Mitigating the Curse of Complexity: The Role of Focus and the Implications for Costs of Care

Online Appendices

Contents

A Relevant Categories of Care for Key Departments

Table A.1: Relevant Categories of Care for Key Departments*

Department	Relevant Categories
Circulatory System	Digestive System; Musculoskeletal System and Connective Tissue; Kidney and Urinary Tract; Nervous System; Respiratory System; Factors Influencing Health Status; Endocrine Nutritional and Metabolic System
Pregnancy, Childbirth, & Puerperium	Skin, Subcutaneous Tissue, and Breast; Mental Diseases and Disorders; Nervous System; Female Reproductive System; Blood and Blood Forming Organs and Immunological Disorders; Endocrine, Nutritional and Metabolic System; Factors Influencing Health Status
Newborn & Other Neonates Perinatal Period	Circulatory System; Ear, Nose, Mouth and Throat; Musculoskeletal System and Connective Tissue; Factors Influencing Health Status
Respiratory System	Musculoskeletal System and Connective Tissue; Digestive System; Nervous System; Factors Influencing Health Status; Endocrine Nutritional and Metabolic System; Circulatory System
Musculoskeletal System & Connective Tissue	Blood and Blood Forming Organs and Immunological Disorders; Mental Diseases and Disorders; Skin, Subcutaneous Tissue, and Breast; Digestive System; Nervous System; Factors Influencing Health Status; Endocrine Nutritional and Metabolic System; Circulatory System
Digestive System	Blood and Blood Forming Organs and Immunological Disorders; Kidney and Urinary Tract; Nervous System; Factors Influencing Health Status ; Circulatory System; Endocrine Nutritional and Metabolic System
Nervous System	Respiratory System; Kidney and Urinary Tract; Digestive System; Mental Diseases and Disorders; Musculoskeletal System and Connective Tissue; Factors Influencing Health Status; Endocrine Nutritional and Metabolic System; Circulatory System
Infectious & Parasitic DDs	Digestive System; Nervous System; Factors Influencing Health Status; Kidney and Urinary Tract; Respiratory System; Circulatory System; Endocrine Nutritional and Metabolic System
Kidney & Urinary Tract	Digestive System; Nervous System; Factors Influencing Health Status; Circulatory System; Endocrine Nutritional and Metabolic System
Mental Diseases & Disorders	Digestive System; Musculoskeletal System and Connective Tissue; Circulatory System; Alcohol Drug Use or Induced Mental Disorders; Endocrine Nutritional and Metabolic System; Nervous System; Factors Influencing Health Status

