

The effect of continuity of ambulatory care on hospitalizations in patients with heart failure

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Verena Vogt¹, Diana Kurch-Bek², Leonie Sundmacher³

¹Fachgebiet Management im Gesundheitswesen, Technische Universität Berlin

²Kassenärztliche Bundesvereinigung, Berlin

³Fachbereich Health Services Management, Ludwig-Maximilians-Universität, München

Background

1. Heart failure is one of the most cost-intensive chronic diseases and the most common cause of hospitalization (Neumann et al. 2009)
 - About 61% of the treatment costs of HF are incurred in the inpatient sector in Germany

2. Hospital admissions due to heart failure are defined as Ambulatory Care Sensitive Conditions
 - Given an effective control and management of the disease in the ambulatory sector hospital admissions could have potentially been avoided (Purdy et al. 2009)

Continuity of ambulatory care

Continuity of care is believed to be essential for high quality ambulatory care (van Walraven et al. 2010)

A higher continuity of care is associated with:

- better quality of care, including better identification of issues and diagnostic accuracy (van Servellen et al. 2006; Sharma et al. 2009)
 - early diagnosis of chronic diseases (Koopman et al. 2003)
 - increased utilization of preventive measures (Atun 2004, Engström et al. 2001)
 - higher rates of compliance to medication recommendations (Becker et al. 1974)
- a decreased likelihood of hospitalization (Gill & Mainous 1998)

Objectives

1. Measuring (provider) continuity in ambulatory care of heart failure patients using claims data
2. Examining whether different measures of “continuous ambulatory care” are associated with hospitalizations due to heart failure using logistic regression models

Methods

Concepts of continuity of care

- Little consensus in the literature about the concept of continuity of care
- Broadly defined as consistent “seamless” treatment over time involving various healthcare providers and settings (Dreier et al. 2012)
- Continuity of care is composed of
 - Relational continuity: relationship between a patient and provider over time
 - Management continuity: coherent delivery of care from different doctors
 - Information continuity: availability and use of data from prior events during current patient encounters (Haggerty et al. 2003)

Operationalizing continuity of care

- *Number of different providers (NOP) (k)*
- *Usual Provider Continuity Index (UPC) = $\frac{\max(n_1, n_2, \dots, n_k) - 1}{N - 1}$*
- *Modified Modified Continuity Index (MMCI) = $\frac{1 - \frac{k}{N + 0.1}}{1 - \frac{1}{N + 0.1}}$*
- *Continuity of Care Index (COCI) = $\frac{\sum_{j=1}^k n_j^2 - N}{N(N - 1)}$*

k = number of providers

n_j = number of visits per provider j

N = total number of visits to all providers

Data

- Claims data for heart failure patients insured by the AOK from 2009 - 2011
- Insured patients aged 35 and over who were diagnosed with heart failure in 2010
- N = 1,580,404 → Sample of 500,014

ICD-Code	Description
I11.0-	Hypertensive heart disease with (congestive) heart failure
I13.0-	Hypertensive heart and renal disease with (congestive) heart failure
I13.2-	Hypertensive heart and renal disease with both (congestive) heart failure and renal failure
I50.-	Heart failure
I50.0-	Congestive heart failure
I50.1-	Left ventricular failure
I50.9	Heart failure, unspecified

Included in analysis if:

- At least 360 insurance days in observation period (2010/2011)
- Did not die in the observation period
- One additional diagnosis in inpatient or outpatient sector in 2009
- At least 4 visits to a physician in 2010

Variables and Method

Variable	Operationalization
Outcome	
Hospitalization (0/1)	ICD I11.0, I13.0, I13.2, I50 in inpatient sector 2011
Continuous care	
Number of providers	NOP
Usual Provider Continuity	UPC
Modified modified continuity of care index	MMCI
Continuity of care	COC
Covariates	
Sex	1= male, 2= female
Age	In years
GP visits	Number of accounting days in ambulatory sector
Comorbidity index	Weighted index of comorbidities in 2011 defined by Charlson et al. (1987)

