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Associations between rationing of nursing care and inpatient mortality in Swiss hospitals

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Abstract

Objectives. To explore the relationship between inpatient mortality and implicit rationing of nursing care, the quality of nurse work environments and the patient-to-nurse staffing ratio in Swiss acute care hospitals.

Design. Cross-sectional correlational design.

Setting. Eight Swiss acute care hospitals examined in a survey-based study and 71 comparison institutions.

Participants. A total of 165 862 discharge abstracts from patients treated in the 8 RICH Nursing Study (the Rationing of Nursing Care in Switzerland Study) hospitals and 760 608 discharge abstracts from patients treated in 71 Swiss acute care hospitals offering similar services and maintaining comparable patient volumes to the RICH Nursing hospitals.

Main outcome measures. The dependent variable was inpatient mortality. Logistic regression models were used to estimate the effects of the independent hospital-level measures.

Results. Patients treated in the hospital with the highest rationing level were 51% more likely to die than those in peer institutions (adjusted OR: 1.51, 95% CI: 1.34–1.70). Patients treated in the study hospitals with higher nurse work environment quality ratings had a significantly lower likelihood of death (adjusted OR: 0.80, 95% CI: 0.67–0.97) and those treated in the hospital with the highest measured patient-to-nurse ratio (10:1) had a 37% higher risk of death (adjusted OR: 1.37, 95% CI: 1.24–1.52) than those in comparison institutions.

Conclusions. Measures of rationing may reflect care conditions that place hospital patients at risk of negative outcomes and thus deserve attention in future hospital outcomes research studies.

Keywords: healthcare rationing, nursing, mortality, outcomes research, work environments

Introduction

Research findings over more than a decade suggest that lower nurse staffing levels are associated with increased risks for a variety of negative outcomes in acute care hospitals (such as inpatient mortality and adverse event rates) [1–8]. However, most studies in this field involve cross-sectional analyses of structure and outcomes without addressing the process of nursing care differences across institutions or care settings.

Recently, considerable interest has been expressed in rationing and omitted nursing tasks as a marker of the quality and processes of nursing care being delivered across settings [9–11]. Especially when measured across nurses in a patient care setting, implicit rationing of nursing care (i.e. the failure to deliver one or more types of needed nursing services) provides insight into the potential causal pathways at the patient-to-nurse interface that link the adequacy of nurse staffing with patient outcomes [10, 12, 13]. For example, when nurses are unable to dedicate sufficient time to monitor patients closely, there may be delays in detection and treatment of serious complications, leading to poor outcomes, including death.

In the Rationing of Nursing Care in Switzerland Study (RICH Nursing Study) [12–14], the Swiss extension of the International Hospital Outcomes Study (IHOS) [14], rationing measured with the Basel Extent of Rationing of Nursing Care (BERNCA) instrument [14] was consistently linked

with lower patient satisfaction, and higher rates of nurse-reported medication errors, falls, nosocomial infections, critical incidents and pressure ulcers. Among the other variables, neither staffing nor the quality of the nurse work environment was consistently linked to any of the outcomes [12]. Early results also suggested a dose–response relationship, providing additional supportive evidence for causal links between rationing and patient outcomes.

The objective of this study was to explore the relationship between implicit rationing of nursing care (a process of care variable tracked using nurses' reports of omitted care due to a lack of time or other resources), the structural variables patient-to-nurse ratios and quality of the nurse work environment and a 'hard' patient outcome (inpatient mortality rates) in Swiss acute care hospitals. Inpatient mortality is clearly a complex outcome sensitive to a host of influences, including but not limited to patient characteristics and interventions by nurses and other members of the healthcare team. However, associations between inpatient mortality and nursing structural variables (especially staffing) have been observed in many earlier studies [15, 16].

