

Patient Reports of Night Noise in Hospitals Are Associated With Unplanned Readmissions Among Older Adults

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Abstract

Objective: Sleep disturbance is a key contributor to posthospital syndrome; a transient period of vulnerability following discharge from hospital. We sought to examine the relationship between patient-reported hospital quietness at night, via a validated survey, and unplanned hospital readmissions among hospitalized seniors (ages 65 and older) in Alberta, Canada. **Design:** Retrospective, cross-sectional analysis of survey responses, linked with administrative inpatient records. **Setting:** Using the Canadian Patient Experiences Survey—Inpatient Care and Discharge Abstract Database, patients aged 65 and older, and living with one or more chronic conditions were identified. **Participants:** Of all, 25 674 respondents discharged from hospital between April 2014 and December 2017. **Main Outcome Measure:** All-cause, unplanned readmission within 30 or 90 days (yes vs no). **Results:** Approximately half (50.5%) of the respondents reported that the area around their room was always quiet at night. Eight (8.1%) percent of respondents (2066) were readmitted within 30 days (2241 total readmissions), while 15.6% (4000) were readmitted within 90 days (5070 total readmissions). When controlling for a variety of demographic and clinical factors, patients not reporting “always” to the survey question regarding hospital quietness at night had slightly greater odds of readmission within 30 (adjusted odds ratio [aOR] = 1.32, 95% confidence interval [CI]: 1.20-1.45) and 90 days (aOR = 1.14, 95% CI: 1.06-1.23). **Conclusion:** Our results demonstrate a clear association between patient-reported hospital quietness at night and subsequent readmission within the first 30 and 90 days following discharge. Efforts to minimize hospital noise, particularly at night, may help promote a restful environment, while reducing readmissions among older patients living with chronic conditions.

Keywords

patient feedback, quality improvement, survey data, HCAHPS

Introduction

A hospital ward can be a very noisy place. Studies (1–3) have shown that average night noise levels on hospital wards can far exceed the recommended level of 30 dB set forth by the World Health Organization (4). Alarming, peak noise levels on an intensive care unit (ICU) have been shown to be as high as 103 dB—a level typically experienced at a playoff hockey game (5). Patient experience surveys have highlighted hospital noise as a frequent concern of those who have received care (6,7). In addition to other factors such as lights, medications, frequent disruptions (8–10), and noise, a good night’s sleep while in hospital can prove challenging. The increased noise levels of hospital wards have been correlated with sleep loss (2,3), with one study documenting a mean nightly sleep deficit reported as high

as 1.8 hours when compared to the study patients’ normal home environment (3).

Sleep disturbance among hospitalized patients has been shown to have a variety of physiologic effects, including poor memory recall, prolonged wound healing, decreases

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in strength, mood disturbances, and increased pain (8). As such, sleep disturbance is a chief contributor to posthospital syndrome (11)—a term used to highlight the transient period of increased patient vulnerability following hospital discharge. This period is characterized by an increased risk of adverse events (eg, hospital readmission, secondary illness, death) thought to be attributable to the increased allostatic stress experienced in hospital (12). Other factors proposed to be contributors to posthospital syndrome include disruption of circadian rhythms, poor nutrition, increased pain, mentally challenging situations associated with care, medications which can alter cognition and physical function, and deconditioning due to bed rest or inactivity (11).

To our knowledge, no studies have examined the potential link between patient reports of hospital quietness at night and unplanned readmissions. As such, our primary aim was to determine whether patient-reported quietness at night, as obtained from a validated patient experience survey, was associated with unplanned readmissions within 30 and/or 90 days following hospital discharge. Our secondary aim was to determine whether patient reports of hospital quietness at night varied according to patient demographics and/or clinical features.