*Top 10 Departments by Patient Volume

B Key Variables - Description & Measurement

Table B.1: Key Variables – Description and Measurement

Variable	Description	Measurement
Complexity	Defined a characteristic of patient-specific need for care that is reflective of the variety, interdependence, and severity of care requirements.	Empirically assessed as a reflective factor score of number of diagnoses, number of co-morbid conditions, and number of chronic conditions on the patient discharge record.
Task Focus	Defined as the hospital's emphasis (specialty) on a specific task area within the department	Proportion of patients receiving care within a specific DRG relative to the overall patient volume within the major diagnostic category of care.
Category Focus	Defined as the hospital's emphasis (specialty) on a specific category within the hospital	Proportion of patients receiving care within a specific category relative to the overall patient volume within the hospital.
Related Focus	Defined as a department's emphasis (specialty) on all the relevant areas of patient care needs	Summation of hospital focus on all the related categories of care, where relatedness is assessed based on the frequency of co-occurrence of patient secondary diagnosis in that category.
ln(Costpd)	Costs of care incurred in serving a patients care needs per inpatient day	(Log Transformed) Ratio of patient-specific costs of inpatient care to the length of stay (in days)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 lnCostpd	1.00																			
2 AGE	0.34	1.00																		
3 FEMALE	-0.04	-0.03	1.00																	
4 RACE	-0.09	-0.25	0.03	1.00																
5 TRAN.IN	0.04	0.09	-0.03	-0.03	1.00															
6 TRAN.OUT	0.08	0.37	0.01	-0.11	0.15	1.00														
7 PL.NCHS	0.02	0.04	-0.01	-0.15	0.03	0.01	1.00													
8 Payor	-0.06	-0.51	-0.01	0.09	-0.06	-0.27	-0.02	1.00												
9 Emergency	0.04	0.38	-0.09	-0.07	-0.01	0.16	-0.10	-0.24	1.00											
10 Weeknd	-0.07	0.00	0.00	0.00	0.02	0.02	0.00	-0.02	0.13	1.00										
11 HBirth	-0.47	-0.58	-0.04	0.13	-0.09	-0.14	-0.02	0.19	-0.36	0.01	1.00									
12 Dischg	0.14	0.37	-0.02	-0.09	0.07	0.23	0.00	-0.22	0.13	0.01	-0.15	1.00								
13 Task.Focus	-0.33	-0.29	0.03	0.05	-0.03	-0.09	0.00	0.12	-0.18	-0.01	0.26	-0.10	1.00							
14 Dept.Focus	0.01	-0.09	0.04	0.00	-0.02	-0.04	-0.05	0.06	-0.22	-0.03	0.12	-0.03	0.06	1.00						
15 Rltd.Focus	0.23	0.40	-0.15	-0.12	0.11	0.19	0.02	-0.21	0.36	0.01	-0.37	0.19	-0.18	-0.42	1.00					
16 O.Focus	-0.16	-0.21	0.08	0.02	-0.03	-0.06	0.01	0.08	-0.26	-0.02	0.23	-0.10	0.18	0.45	-0.37	1.00				
17 O.Rel.Focus	0.31	0.50	-0.18	-0.13	0.11	0.21	0.00	-0.25	0.44	0.01	-0.43	0.23	-0.22	-0.26	0.84	-0.51	1.00			
18 O.Mortality	0.14	0.32	-0.10	-0.07	0.10	0.15	0.00	-0.18	0.32	0.05	-0.21	0.23	-0.14	-0.13	0.42	-0.29	0.51	1.00		
19 O.Electives	0.30	0.04	0.18	-0.01	-0.04	0.03	0.07	0.09	-0.31	-0.08	-0.32	-0.02	0.04	0.15	-0.20	0.21	-0.26	-0.40	1.00	
20 O.Procs	0.48	0.03	-0.01	0.00	0.04	0.03	-0.03	0.06	-0.25	-0.06	-0.10	0.09	-0.23	0.08	-0.05	0.00	-0.05	0.05	0.21	1.00

Table B.2: Correlations of Controls with DV

C Robustness – Alternative Model Specification

C.1 Endogeneity Check

Endogeneity bias, a violation of the independence of the predictor variable(s) and the error term in empirical models, can be attributed to a host of factors including omitted variables, measurement errors, and simultaneity bias in the model specification. In the healthcare setting, endogeneity in hospital's focus may be attributed to unobserved heterogeneity related to hospital characteristics (e.g., access to specialized equipment, skillset, legacy effects) that motivate strategic decisions related to focus at the hospital in expectation of performance gains. Similarly, hospitals may normatively focus on i.e., 'cherry-pick' (Kc and Terwiesch 2011) patients within narrow bands of clinical, demographic, and/or environmental characteristics that may be best suited to their operational capabilities. Such unobserved heterogeneity may give rise to non-zero correlations between the X_i variables (e.g., focus) and the error term (ε_i) in the model specification, giving rise to potential endogeneity bias.

While the inclusion of fixed effects allows us to control for hospital-specific, and category-specific unobserved heterogeneity that may confound our analysis, they may not be exhaustive of all potential omitted variables or simultaneity in hospital focus decisions. To further examine the robustness of our models to potential endogeneity, we leverage plausible exogenous variation created by instrumental variables following a Control Function Approach based on the Two-Stage Least Squares (2SLS) methodology (Petrin and Train 2010, Wooldridge 2015). The effectiveness of this approach however, depends on strong instruments, i.e., instruments that are correlated with the independent variable (relevant) and yet (exogenous) not directly related to the dependent variable (Rossi 2014).

Instruments: The choice of instruments in our study is similar in spirit to [BLP] Berry et al. (1995), who use the characteristics of competitor's products as instruments. The identifying assumption (cf. Hausman 1996) is that departments across similar hospitals in other 'markets' share supply-side resource cost structures (e.g., medical equipment, staffing, and pharmaceutical) enabling the relevance of 'other-market' hospital characteristics to the focal hospitals' strategy. The 'other-market' hospital characteristics, however, are not expected to directly influence and are exogeneous to care delivery outcomes for patients in the focal hospital (cf. Nevo 2000).