Methods

Design

This study used a comparative cross-sectional design involving patient outcomes from the Swiss Federal Statistical Office (FSO) national discharge abstract database for 2003 and 2004 for all selected hospitals, combined with nurse survey-derived indicators of rationing, patient-to-nurse ratios and quality of the nurse practice environment for the eight hospitals involved in the earlier RICH Nursing Study.

Setting/sample

In this analysis, the eight Swiss acute care hospitals in the RICH Nursing Study were the primary institutions under study. Survey data from 1338 nurses were used to characterize rationing, nurse staffing and work environment levels in these institutions. All nurses who worked in the direct patient care in a medical, surgical or gynecological unit for at least 3 months, including at least 1 month on their current units, were approached to complete a variety of instruments tapping working conditions, job outcomes and nurse reports of patient safety [12–14]. The eight RICH Nursing hospitals were originally chosen to provide a cross-section of mid-sized to large Swiss facilities. Discharge abstracts were available for 165 862 patients meeting our selection criteria who were treated at these hospitals.

To provide a reference condition for the analyses, 760 608 discharge abstracts from 71 Swiss hospitals offering comparable services and maintaining parallel service volumes (mean annual volumes of 3000 or more discharges for 2003 and 2004) were also analyzed. These comparison hospitals were selected from 352 acute care hospitals and specialized clinics operating in Switzerland.

Outcomes were examined for general medical, surgical and gynecological patients, 18–95 years of age and hospitalized between January 2003 and December 2004 for 2–320 days. Excluded were children and newborns, as well as patients discharged from psychiatric, obstetric, ear-nose-throat, dermatological, ophthalmological, medical radiotherapy, geriatric and physical therapy services or whose service at discharge was not specifically recorded.

Variables and measurements

Table 1 contains a list of the dependent, independent and control variables.

'Inpatient mortality' (dependent variable) for the patients in the 79 hospitals was constructed from a variable in the FSO database indicating the patient's discharge disposition.

'Implicit rationing of nursing care' (independent variable) was measured in the RICH Nursing Study with the BERNCA instrument. The BERNCA is a 20-item self-report tool developed from published frameworks describing domains of nursing practice [14]. Nurses were asked to estimate how often in the past 7 working days they had been unable to carry out 20 listed tasks using the 4-point Likert-type scales (never, rarely, sometimes, often). Published data provide support for the BERNCA's content validity, construct validity (in terms of unidimensionality of the scale) and concurrent validity (the correlation between rationing and quality of the nurse work environment, particularly the staffing adequacy subscale) as well as its internal consistency and homogeneity [Cronbach's α 0.93, inter-item correlation $r = 0.39$ (0.19 to 0.63)] [14]. To calculate the average level of implicit rationing of nursing care on the hospital level, the scores for each nurse were averaged over all 20 items and aggregated to the hospital level.

The 'quality of the nurse practice environment' (independent variable) was measured in the RICH Nursing Study with the nurse work environment index-revised (NWI-R), a 51-item internationally recognized instrument with established validity and reliability [14, 17]. The three subscales (nursing leadership and professional development, nursing resources and autonomy and interdisciplinary collaboration and competence) used here emerged from factor analyses reported in an earlier paper [14].

The 'patient-to-nurse staffing ratio' (independent variable) was assessed with a single-item asking respondents about the number of patients assigned to them on the last shift aggregated to the hospital, a measure with extensively demonstrated predictive validity [14].

The following patient characteristics were extracted from the discharge abstracts and included in the analysis as 'control variables': patient age, sex, type of admission and referring facility, information about the hospitalization (e.g. ICU stay, length of stay) as well as the admitting service (e.g. surgical, medical), primary diagnoses (ICD-10 Codes) [18] and treatments/procedure codes (CHOP) [19]. 'Comorbidities' were identified by scanning the discharge abstracts for secondary diagnoses using a version of the Charlson comorbidity index adapted for ICD-10 codes [20].