Methods

Data Sources

We conducted a retrospective analysis of patient experience surveys linked with administrative inpatient data. All data encompassed discharges from hospitals across Alberta, Canada, from April 1, 2014, to December 31, 2017. We included all patients aged 65 years and older who completed a telephone survey about their inpatient hospital experiences across Alberta during the period identified above. Participants completed a modified version of the Canadian Patient Experience Survey—Inpatient Care (CPES-IC) instrument. The CPES-IC is a survey which was developed by the Canadian Institute of Health Information (CIHI), in collaboration with stakeholders in many jurisdictions (13). Details regarding its development and validation have been previously reported (13,14). Respondents were a random sample of seniors (ages 65 years and older) who were discharged home (with or without support services), from 93 hospitals across the province. The complete survey inclusion criteria, including those which are specific to Alberta, have been previously published by our research group (15). Surveys required approximately 12 to 18 minutes to complete and captured patient feedback on a variety of topics. Surveys were administered via random-digit dialing within 6 weeks of discharge from hospital, by a team of trained interviewers employed by Alberta Health Services (AHS); the sole provider of inpatient hospital services in the province. Surveys followed a standard script with a list of prompts and answers to some frequently asked questions. Surveys concluded with an open-ended question, where participants were given the

opportunity to provide feedback regarding any compliments or concerns about the care which they received.

Surveys were linked to administrative inpatient records from the Discharge Abstract Database (DAD) (16), using exact matches of personal health number, facility code, and discharge date. Index visits included those discharged to home, either with or without support services (discharge disposition code of “4,” or “5”). To eliminate any potential confounding effects of sleep disorders upon our results, we eliminated any index cases where a sleep disorder was coded in any of the 25 DAD diagnosis positions (17). Unplanned readmissions were identified as subsequent visits with an admission category of “U” (urgent) in the DAD data set.

Study Variables

The outcome variable was all-cause, unplanned readmission to hospital (yes vs no) within 30 or 90 days following initial discharge. The independent variable was a survey question regarding quietness of the hospital environment at night. It was worded as follows: “During this hospital stay, how often was the area around your room quiet at night.” Possible answer choices were “always,” “usually,” “sometimes,” or “never.” Answers to this survey question were classified as “top box” (most positive answer) versus other responses. In alignment with Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) methodology, a “top box” response was considered to be “always” (18).

A variety of demographic and clinical variables were included as covariates. These included sex, age group (at time of hospital discharge [65-74 years; 75 years and older]), education level (high school or less; high school or college; university), hospital category (urban; rural), index admission type (urgent; elective), intensive care stay during index visit (yes; no), length of index hospital stay (less than 3 days; 3.01-7 days; more than 7 days), and number of medical comorbidities (none, 1, 2, 3, or more) (19). Respondents’ self-reported physical and mental health were also included (each classified as excellent; very good/good; fair/poor from the CPES-IC survey).

Analysis

Demographics and clinic characteristics of the study cohort were reported using descriptive statistics. Multivariable logistic regression was used to assess the relation between unplanned readmissions within 30 or 90 days and responses regarding quietness at night, in the presence of the covariates, as described above. We also explored the relationship between responses regarding the quietness of the hospital environment and the demographic/clinical covariates. Crude and adjusted models (including all covariates) were generated, along with corresponding odds ratios and 95% confidence intervals (CI). Effect sizes were calculated using Cohen’s *h* (20). Values of 0.2 or less were deemed as a small effect size, 0.21 to 0.5 as moderate, and greater than 0.5 as

large (20). All analyses were conducted using SAS version 9.3 (SAS Institute; Cary, North Carolina).

Ethics Approval

The study was approved by the Conjoint Health Research Ethics Board (CHREB) at the University of Calgary. A waiver of participant consent was granted. All necessary data and administrative approval were provided via a research agreement between our local health authority (AHS) and our research team.