Building on this literature (e.g., Berry et al. 1995, Hausman 1996, Nevo 2000, Fan 2013, Berry and Haile 2014), we then use other market hospitals' care characteristics specific to a category including *number of electives* offered within the category, *number of procedures*, *mortality rate*, and *focus*, as instruments for task focus, category focus, and related focus at the focal hospital in that category. As noted in our manuscript, hospitals in our study analysis were located in the North-Eastern division of the United States. We identify 'other-market' hospitals as hospitals from other divisions in the US that are similar to hospitals in our study sample. The similarity is based on identifying hospitals that are of the same size (bedsize category), location (rural/urban), teaching status, profit status, and control (private/non-private) for that specific category of care. We then obtained the averaged values of the instruments across these similar 'other market' hospitals for each category of care.

Estimation Technique: We follow a Control Function Approach based on the Two-Stage Least Squares (2SLS) methodology for model estimation (Petrin and Train 2010, Wooldridge 2015). It involves the inclusion of a 'control function', representing the endogenous part of the independent variable of interest, alongside the independent variable in the second stage regression to directly control for the endogeneity (Papies et al. 2017). The control function is obtained from the residuals of the first stage (auxiliary) regression of the independent variable (endogenous regressor) on the instruments. The significant F-statistics for each of the auxiliary regressions (well above 10) in our study are suggestive of instrument strength and relevance.[1]

Results from the second stage regression analyses (see Model 1, Table C.1) show that the control function terms are not statistically significant, allaying concerns of endogeneity in our model and reinforcing the rich set of fixed effects and control variables in our

[1]Additionally, to examine the validity of the instruments, we conducted the under-identification test using an clustered error variance adaptation of the multi-level mixed effects model in our study. The under-identification test examines whether the excluded instruments are 'relevant,' i.e., correlated with the endogenous regressors. The test statistic, Anderson canon. corr. LM statistic: $(195.190, p = 0.00)$, rejects the null hypothesis that the instruments are unrelated to the endogeneous regressors.

model (Hausman 1978, Woolridge 2015). Note that the coefficients of the study variables representing the main and interaction effects of focus (see Model 1, Table C.1) are highly consistent with our study findings further reinforcing the robustness of our study findings.

Table C.1: Additional Analysis – Alternative Models

	Alternative Models	
	Endogeneity Check	**Task-Category Focus Interaction**
	Model (1)	Model (2)
The Main Effects		
Complexity	0.0400***	0.0413***
	(0.00555)	(0.00595)
Task Focus	-0.0496***	-0.0119
	(0.0164)	(0.0126)
Category Focus	0.628***	0.302***
	(0.0294)	(0.0323)
Related Focus	-0.247**	-0.301***
	(0.119)	(0.0211)
The Interaction Effects		
Task Focus*Complexity	0.0619***	0.0603***
	(0.00492)	(0.00499)
Category Focus*Complexity	-0.0260	-0.0354**
	(0.0172)	(0.0161)
Related Focus*Complexity	-0.0394***	-0.0393***
	(0.0112)	(0.0113)
Task Focus*Category Focus		-0.172***
		(0.0362)
Endogeneity Correction		
Task Focus	0.0229	
	(0.0121)	
Category Focus	-0.392	
	(0.284)	
Related Focus	-0.0534	
	(0.129)	
Other Controls and Patient-level Covariates included but not shown here are:		
*Hospital FE, Category FE, Month FE, Task RE, Weekend Admission, Hospital Birth, Transfer In, Transfer Out, Patient Age, Gender, Age*Gender, Comorbities, Payor, Race, Disposition at Discharge, Hospital-Category Scale Effects, Hospital-DRG Scale Effects, Hospital Birth, Transfer In, Transfer Out,*		
Chi-squared	65883.4	65856.2
degrees_of_freedom	259	260
Prob > Chi-squared	0	0
N	234171	234171