Table 1 Definitions and measures of the dependent, independent and control variables

Variables	Definition
Dependent variable	Discharge status of the patient: alive or dead
Inpatient mortality	This outcome variable at the patient level was retrieved from the patient discharge abstracts of the 79 hospitals
Control variables	With inpatient mortality-associated patient characteristics at the patient level retrieved from the patient discharge abstracts of the 79 hospitals
Age	Age of the patients (continuous variable)
Comorbidities	Seventeen comorbidities according to the Charlson comorbidity index: acute myocardial infarction/heart disease, congestive heart failure, peripheral vascular disease N, cerebral vascular accident, dementia, pulmonary disease, connective tissue disorder, Peptic ulcer, liver disease, diabetes, diabetic complications, paraplegia, renal disease, cancer, metastatic cancer, severe liver disease and HIV
Medical diagnosis	Principal and secondary diagnoses as defined in the International Classification of Diseases, 10th Revision (ICD-10 Codes)
Treatment	Principal and secondary treatment as defined in the Swiss Operation Classification (CHOP), the CHOP codes are based on ICD-9 codes
Death related to the same principal diagnosis	Proportion of patients who died with the same principal diagnosis
Death related to the same primary treatment	Proportion of patients who died with the same primary treatment
Type of admission	Emergency vs. non-emergency hospital admission
Referring organization type	Transfer from another hospital, another healthcare institution
Length of stay	Total length of hospital stay in days
ICU stay	Any stay in an intensive care unit during the hospital stay
Service	Surgical, medical, critical care, gynecology-obstetric and others to which the patients were admitted
Year	The year (2003 or 2004) when the patient data were recorded
Independent (predictor) variables	Nurse survey data, collected with different tools in the eight RICH Nursing Study hospitals aggregated at the hospital level
Model 1: rationing of nursing care (Groups 1–3)	Average implicit rationing score measured with the BERNCA. For the analysis, the hospitals were grouped on the basis of their at the hospital aggregated rationing score: Group 1: hospitals with the lowest rationing level: BERNCA score 0.51–0.80 ($n = 3$) Group 2: hospitals with a medium rationing level: BERNCA score 0.81–1.10 ($n = 4$) Group 3: hospitals with the highest rationing level: BERNCA score 1.11–1.40 ($n = 1$)
Model 2: quality of the nurse work environment (Groups 1 and 2)	Average quality of the nurse work environment measured with the NWI-R. For the analysis, the hospitals were grouped on the basis of their at the hospital level aggregated quality of the work environment: Group 1: hospitals with highest work environment quality: NWI-R scores 2.91–3.20 ($n = 3$) Group 2: hospitals with lowest work environment quality: NWI-R scores 2.61–2.90 ($n = 5$)
Model 3: patient-to-nurse ratio (Groups 1–4)	Average number of patients cared for by nurses in the unit on their last shift measured with one single item of the 'last shift'. For the analysis, the hospitals were grouped on the basis of their at the hospital level aggregated patient-to-nurse ratios: Group 1: patient-to-nurse ratio 6:1 ($n = 1$) Group 2: patient-to-nurse ratio 7:1 ($n = 1$) Group 3: patient-to-nurse ratio 9:1 ($n = 5$) Group 4: patient-to-nurse ratio10:1 ($n = 1$)

Data collection

The survey data collection was approved by the local ethics committees overseeing research in the eight RICH Nursing Study hospitals. Analyses of the patient outcome database for all 79 hospitals were governed by a data use agreement between the study team, the FSO and the directors of the participating hospitals.

Data analysis

For each RICH Nursing hospital, survey data on rationing, quality of the nurse work environment and the patient-to-nurse ratio were aggregated to the hospital level. Descriptive statistics (mean, median, standard deviation and range) were used to present the characteristics of the hospitals, nurses and patients as well as survey-derived aggregate measures.