Method: Separate logistic regressions for each continuity index

Results

Descriptive Statistics

		NOP (sd)	UPC (sd)	MMCI (sd)	COCI (sd)
Total		1.811 (0.991)	0.884 (0.152)	0.938 (0.079)	0.817 (0.215)
Hospitalization	0	1.795 (0.978)	0.886 (0.151)	0.938 (0.079)	0.819 (0.214)
	1	2.098 (1.168)	0.858 (0.163)	0.929 (0.077)	0.778 (0.222)
Physician Visits	4-9	1.380 (0.612)	0.926 (0.129)	0.938 (0.103)	0.874 (0.203)
	9-15	1.749 (0.844)	0.887 (0.143)	0.934 (0.074)	0.817 (0.207)
	16-20	2.109 (1.033)	0.848 (0.164)	0.934 (0.061)	0.767 (0.219)
	>20	2.389 (1.327)	0.843 (0.174)	0.948 (0.050)	0.768 (0.223)
Sex	Male	1.886 (1.007)	0.869 (0.159)	0.931 (0.082)	0.794 (0.222)
	Female	1.766 (0.979)	0.894 (0.147)	0.942 (0.077)	0.831 (0.209)
Age	35-49	1.982 (1.111)	0.842 (0.175)	0.908 (0.103)	0.754 (0.244)
	50-64	1.923 (1.053)	0.856 (0.167)	0.924 (0.089)	0.776 (0.232)
	65-79	1.856 (1.011)	0.874 (0.157)	0.935 (0.079)	0.802 (0.220)
	80-94	1.734 (0.945)	0.902 (0.139)	0.945 (0.074)	0.843 (0.201)
	>95	1.638 (0.889)	0.927 (0.119)	0.956 (0.068)	0.879 (0.176)

Logistic regressions results

VARIABLES	Hospitalization Odds Ratio (CI)	Hospitalization Odds Ratio (CI)	Hospitalization Odds Ratio (CI)	Hospitalization Odds Ratio (CI)
NOP	1.135*** (1.116 - 1.155)	-	-	-
UPC	-	0.518*** (0.461 - 0.583)	-	-
MMCI	-	-	0.244*** (0.193 - 0.308)	-
COC	-	-	-	0.592*** (0.543 - 0.644)
Sex	0.897*** (0.862 - 0.934)	0.898*** (0.863 - 0.934)	0.897*** (0.862 - 0.934)	0.899*** (0.864 - 0.936)
Age	1.019*** (1.017 - 1.021)	1.019*** (1.017 - 1.021)	1.018*** (1.016 - 1.020)	1.019*** (1.017 - 1.021)
Comorbidity	1.480*** (1.470 - 1.489)	1.481*** (1.472 - 1.491)	1.482*** (1.473 - 1.491)	1.481*** (1.472 - 1.491)
GP Visits	1.011*** (1.009 - 1.013)	1.014*** (1.012 - 1.016)	1.016*** (1.014 - 1.018)	1.014*** (1.012 - 1.016)
Constant	0.005*** (0.004 - 0.006)	0.011*** (0.009 - 0.013)	0.022*** (0.017 - 0.029)	0.010*** (0.008 - 0.011)
Pseudo-R ²	0.156	0.155	0.155	0.155
AIC	87975.33	88061.28	88045.96	88036.65
N	257561	257561	257561	257561

*** p<0.01, ** p<0.05, * p<0.1

Discussion

- Hospitalizations decrease as continuity of ambulatory care increases
- Potential benefit of increased care coordination is reduced hospitalizations and cost savings

Limitations:

- Due to the implementation of „lump-sums“ for billing not every visit is visible in the data
- Limited validity of diagnoses

Thank you

Contact:

Verena Vogt

Department of Health Care Management

WHO Collaborating Center for Health Care Systems Research and Management

Technische Universität Berlin

Straße des 17. Juni 135, H80

10632 Berlin,

Germany

Phone: +49-30-31426933

E-Mail: verena.vogt@tu-berlin.de