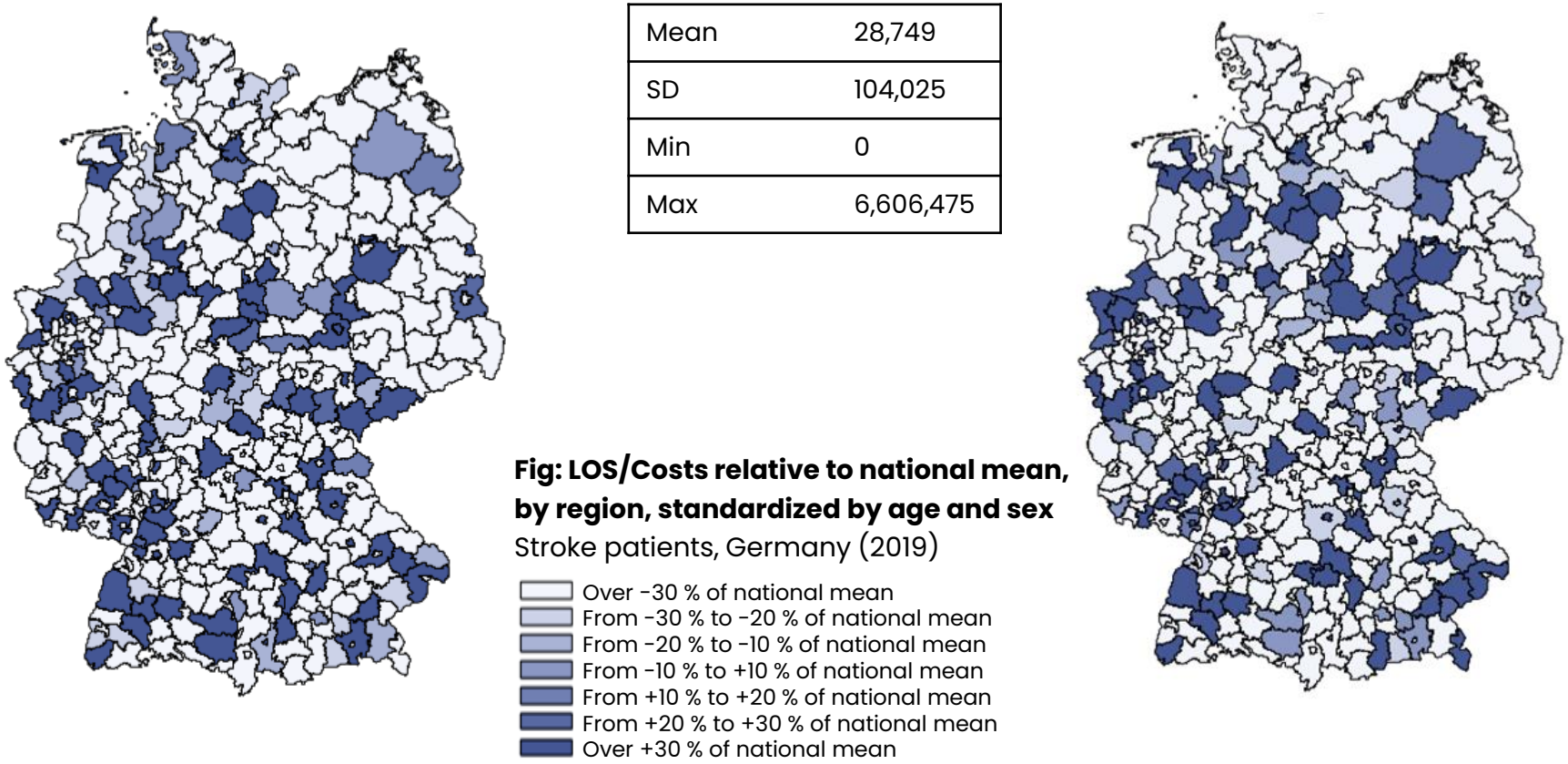



**Fig: LOS/Costs relative to national mean, by region, standardized by age and sex**
Stroke patients, Germany (2019)

Methods

# Multilevel regression model to explain the outcome variables (LOS and costs)

Model for patient *i* in region *j* :