Notes: Standard Errors in Parentheses. *** $p < 0.01$, ** $p < 0.05$

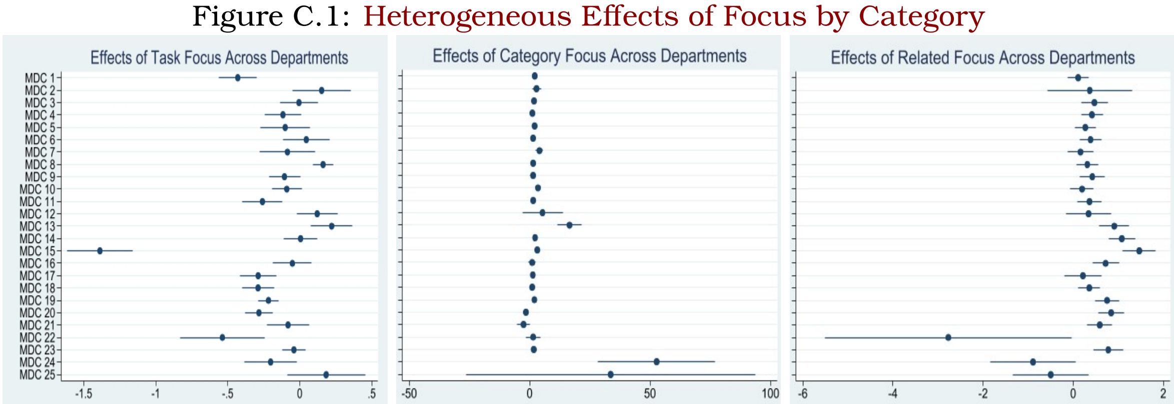
C.2 Interactions of Task and Category Focus

Our main results highlight the implications of focus at the task and category levels for costs for care. We note that while focus at the task level is beneficial for costs of care, there may be a dilution effect at the category level. However, as discussed earlier, it is interesting to study the interaction effects, specifically examining if the category is focused on a smaller subset of tasks. Our analysis (see Model 2, Table C.1) reveals that while the main effect of category focus is positive, the interaction effect is negative. In other words, focus at the category level may be detrimental to performance unless the category is highly focused on a small subset of tasks.

C.3 Heterogeneous Effects Across Care Categories

Our study analysis examined the effects of complexity and focus across hospitals and care categories, and the insights from the study findings are generalizable, on average across care categories. However, we believe there may be heterogeneity in the effects of focus across departments owing to the inherent heterogeneity in the complexity of patient care needs and the clinical care characteristics across these departments. While a systematic examination of the differential clinical characteristics of individual departments and their implications for care outcomes is beyond the scope of this study, we nevertheless explore the heterogeneity in the effects of focus across departments. Figure C.1 highlights the differential effects of focus across MDCs, highlighting the need for further research examining the nuances across these departments.

Figure C.1: Heterogeneous Effects of Focus by Category



C.4 Heterogeneous Effects by Admission Type

Our study analysis examined the effects of complexity and focus across hospitals and care categories for patients across all admission types (emergency and routine). However, it is conceivable that emergency admissions may be exogenous to hospital focus in various of categories of care vis-à-vis elective admissions, and may reveal heterogeneous effects of focus. To examine this potential source of heterogeneity, we reran the base models estimating separate coefficients for the emergency and non-emergency patients. We note that the pattern of coefficients (please see Figure C.2 for marginal plots) continue to be consistent with our main analysis.

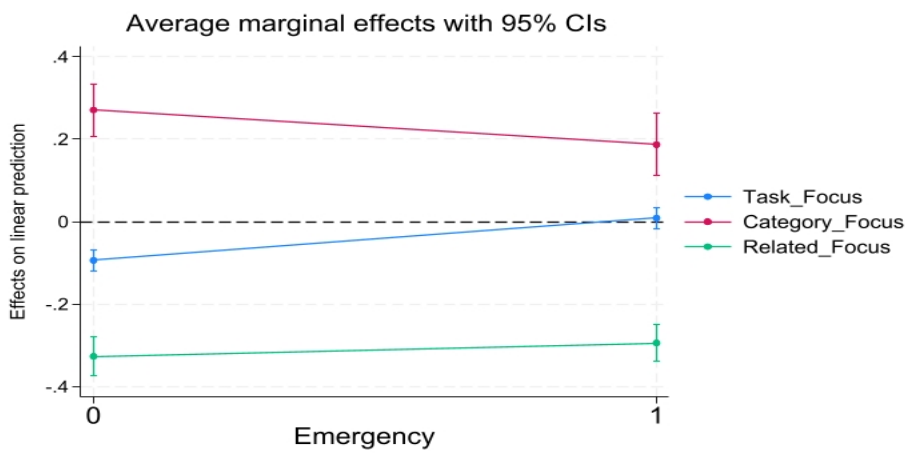


Figure C.2: Effects of Focus – Emergency vs. Non-Emergency Patients

C.5 Clustering

We also conducted additional analyses that account for any cross-sectional correlations across patient discharges owing to hospital-type, payor or discharge timing characteristics, that may be left unaccounted for by the rich set of fixed effects and controls already in our model. Below, we provide a brief discussion of these additional analysis with clustering.