Given the number of observed values for rationing and work conditions, rather than fitting models considering them as continuous variables, categorical variables were constructed based on their distributions, and, when possible, drawing on earlier work using the instruments [12] (Table 1). Some earlier results suggested a score of 1 (corresponding roughly to nurses' consistent reports that at least 'rare' rationing was occurring regularly) as a threshold for negative effects and was used as a cut-off point again here. Three of the eight hospitals had mean NWI-R scores that were in the range of 3, corresponding to average agreement across nurses that various practice environment characteristics were present. Finally, four groups of hospitals were constructed by rounding nurse staffing ratios to the nearest whole integer.

Logistic regression models were used to estimate the risk of death (dependent variable) for patients in relation to the group assignments of their hospital on rationing, work environment and staffing. The 71 comparison hospitals were the reference category in each case. Two sets of models were fitted for each independent variable: before and after controlling for the patient characteristics listed above and in Table 1. Since survey-derived organizational measures were available for only eight institutions and there was clear multicollinearity among the independent measures, separate rather than joint models for each of these variables were fitted. To account for the clustering of patients within the 79 hospitals, robust procedures (Huber–White) were used to correct the asymptotic standard error estimates [21–23].

A risk adjustment approach to account for differences in mortality risk across patients within hospitals was adapted from earlier work [1, 5]. In many earlier papers, dummy variables capturing a limited number of admission types were constructed and used as control variables. However, because a very heterogeneous set of medical and surgical patient groups were analyzed here, the probabilities of mortality for hundreds of types of medical and surgical admissions were calculated across all Swiss hospitals and these probabilities (continuous variables) were merged back into each record and used in the risk adjustment model. The area under the receiver operating characteristic curve (C-statistic) assessing the performance of the risk adjustment model for all patients [24] was 0.85 (AUC).

All analyses were performed using SPSS 17/18 (SPSS for Windows, Rel17. 2008, SPSS Inc., Chicago, USA) and STATA 11 (StataCorp LP, College Station, TX, USA). The level of significance was set at $P < 0.05$.

Results

The characteristics of the RICH Nursing hospitals and their groupings by organizational variables are shown in Table 2. Mean nurse reports of rationing levels varied from 0.63 to 1.15 across the RICH Nursing hospitals (on a scale with a 0–3 theoretical range), suggesting that, on average, nurses reported 'rarely' being unable to perform the nursing tasks listed in the BERNCA within the last 7 working days due to a lack of time or other resources. Values on the aggregated measure of the quality of the work environment varied from 2.67 to 3.16, indicating that the nurses tended to agree (albeit not strongly) that the nurse practice environment characteristics in the NWI-R were present in their current jobs. The average patient-to-nurse staffing ratio for all three shifts varied between 6 and 10 (Table 2).

The clinical characteristics of the patients treated in the 8 RICH Nursing hospitals and the 71 comparison hospitals are shown in Table 3. Overall, the RICH Nursing patients were somewhat younger, more likely to be male and to have been admitted to a medicine service and to have experienced an emergency admission and an ICU stay. Furthermore, some of the comorbidities, for instance, histories of acute myocardial infarction, cerebrovascular accidents, diabetes and metastatic cancer, were more common in the RICH Nursing patients (Table 3).

On average, ~3% of the patients hospitalized in the RICH Nursing hospitals and comparison institutions died during their hospital stays. Across the RICH Nursing hospitals, the unadjusted mortality rate varied from 2.1 to 4.3%.

Three separate sets of logistic regression models were fit to examine the risk of death for patients treated in RICH Nursing hospitals with different: (i) rationing levels, (ii) patient-to-nurse staffing ratios and (iii) quality of the work environment relative to patients treated in comparison institutions. The results of all six models (for each of the three independent variables, both unadjusted and fully adjusted) are shown in Table 4. Patients treated in the RICH Nursing hospital group with the highest measured rationing levels were 51% more likely to die than those in the comparison institutions. Patients treated in the RICH Nursing hospital group with the lowest measured rationing level (Group 1) were significantly less likely to die than those in the comparison institutions. Patients treated in RICH Nursing hospitals with higher quality work environments (Group 1) had also a significantly lower likelihood of death. Finally, patients treated in RICH Nursing hospitals with the highest measured patient-to-nurse staffing ratios were 37% more likely to die, and those treated in hospitals with the lowest (most