$$y_{ij} = \alpha + \delta PG_{ij} + \sum_{n=1}^{N} \beta_n X_{ij} + u_j + \varepsilon_{ij}$$

$$u_j = \alpha_0 + \sum_{m=1}^{M} \gamma_m Z_j + \mu_j$$

1) *Log LOS*
2) *Log Costs*

*PopGroup variable*

*Vector of patient characteristics*

*Regional effect*

*Vector of regional characteristics*

| Patient-level factors (X) |
|---|
| Gender |
| Type of stroke |
| Age (grouped) |
| Care level |
| Deceased |
| Intensive care |
| Complex stroke care |
| Number of MDGs |

| Regional-level factors (Z) |
|---|
| Urbanization status |
| German Index of Socioeconomic Deprivation |
| Hospital beds per 1,000 inhabitants |
| Physicians per 1,000 inhabitants |
| Long-term care patients per 100 inhabitants |

Results

# Intraclass correlations & residual difference for length of stay and costs

| Covariance Parameter Estimates – Length of stay | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Cov. Param.** | **Subject** | **Estimate** | **SD** | **Z-score** | **Pr>Z** | **Intra-class corr.*** | **Residual Diff.**** |
| **Not including any determinants** | | | | | | | |
| Intercept | Region | 0.0089 | 0.002 | 4.88 | <.0001 | 1.2 % | - |
| Residual | | 0.7442 | 0.007 | 101.88 | <.0001 | | |
| **Stage 1: Including PopGroup variable** | | | | | | | |
| Intercept | Region | 0.0085 | 0.001 | 5.78 | <.0001 | 1.6 % | 29.0 % |
| Residual | | 0.5287 | 0.005 | 101.33 | <.0001 | | |
| **Stage 2: Including PopGroup and patient-level predictors** | | | | | | | |
| Intercept | Region | 0.0090 | 0.001 | 6.40 | <.0001 | 2.0 % | 39.7 % |
| Residual | | 0.4491 | 0.004 | 101.27 | <.0001 | | |
| **Stage 3: Including PopGroup, patient and regional-level predictors (DEPRIVATION ONLY)** | | | | | | | |
| Intercept | Region | 0.0084 | 0.001 | 6.13 | <.0001 | 1.8 % | 39.7 % |
| Residual | | 0.4491 | 0.004 | 101.28 | <.0001 | | |