Results

Over the study period, 25 674 eligible patients aged 65 years and older responded to the survey. The demographic and clinical profile of respondents is shown in Table 1. The mean age of the cohort was 74.8 ± 7.0 years (range = 65-102), and respondents had an average length of stay of 6.9 ± 10.5 days (range = 1-465). The majority of respondents (52.3%) were female and had an education level of high school or greater (68.3%). From a clinical perspective, 18 719 (72.9%) patients were cared for at urban hospitals, and 17 026 (66.3%) were admitted to hospital on an urgent basis. Only 737 (2.9%) patients had an ICU stay, while a majority of patients (65.1%) had at least one medical comorbidity. Approximately 1 (15.7%) in 6 respondents had 3 or more comorbidities documented in their inpatient record. Respondents had more favorable ratings of their mental health than their physical one (24.6% vs 9.4% reporting “excellent”). Of all, 50.5% of respondents reported that the area around their room was always quiet at night. Eight (8.1%) percent of respondents (2066) were readmitted at least once within 30 days following their discharge (2241 total readmissions), while 15.6% (4000) were readmitted at least once within 90 days (5070 total readmissions). Those who were readmitted to hospital responded “always” to the question about quiet at night less frequently (45.0% vs 51.0% for within 30 days, 49.0% vs 50.7% for 90 days).

From the adjusted logistic regression analyses (Table 2), not reporting “always” to the survey question regarding hospital quietness at night was associated with greater odds of readmission within 30 (adjusted odds ratio [aOR] = 1.32, 95% CI: 1.20-1.45) and 90 days (aOR = 1.14, 95% CI: 1.06-1.23) after hospital discharge. The effect size for the association between quietness at night and readmission was 0.22 at 30 days and 0.15 at 90 days. These indicate a moderate and small effect size, respectively, as per Cohen’s *h*. Other demographic and clinical predictors were associated with readmission in our cohort. Males had higher odds of readmission within 30 (aOR = 1.24, 95% CI: 1.13-1.36) and 90 days (aOR = 1.22, 95% CI: 1.13-1.31). When compared with those aged 75 and older, seniors 65 to 74 years of age had lower odds of readmission within 90 days (aOR = 0.91, 95% CI: 0.84-0.98). When compared to respondents with a university-level education, those who completed less than

Table 1. Sample Demographics and Clinical Characteristics.^a

Variable	n (%)
Sex	
Male	12 238 (47.7)
Female	13 436 (52.3)
Age-group (years)	
65 to 74	13 873 (54.0)
75 and older	11 801 (46.0)
Level of education (n = 24 568)	
Less than high school	7790 (31.7)
High school or college	11 547 (47.0)
University (any or completed)	5231 (21.3)
Hospital category	
Urban	18 719 (72.9)
Rural	6955 (27.1)
Admission category	
Urgent	17 026 (66.3)
Elective	8648 (33.7)
Intensive care unit stay	
Yes	737 (2.9)
No	24 937 (97.1)
Length of stay	
3 days or less	6722 (26.2)
3.01 to 7 days	12 421 (48.4)
More than 7 days	6531 (25.4)
Number of comorbidities	
None	8955 (34.9)
1	7526 (29.3)
2	5175 (20.2)
3 or more	4018 (15.7)
Self-reported physical health (n = 25 311)	
Excellent	2367 (9.4)
Very good/good	15 413 (60.9)
Fair/poor	7531 (29.8)
Self-reported mental health (n = 25 512)	
Excellent	6272 (24.6)
Very good/good	16 605 (65.1)
Fair/poor	2635 (10.3)
Hospital room quiet at night	
Always	12 957 (50.5)
Usually	7711 (30.0)
Sometimes	3866 (15.1)
Never	1140 (4.4)
Readmission within 30 days	
Yes	2066 (8.1)
No	23 608 (91.9)
Readmission within 90 days	
Yes	4000 (15.6)
No	21 674 (84.4)

^an = 25 674 unless specified.

high school had higher odds of readmission within both 30 (aOR = 1.17, 95% CI: 1.02-1.34) and 90 days (aOR = 1.19, 95% CI: 1.07-1.32). Those discharged from urban hospitals had lower odds of readmission at 30 (aOR = 0.87, 95% CI: 0.78-0.97), and 90 days (aOR = 0.79, 95% CI: 0.73-0.86). Those who were admitted to hospital urgently had higher odds of readmission within 30 (aOR = 1.57, 95% CI: 1.39-1.78), and 90 days (aOR = 1.89, 95% CI: 1.71-2.08).