Table 2 Characteristics of the RICH Nursing Study hospitals and Hospital Groupings on Implicit Rationing, Work Environment and Staffing Levels

RICH Nursing hospital (Nr)	7	3	2	1	5	4	6	8
Nurse (N)	75	426	114	103	253	239	41	87
Typology	R	U	U	C	U	U	R	C
Ownership	Pub	Pub	Pub	Pub	Pub	Pub	Pub/Pr	Pub
Size[a]	Medium	Large	Small	Medium	Large	Large	Small	Medium
Years worked as a nurse [mean (SD)]	9.2 (7.96)	9.9 (8.67)	6.6 (7.02)	11.3 (9.87)	10.2 (7.82)	13.6 (10.27)	9.5 (9.50)	9.2 (8.27)
	Rationing lowest level			Rationing medium level				Rationing highest level
Rationing (mean)	0.63	0.68	0.73	0.89	0.90	0.93	0.96	1.15
	Work environment higher quality level				Work environment lower quality level			
Perceived average quality of the work environment (mean)	2.92	3.16	2.98	2.74	2.87	2.72	2.67	2.78
Nurse-to-patient ratio [mean (SD)]	9:1 [9.01 (5.71)]	6:1 [6.19 (4.63)]	9:1 [9.25 (7.06)]	10:1 [10.13 (7.03)]	9:1 [9.14 (4.52)]	9:1 [9.14 (6.71)]	7:1 [7.32 (3.65)]	9:1 [8.89 (4.31)]

C, cantonal; U, university; R, regional; Pub, public; Pr, private.
[a]Size: small $\leq$ 300 beds, medium = 300–600 beds, large $\geq$ 600 beds.

favorable) patient-to-nurse ratio were 17% less likely to die than those in comparison institutions.

Discussion

This study is one of the first to suggest differences in objectively measured patient outcomes across hospitals with different levels of a process measure of nursing care—rationing of nursing care. Despite relatively small variations in rationing levels across hospitals, overall, patients treated in the institutions with the lowest rationing levels were at a lower risk of inpatient mortality than those in comparison institutions. Conversely, patients in the hospital with the highest rationing scores were more likely to die. In the adjusted models, patients treated in the hospitals with mid-range scores on rationing had mortality risks that were statistically indistinguishable from the comparison institutions.

While rationing, staffing and quality of the nurse work environment represent distinct organizational properties, their relationship with patient outcomes were examined with separate logistic regression models, due to multicollinearity between rationing and the nurse work environment ($r = -0.82$) and staffing ($r = 0.65$). The relationship between higher rationing scores and elevated patient mortality risk might be explained in terms of the omission of important aspects of care, such as close monitoring, directly or indirectly related to the perceived lack of resources and time constraints. Such omissions could have important consequences for patients' risks of developing serious problems and/or receiving inadequate treatment for complications, whether preventable or not. Nonetheless, the inherent limitations of findings from cross-sectional studies and analyses of complex patient outcomes influenced by multiple patient and organizational factors and care by multiple disciplines all apply here. The results here are clearly tentative and in need of further elaboration and explanation with longitudinal and mechanistic studies. However, the observed associations are in line with earlier findings linking rationing with nurse- and patient-reported outcomes and add to the body of literature hinting at rationing of nursing care as a useful process measure in hospital outcomes research [12, 13].

Other findings were consistent with earlier work linking nurse staffing and patient outcomes [1, 4, 5, 15, 25] as well as the smaller pool of papers dealing with work environments in relation to patient outcomes [25–27]. Higher risk-adjusted mortality in hospitals with poorer staffing and worse work environments is generally explained in terms of reductions in the quantity or quality of nursing care received by patients [16–28]. Although increased rationing under poorer staffing and work environments could explain the associations, the design here did not permit a formal examination of this hypothesis.