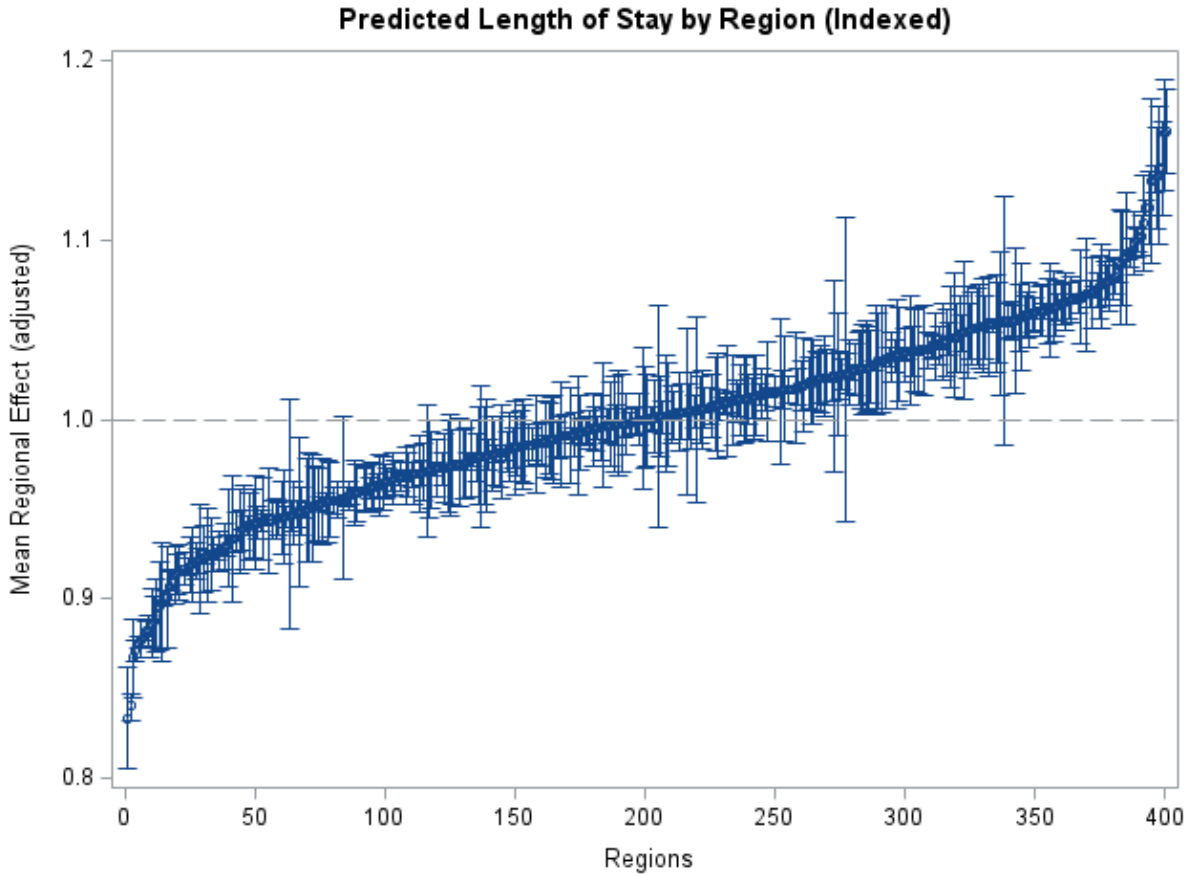
| Covariance Parameter Estimates - Costs | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Cov. Param.** | **Subject** | **Estimate** | **SD** | **Z-score** | **Pr>Z** | **Intra-class corr.*** | **Residual Diff.**** |
| **Not including any determinants** | | | | | | | |
| Intercept | Region | 0.0033 | 0.001 | 2.91 | 0.0018 | 0.4 % | - |
| Residual | | 0.7569 | 0.007 | 102.14 | <.0001 | | |
| **Stage 1: Including PopGroup variable** | | | | | | | |
| Intercept | Region | 0.0035 | 0.001 | 4.02 | <.0001 | 0.8 % | 41.6 % |
| Residual | | 0.4424 | 0.004 | 101.45 | <.0001 | | |
| **Stage 2: Including PopGroup and patient-level predictors** | | | | | | | |
| Intercept | Region | 0.0035 | 0.001 | 4.30 | <.0001 | 0.9 % | 50.2 % |
| Residual | | 0.3770 | 0.004 | 101.36 | <.0001 | | |
| **Stage 3: Including PopGroup, patient and regional-level predictors (DEPRIVATION ONLY)** | | | | | | | |
| Intercept | Region | 0.0036 | 0.001 | 4.40 | 0.0010 | 0.9 % | 50.2 % |
| Residual | | 0.3769 | 0.004 | 101.37 | <.0001 | | |