We would like to note that unlike time-series panel analysis, our study looks at a cross-section of patients across hospitals across MDC and procedures. So, the correlations are not time-series but cross-sectional. Furthermore, the patients within the cross-sections of hospital-departments are a random selection by HCUP. According to HCUP, NIS data is a systematic random sample of discharges stratified by hospital characteristics drawn from all HCUP-participating hospitals. This sample includes approximately 20% of discharges from US community hospitals. It is systematically drawn from all discharges sorted on characteristics such as DRG and admission month. In other words, patient discharges in our data are a random sample from a the population of discharges from across hospitals and categories of care with varied focus levels. In this vein, Abadie et al. (2023) note that "*...if one has a random sample of units from a large population with randomized treatment assignment at the unit level, there is no reason to cluster the standard errors of the least-square estimator. Doing so can be harmful, resulting in unnecessarily wide confidence intervals. In this case, clustering is not appropriate even if there is within-cluster correlation in outcomes (however those clusters are defined) and thus even if clustering makes a substantial difference in the magnitude of the standard errors...*" Additionally, we note that our study includes elaborate fixed effects at the Hospital, MDC, DRG levels, hospital-department and hospital-DRG specific scale effects, and an elaborate set of patient controls (clinical comorbidities, demographics, and socio-economic factors) to account for individual specific factors in the model specification. The random selection of individuals from across these hospital-departments while accounting for patient, DRG, MDC, and hospital specific effects thus accounts for the correlational structure arising from these groupings.

Nevertheless, to account for any cross-sectional correlations from factors outside of those included above, we re-ran multiple additional analysis by clustering standard errors by hospital type (Government nonfederal, Private not-profit, Private invest-own); payor (Medicare, Medicaid, Private insurance, Self-pay); and, discharge quarter (Jan - Mar, Apr - Jun, Jul - Sep, Oct - Dec). The results from all of these analyses (see Table C.2) are highly consistent with our main results, reinforcing the robustness of our study findings.

Table C.2: Robustness - Clustering

Clustering by:	**Hospital-Type**	**Payor**	**Discharge Qtr**
	Model (1)	Model (2)	Model (3)
The Main Effects			
Complexity	0.0405***	0.0405**	0.0405***
	(0.00302)	(0.0206)	(0.00169)
Task Focus	-0.0278	-0.0278	-0.0278
	(0.0162)	(0.0279)	(0.0161)
Category Focus	0.240***	0.240	0.240***
	(0.0249)	(0.143)	(0.0162)
Related Focus	-0.302***	-0.302***	-0.302***
	(0.0659)	(0.0170)	(0.0352)
The Interaction Effects			
Task Focus*Complexity	0.0615***	0.0615***	0.0615***
	(0.0139)	(0.00316)	(0.000818)
Category Focus*Complexity	-0.0263***	-0.0263	-0.0263**
	(0.00346)	(0.0488)	(0.0119)
Related Focus*Complexity	-0.0398***	-0.0398	-0.0398***
	(0.00604)	(0.0212)	(0.00739)
Other Controls and Patient-level Covariates included but not shown here are: *Hospital FE, Category FE, Month FE, Task RE, Weekend Admission, Hospital Birth, Transfer In, Transfer Out, Patient Age, Gender, Age*Gender, Comorbities, Payor, Race, Disposition at Discharge, Hospital-Category Scale Effects, Hospital-DRG Scale Effects,*			
R-Squared	0.416	0.416	0.416

Notes: N = 234171. Std. Error in Parentheses. *** $p < 0.01$, ** $p < 0.05$

D Robustness – Alternative Data

D.1 Data – Representation

With data from around 7 million hospital stays each year, the National (Nationwide) Inpatient Sample (NIS) is part of a family of databases developed for the Healthcare Cost and Utilization Project (HCUP), and is the largest publicly available all-payer inpatient healthcare database designed to produce key insights on healthcare in the U.S. Also, each year the NIS is drawn from all states participating in HCUP, covering more than 97 percent of the U.S. population. Thus, we believe that the annual NIS data provides valid, reliable, and representative insights on healthcare in the U.S.