Cross-sectional nurse survey data from the small number of hospitals in RICH Nursing limit the representativeness and generalizability of the findings. A novel approach that approximates a 'benchmarking' technique was used to compare 8 hospitals against a larger pool of 71 hospitals for

Table 3 Characteristics of the surgical, medical and gynecological patients in the study hospitals

	Patients in 71 hospitals ($N = 760\,608$)	Patients in the eight RICH Nursing Study hospitals ($N = 165\,862$)
Age, mean (SD) [median]	61 (18.44) [63]	59 (18.47) [61]
Female, *N* (%)	389 169 (51.2)	78 712 (47.5)
Medical patient, *N* (%)	312 143 (41.0)	73 624 (44.4)
Surgical patients, *N* (%)	395 760 (52.0)	79 937 (48.2)
Gynecological patients, *N* (%)	49 197 (6.5)	10 069 (6.1)
Inpatient mortality/mortality risk		
Inpatient mortality, *N* (%)	20 951 (2.8)	4462 (2.7)
Comorbidities		
Acute myocardial infarction/heart disease, *N* (%)	16 960 (2.2)	6027 (3.6)
Congestive heart failure, *N* (%)	13 795 (1.8)	3114 (1.9)
Peripheral vascular disease, *N* (%)	12 296 (1.6)	5249 (3.2)
Cerebral vascular accident, *N* (%)	15 429 (2.0)	5854 (3.5)
Dementia, *N* (%)	3236 (0.4)	817 (0.5)
Pulmonary disease, *N* (%)	36 238 (4.8)	9702 (5.8)
Connective tissue disorder, *N* (%)	6109 (0.8)	1684(1.0)
Peptic ulcer, *N* (%)	3009 (0.4)	856 (0.5)
Liver disease, *N* (%)	4031 (0.5)	1802 (1.1)
Diabetes, *N* (%)	30 533 (4.0)	9020 (5.4)
Diabetic complications, *N* (%)	6186 (0.8)	1587 (1.0)
Paraplegia, *N* (%)	6704 (0.9)	2117 (1.3)
Renal disease, *N* (%)	30 585 (4.0)	7614 (4.6)
Cancer, *N* (%)	28 030 (3.7)	9049 (5.5)
Metastatic cancer, *N* (%)	18 342 (2.4)	5525 (3.3)
Severe liver disease, *N* (%)	1633 (0.2)	646 (0.4)
HIV, *N* (%)	1358 (0.2)	836 (0.5)
Type of admission, referring org.		
Transfer other hospital, *N* (%)	24 584 (3.2)	9078 (5.5)
Transfer other healthcare institution, *N* (%)	13 614 (1.8)	3398 (2.0)
Emergency admission, *N* (%)	347 336 (45.7)	78 627 (47.4)
Characteristics of the stay		
ICU stay, *N* (%)	46 104 (6.1)	22 791 (13.7)
LOS, mean (SD) [median]	9.00 (9.89) [6.0]	10.32 (13.43) [7.0]

which no survey data were available. Experience with this technique is limited and that the appropriateness of the conclusions hinge not only on confidence in the overall approach but on the comparability of the hospital groups. Although the non-RICH (comparison) hospitals were matched on mission and patient volumes, unmeasured differences between the two types of facilities cannot be ruled out.

Another issue is the quality of the patient discharge data used. While the nationwide uniform database was implemented in 1997, institution to institution in coding remains [29–31].