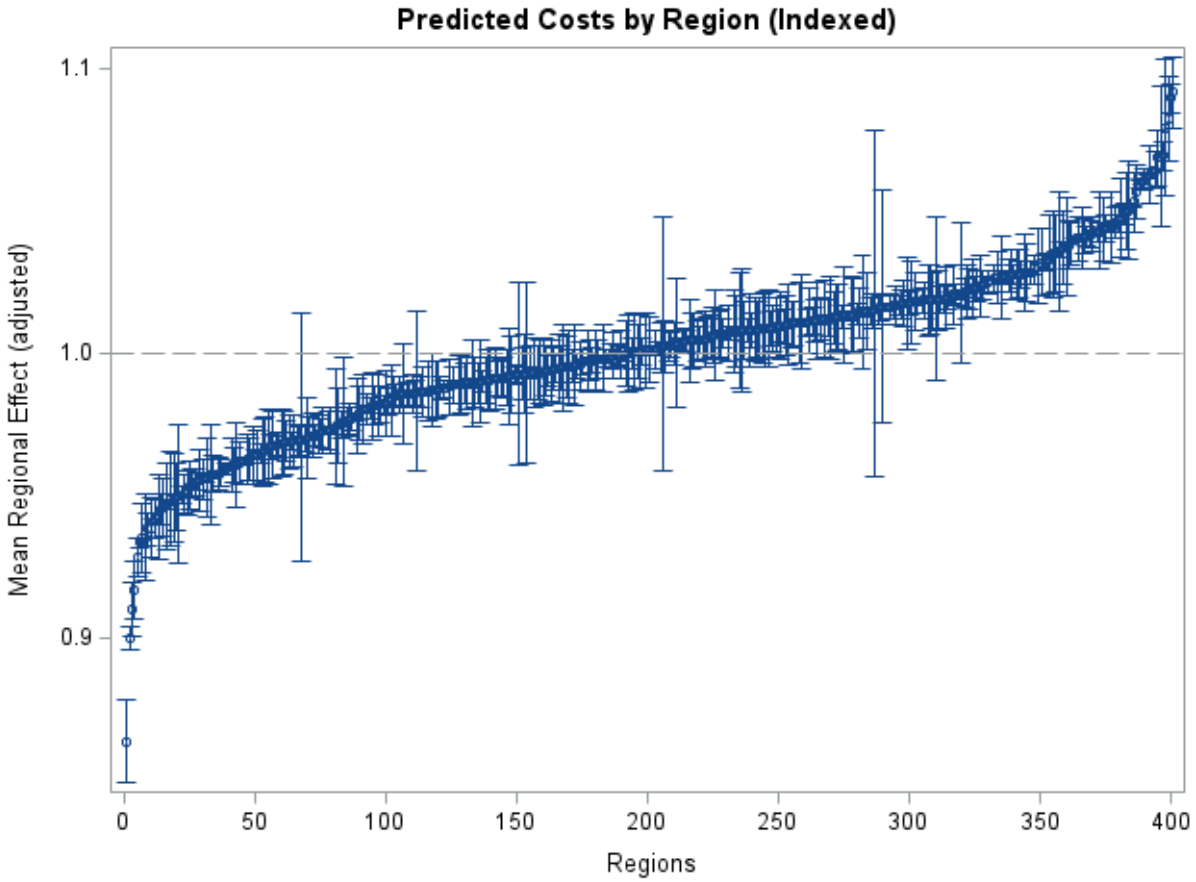
*Intraclass correlation = intercept / (intercept + residual)

**Residual difference = 1 – ($residual_{stage\ x}$ / $residual_{base}$)

Results

# Predicted values for length of stay and costs, by region



## Summary & next steps

- Regional variation in length of stay and costs observed
- PopGroups can explain large proportion of variance, higher explanatory power for costs than length of stay
- Regional variations remain significant, even after controlling for PopGroups and patient characteristics

## Next steps

1. Control for additional patient-level risk factors
2. Add fourth stage with provider-level factors
3. Additional quality outcomes:
   a. Mortality after 30 or 365 days
   b. Treatment on a stroke unit
4. Describe and analyze outlier regions
5. Perform analyses for further diseases
6. Discuss results in workshops with experts

# Thank you for your attention!

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