The NIS data approximates a 20-percent stratified sample of all discharges from U.S. community hospitals, excluding rehabilitation and long-term acute care hospitals. As detailed in the NIS Redesign Report (p.10-11), rather than draw a sample of hospitals and then keep all discharges from the sample of hospitals, HCUP draws a sample of discharges from all hospitals in several steps. Within each hospital, HCUP first sorts discharges by their DRG and their admission month to ensure that the NIS sample will be representative and then samples every 5th discharge from the sorted list of discharges, corresponding to the 20% sampling rate. Thus, it must be noted, that sample of discharges is proportionally representative of the patients across DRGs (and departments) in every participating HCUP hospital.[2]

D.2 Alternative Data - NIS, Other Division

The analysis in the study was based on data from the northeast division of the NIS data. The choice of one division, and the NE division in particular, was primarily driven by sample size and computational tractability. That said, to further examine the robustness of our study model to alternate data (i.e., data from other divisions in the U.S.) we re-ran the analysis using Division 7 (the division that was the median, by volume

[2] If a hospital had less than five patients in a particular DRG, sampling every 5th discharge may possibly not pick up any discharge from this DRG of that hospital, suggesting a zero focus. Note however, that if the hospital had less than 5 patients in a DRG in the entire year, it already suggests a very low focus in that DRG. Thus, the information (of very low focus) is sustained in the NIS sample owing to the proportionality.

Table D.1: Additional Analysis – Alternative Data

	Study Sample	**Alternate Data**		
	Model (1)	Model (2)	Model (3)	Model (4)
	2015 - DIV 1	**2015 - DIV 7**	**2014 - DIV 1**	**2015 - SID**
Complexity	0.0405***	0.104***	0.0526***	0.0089***
	(0.00594)	(0.0041)	(0.0057)	(0.0025)
Task Focus	-0.0278***	-0.396***	0.0060	-0.1841***
	(0.0121)	(0.0043)	(0.0110)	(0.0057)
Category Focus	0.240***	-0.124***	0.307***	0.4743***
	(0.0296)	(0.0043)	(0.0289)	(0.0101)
Related Focus	-0.302***	-0.286***	-0.177***	-0.1401***
	(0.0211)	(0.0139)	(0.0194)	(0.0156)
The Interaction Effects				
Task Focus*Complexity	0.0615***	0.199***	0.0568***	0.0278***
	(0.00498)	(0.0037)	(0.0047)	(0.0005)
Category Focus*Complexity	-0.0263	0.198**	-0.0787***	-0.0253***
	(0.0160)	(0.0093)	(0.0148)	(0.0009)
Related Focus*Complexity	-0.0398***	-0.0746***	-0.0701***	-0.0116***
	(0.0113)	(0.0078)	(0.0108)	(0.0011)
Other Controls and Patient-level Covariates included but not shown here are: *Hospital FE, Category FE, Month FE, Task RE, Weekend Admission, Hospital Birth, Transfer In, Transfer Out, Patient Age, Gender, Age*Gender, Comorbities, Payor, Race, Disposition at Discharge, Hospital-Category Scale Effects, Hospital-DRG Scale Effects, Hospital Birth, Transfer In, Transfer Out,*				
N	234171	628980	304053	1792473
R-Squared	0.416	0.658	0.444	
Chi-squared	65827.7	1205888	96592	520103
degrees_of_freedom	257	835	258	
Prob > Chi-squared	0	0	0	0

Notes: N = 234171. Standard Errors in Parentheses. *** $p < 0.01$, ** $p < 0.05$

of discharges).[3] Model (2) in D.1 provides the results from these analyses. Also, for a comparative evaluation, included in Table D.1 are the model estimates from using the 2015 (the primary dataset in our study) data (see Model 1). The findings from this estimation are highly consistent with our study findings reinforcing the robustness of our study results.

D.3 Alternative Data - NIS, Other Year

The analysis in our study is based on data from 2015 NIS data. That said, we also collected another year (2014) of NIS data to verify the robustness of our study findings. Model (3) in Table Table D.1 provides the results from the estimation of our study model using 2014 data. The consistency in the study results across models using alternate

[3] Division 7 of the HCUP NIS sample represented hospitals in the West-South-Central region of the country, including the states Oklahoma, Texas, Arkansas, and Louisiana.

data serves to verify our findings.