Finally, cutpoints for rationing and work environment levels were used in the analyses; therefore, sensitivity analyses were conducted. The highest level of rationing included only one institution and in unadjusted models, patients in this institution had a 59% increase in mortality risk. Adding an additional hospital to the 'highest level' group by including the hospital with the next-highest rationing score (just below the earlier cutoff of 1) revealed a 33% increased mortality risk and subsequent additions of the next one or two hospitals showed that patients were at only 5–7% increased risk (albeit statistically significantly different) from comparison hospitals, respectively. This suggests that the results with respect to rationing were 'driven' by the two hospitals at the top of the range. Moving the cutpoint for 'higher' vs. 'lower' work environments to include an additional hospital in the 'higher' group revealed an almost identical pattern of results; we concluded that the work environment result was robust to cutpoint. Although the results of the sensitivity analyses are reassuring, these relationships should be reevaluated in larger data sets where hospitals show more variation on the independent variables.

Beyond these limitations, the study has several strengths. First of all, the use of a powerful risk adjustment method enabled control for important differences in terms of patient clinical characteristics. The benchmarking of the patient

Table 4 Odds ratios for inpatient mortality across groupings of eight RICH Nursing hospitals by levels of rationing, quality of the nurse work environment and reported patient-to-nurse ratio (reference category: 71 comparison Swiss hospitals without survey data)

	Group 1: lowest level	*P*-value	Group 2: medium level	*P*-value	Group 3: highest level	*P*-value		
Rationing level (BERNCA)								
Unadjusted mortality risk[a]	0.82 (0.74, 0.90)	<0.001	1.02 (0.90, 1.17)	0.73	1.59 (1.46, 1.74)	<0.001		
Adjusted mortality risk[b]	0.80 (0.67, 0.97)	0.02	0.82 (0.65, 1.05)	0.12	1.51 (1.34, 1.70)	<0.001		
	Group 1: higher level	*P*-value	Group 2: lower level	*P*-value				
Quality of the work environment (NWI-R)								
Unadjusted mortality risk[a]	0.82 (0.74, 0.90)	<0.001	1.07 (0.92, 1. 24)	0.38				
Adjusted mortality risk[b]	0.80 (0.67, 0. 97)	0.02	0.92 (0.88, 1. 14)	0. 33				
	Group 1: ratio 6:1	*P*-value	Group 2: ratio 7:1	*P*-value	Group 3: ratio 9:1	*P*-value	Group 4: ratio 10:1	*P*-value
Ratio patient-to-nurse ratio								
Unadjusted mortality risk[a]	0.82 (0.75, 0.90)	<0.001	1.05 (0.96, 1.15)	0.28	1.01 (0.86, 1.20)	0.87	1.03 (0.94, 1.13)	0.50
Adjusted mortality risk[b]	0.83 (0.75, 0.92)	<0.001	0.76 (0.70, 0.83)	<0.001	0.81 (0.65, 1.02)	0.07	1.37 (1.24, 1.52)	<0.001

All modeling employed Huber–White standard error estimates correcting for clustering of patients within hospitals

[a]Unadjusted model: odds ratios computed in logistic regression models

[b]Adjusted model: odds ratios computed in logistic regression models with adjustment for clustering of subjects by hospitals. Patient characteristics included: age, the proportion of patient with the same principal diagnosis as well as same principal treatment who died, comorbid medical conditions (Charlson comorbidity index for ICD-10), type of admission (emergency vs. non-emergency admission), referring organization type (another hospital, another healthcare institution), year and service (medicine, surgery, critical care, gynecology/obstetrics).

outcomes in 8 RICH Nursing Study hospitals, where we had detailed organizational data, against those of 71 comparison institutions was an innovative feature that allowed us to replicate key findings from earlier research and identify a new association of both theoretical and practical significance.

Conclusions

These preliminary data suggest that patients treated in facilities with higher rationing levels experience higher risk-adjusted in-hospital mortality, perhaps due to a greater likelihood that nurses in these hospitals omit actions preventing or remedying life-threatening complications. These results add to a body of findings suggesting a dose–response relationship between rationing and poor outcomes in hospitals. Rationing of nursing care holds considerable promise as an explanatory variable in hospital outcome research. We recommend continued investigation of this newer process of care indicator in larger and more sophisticated studies that both confirm the patterns and examine competing explanations for the rationing–outcomes relationship.

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