Table 2. Odds of Unplanned Readmission Within 30 and 90 Days of Discharge.

Variable	30 Days		90 Days	
	aOR	95% CI	aOR	95% CI
Hospital room quiet at night				
Always		–		–
Other responses	1.32	(1.20-1.45)	1.14	(1.06-1.23)
Sex				
Male	1.24	(1.13-1.36)	1.22	(1.13-1.31)
Female		–		–
Age-group (years)				
65 to 74	0.98	(0.89-1.08)	0.91	(0.84-0.98)
75 and older		–		–
Level of education				
Less than high school	1.17	(1.02-1.34)	1.19	(1.07-1.32)
High school or college	1.09	(0.96-1.24)	1.08	(0.98-1.20)
University (any or completed)		–		–
Hospital category				
Urban	0.87	(0.78-0.97)	0.79	(0.73-0.86)
Rural		–		–
Admission category				
Urgent	1.57	(1.39-1.78)	1.89	(1.71-2.08)
Elective		–		–
Intensive care unit stay				
Yes	0.95	(0.73-1.25)	0.93	(0.76-1.15)
No		–		–
Length of stay				
3 days or less	0.68	(0.59-0.79)	0.65	(0.58-0.72)
3.01 to 7 days	0.88	(0.79-0.98)	0.84	(0.78-0.92)
More than 7 days		–		–
Number of comorbidities				
None	0.71	(0.62-0.82)	0.64	(0.57-0.71)
1	0.85	(0.74-0.97)	0.77	(0.69-0.85)
2	0.89	(0.77-1.03)	0.87	(0.78-0.97)
3 or more		–		–
Self-reported physical health				
Fair/poor	1.99	(1.60-2.47)	2.08	(1.77-2.45)
Very good/good	1.11	(0.91-1.37)	1.04	(0.89-1.21)
Excellent		–		–
Self-reported mental health				
Fair/poor	0.99	(0.83-1.18)	1.15	(1.01-1.32)
Very good/good	1.04	(0.92-1.18)	1.11	(1.01-1.22)
Excellent		–		–

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.

Length of stay, number of medical comorbidities, and self-reported physical health were also associated with readmission at both time points. Those with shorter lengths of stay, fewer medical comorbidities, and better self-reported health had lower odds of readmission. Intensive care unit stay and self-reported mental health were not associated with readmission within the 30- or 90-day time frames.

Table 3 shows the regression results for the association between patient-reported hospital quietness at night and the demographic/clinical variables which we included. Respondents were less likely to respond “always” to the survey question about quietness at night if they were 65 to 74 years

Table 3. Odds of Reporting “Always” to Survey Question Regarding Quietness at Night.

Variable	aOR	95% CI
Sex		
Male	1.23	(1.17-1.30)
Female		–
Age-group (years)		
65 to 74	0.86	(0.82-0.91)
75 and older		–
Level of education		
Less than high school	2.03	(1.88-2.19)
High school or college	1.42	(1.33-1.52)
University (any or completed)		–
Hospital category		
Urban	0.5	(0.47-0.54)
Rural		–
Admission category		
Urgent		(0.94-1.06)
Elective		–
Intensive care unit stay		
Yes	1.3	(1.11-1.51)
No		–
Length of stay		
3 days or less	1.37	(1.27-1.48)
3.01 to 7 days	1.21	(1.14-1.30)
More than 7 days		–
Number of comorbidities		
None	0.91	(0.83-0.99)
1	0.96	(0.88-1.04)
2	1.04	(0.95-1.14)
3 or more		–
Self-reported physical health		
Fair/poor	0.6	(0.54-0.67)
Very good/good	0.7	(0.63-0.77)
Excellent		–
Self-reported mental health		
Fair/poor	0.69	(0.62-0.77)
Very good/good	0.78	(0.73-0.83)
Excellent		–