D.4 Alternative Data - SID (Statewide Inpatient Data)

Lastly, to further examine the robustness of the study findings, we obtained the 2015 Statewide Inpatient Data (SID) for Florida. This data includes the set of *all* patient discharges from the state of Florida in 2015. We then repeated the study analysis using this data set. Model 4 (Table D.1) provides the results from this analysis. Results from these analysis are highly consistent with our study findings using the NIS data, thus reinforcing the robustness of our study insights.

E Robustness – Alternative Variable Specification & Measures

E.1 Alternative Measure for Complexity

The measure of complexity in our study was assessed as a composite (factor analytic) score of the number of chronic conditions, number of co-morbidities, and the number of diagnostic conditions presented by a patient. To assess the robustness of the study findings, we examine two alternate operationalizations of complexity. First, we measure complexity as the number of chronic conditions, which captures the variety of pre-existing conditions presented by patients at admission and a key indicator of complexity. The second measure of complexity is based on the number of diagnostic conditions presented by the patient at admission, reflective of the interrelatedness and complexity of care needs. Results from these analysis (see Model 1-2, Table E.1) are consistent with our study findings reinforcing the robustness of our study findings.

Table E.1: Additional Analysis – Alternative Measures

	Alternative Complexity		**Alternative Related Focus**	
	# of Chronic Conditions	# of Diagnostic Conditions	15%	All%
	Model (1)	Model (2)	Model (3)	Model (4)
The Main Effects				
Complexity	0.00487***	0.00682***	0.0117***	0.00685
	(0.00146)	(0.000744)	(0.00392)	(0.00757)
Task Focus	-0.0831***	-0.128***	-0.0225*	-0.0250**
	(0.0131)	(0.0133)	(0.0121)	(0.0121)
Category Focus	0.278***	0.267***	0.351***	0.184***
	(0.0334)	(0.0347)	(0.0286)	(0.0299)
Related Focus	-0.288***	-0.188***	-0.236***	-4.246***
	(0.0254)	(0.0261)	(0.0434)	(0.218)
The Interaction Effects				
Task Focus*Complexity	0.0104***	0.0107***	0.0621***	0.0596***
	(0.00126)	(0.000678)	(0.00501)	(0.00498)
Category Focus*Complexity	-0.00893**	-0.00189	0.0152	-0.0185
	(0.00399)	(0.00220)	(0.0154)	(0.0171)
Related Focus*Complexity	-0.00379	-0.0111***	0.0761***	0.317***
	(0.00286)	(0.00150)	(0.0189)	(0.113)
Other Controls and Patient-level Covariates included but not shown here are: *Hospital FE, Category FE, Month FE, Task RE, Weekend Admission, Hospital Birth, Transfer In, Transfer Out, Patient Age, Gender, Age*Gender, Comorbities, Payor, Race, Disposition at Discharge, Hospital-Category Scale Effects, Hospital-DRG Scale Effects,*				
Chi-squared	65601.9	66171.1	65601.9	66058.1
degrees_of_freedom	257	257	257	257
Prob > Chi-squared	0	0	0	0

Notes: N = 234171. Standard Errors in Parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

E.2 Alternative Measure for Related Focus

In our measure of related focus, we included all secondary diagnostic categories that were listed on at least 5% of inpatient discharge records as relevant areas. On a comparative note, Clark and Huckman (2012) use a 20% cutoff for Cardiology (which, we believe, may be too restrictive for most departments[4]). As a robustness check, we repeated the study analysis now including alternative (more restrictive, and all encompassing) operationalizations of related focus (cf. Clark and Huckman 2012). First, in the more restrictive operationalization, we assessed related focus using secondary diagnosis categories that were listed on at least 15% of inpatient discharge records instead of the 5% cutoff used in our main analysis. Next, in the all encompassing operationalization, we assessed related focus by including the focus of all related areas. Results from the additional analysis using alternate operationalizations of of relatedness (see Models 3-4, Table E.1) consistently highlight the beneficial impact (marginal effects) of related focus, reinforcing the robustness of our study findings.

E.3 Alternative Dependent Variables

There are multiple outcomes variables relevant within the healthcare context including costs of care, patient length of stay, and clinical quality of care (e.g., KC & Terwiesch 2011, Roth et al. 2021, Thirumalai et al. 2022). While our analysis of the implications of focus for costs for care accounts for patient length of stay (LOS) and clinical outcomes of care, an analysis of the implications of focus for LOS and mortality may carry additional insights. To that end we conducted additional analysis with alternative dependent variables. We discuss the details below.