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.

of age (vs 75 years and older; aOR = 0.86, 95% CI: 0.82-0.91), were cared for in a large urban hospital (vs rural; aOR = 0.50, 95% CI: 0.47-0.54), or had self-reported physical and mental health ratings of less than excellent. Males were more likely to respond “always” (aOR = 1.23, 95% CI: 1.17-1.30), along with those with an education level of less than university, who had an ICU stay (aOR = 1.30, 95% CI: 1.11-1.51), and who had a length of stay of less than 7 days. No relationship was observed between the question regarding quietness at night, admission category, and number of medical comorbidities.

Discussion

We found that responses to a validated survey question regarding hospital quietness at night were associated with unplanned readmissions within both 30 and 90 days.

Specifically, those not responding “always” (responses of “usually,” “sometimes,” or “never”) experienced 32% higher odds of readmission at 30 days, and 14% higher odds of readmission within 90 days. This was shown after adjusting for a variety of common demographic and clinical characteristics. We also found that patient reports of hospital quietness at night varied according to these demographic and clinical features.

Readmissions have a tremendous impact upon patients, caregivers, and health-care system. Readmission rates are also an established quality measure within many health-care organizations, including AHS (21). Much work has been done to assess the risk factors associated with unplanned readmissions. For example, in a comprehensive, national study, CIHI presented many risk factors found to be associated with readmissions among Canadian patients. These included many of the factors examined in the present study, such as age, gender, length of stay, and number of comorbidities (22). However, no patient-reported data were among these factors. Our results present a novel contribution in this regard.

There are many possible sources of hospital noise. A comprehensive understanding of these is important, as they may inform improvements. Recent research has shown that the primary sources of noise on a hospital ward are the product of human activity. These include noisy caregivers or visitors, other patients (eg, snoring, trips to the washroom, televisions, or telephone conversations), and communication between staff (23–25). Other contributors may include sound production from medical equipment (eg, IV machines), medical alarms (eg, monitoring of vitals), and physical attributes of the hospital (eg, automatic doors, elevators, ice machines).

Limitations

As part of this study, we did not collect any objective measures of sleep or of the noise encountered by respondents. We also did not ask participants to complete sleep logs to document the quantity and quality of sleep that they obtained each night while in hospital. However, given that noise levels in hospitals and their resultant effects upon sleep are well documented in the literature, we have no reason to believe that this would have differed according to the study setting or characteristics of our study participants. One potential benefit of obtaining subjective feedback using surveys is that respondents may frame their answer within the context of their own preferences and perceptions. Our data showed that patients who had an ICU stay had greater odds of responding “always” to the question regarding quietness at night. Patient expectations and/or acclimatization may play a part in explaining this counterintuitive result.

Additional limitations pertain to the sample of respondents and mode of survey administration. Previous research has shown that health survey respondents tend to be healthier than nonrespondents (26,27). Our survey protocol did not

allow for proxy respondents. For these reasons, our results may not be generalizable to seniors with poor health. The survey was also administered by telephone; therefore, our results may have been subject to social desirability on the part of respondents and may not be generalizable to a mail-out format (28,29). Surveys were administered up to 42 days following the patient’s discharge from hospital. Some patients may have been readmitted prior to completing a survey regarding their index visit. Although respondents are reminded to only answer questions pertaining to their index visit, this may have resulted in some instances of recall bias. Lastly, the survey was only administered in English, which resulted in the exclusion of some potential respondents.

In conclusion, reducing readmissions among hospitalized patients is a priority for many health systems. Although many clinical improvements have been made, these efforts have largely focused upon patient and clinical characteristics and have not incorporated the patient voice. Our study is novel, in that it linked 2 routinely collected data sets to shed light upon the relationship between hospital noise and unplanned readmissions. Further, our work highlights the value and tremendous potential for patient-reported experience data. Given that the CPES-IC is administered in other Canadian provinces, future research can be conducted to replicate our results for a variety of clinical populations.

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