- First, the dependent variable in our study is logarithmic costs per inpatient day controlling for the patient's medical Disposition at Discharge. We replicated the study analysis using *logarithmic costs*, and logarithmic costs controlling for length of stay, as alternative dependent variables. Results from these analysis (see Model

[4]While Clark and Huckman (2012) use a 20% cutoff, we note that this cutoff may be too high as only 8 out of 25 departments had a secondary diagnosis with atleast 20% of its patients in that secondary category, and, only 1 of 25 departments that had two such related areas.

1-2, Table E.2) are consistent with our study findings reinforcing the robustness of our study findings.

- Next, we examined the impact of focus across the hierarchical levels for patient *length of stay*. Prior research (e.g., KC and Terwiesch 2011) indicates that focus at more granular levels (focus on specific DRGs) is associated with shorter LOS, accounting for selective admissions for cardiology patients. However, this body of research has not examined the effects at the focus across care categories, and the effects of related focus on LOS accounting for the complexity of patient care needs. To that end, we re-ran the study analysis now examining the impact of focus on LOS. Table E.2 provides results from the new analysis (Model 3).[5] The results from this analysis are highly consistent with the findings in KCT, reinforcing the consistency of insights in the two studies.

- Lastly, we conducted additional analysis largely retaining the variable specification, now using a logit model and *mortality* as the key outcome variable.[6] The results (see Model 4, Table E.2) are interesting in that in contrast to the cost implications, we note that category focus has a marginally beneficial impact in lowering mortality rates albeit it is associated with higher mortality in complex care settings. Furthermore, contrary to our findings for costs of care, we note that focus at the task level (i.e., focus on specific DRGs) does not provide key benefits in lowering mortality. These additional insights on how complexity and focus affect outcome quality of care serve to highlight the differential impacts of focus and complexity on the costs of care vis-à-vis mortality, and motivate further research in this regard.

[5]We additionally repeated this new analysis for Cardiology category only replicating the analysis in KC and Terwiesch 2011. The results from these analyses are consistent. We are thankful to an anonymous reviewer for this suggestion.

[6]The model is computationally intensive with long run-times, possibly owing to a large dataset and a non-linear (logit) model with a rich set of fixed effects.

Table E.2: Additional Analysis – Alternative DVs

	lnCosts	**lnCosts** controlling for LOS	**lnLOS**	**Mortality**
	Model (1)	Model (2)	Model (3)	Model (4)
The Main Effects				
Complexity	0.266***	0.0800***	0.0326***	0.692***
	(0.00829)	(0.00582)	(0.0213)	(0.132)
Task Focus	0.0130	-0.0205*	-0.317***	0.747**
	(0.0169)	(0.0119)	(0.058)	(0.298)
Category Focus	0.374***	0.263***	0.420*	-1.746*
	(0.0413)	(0.0289)	(0.2463)	(1.012)
Related Focus	-0.295***	-0.301***	-0.808***	-1.789***
	(0.0294)	(0.0206)	(0.0254)	(0.642)
The Interaction Effects				
Task Focus*Complexity	0.0236***	0.0547***	-0.0602***	-0.0402
	(0.00694)	(0.00487)	(0.017)	(0.0990)
Category Focus*Complexity	-0.000113	-0.0218	-0.0881	1.123**
	(0.0223)	(0.0157)	(0.00399)	(0.537)
Related Focus*Complexity	-0.0457***	-0.0410***	-0.0068	0.588**
	(0.0157)	(0.0110)	(0.0375)	(0.254)
Other Controls and Patient-level Covariates included but not shown here are:				
*Hospital FE, Category FE, Month FE, Task RE, Weekend Admission, Hospital Birth, Transfer In, Transfer Out, Patient Age, Gender, Age*Gender, Comorbities, Payor, Race, Disposition at Discharge, Hospital-Category Scale Effects, Hospital-DRG Scale Effects, Hospital Birth, Transfer In, Transfer Out,*				
Chi-squared	58173.0	359676.7	187029.5	66171.1
degrees_of_freedom	257	258	101	257
Prob > Chi-squared	0	0	0	0

Notes: N = 234171. Standard Errors in Parentheses. *** p < 0.01, ** p < 0.05, * p < 0.10