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Association of health confidence with hospital length of stay and readmission

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Abstract

Background: Length of stay (LOS) is an important measure of hospital quality and may be impacted by patient participation. However, concepts of patient participation, like health confidence, have received little examination in hospitalized patients' LOS, especially in diverse populations.

Objective: To determine if the Health Confidence Score (HCS) is associated with hospital LOS and readmission in a socioeconomically diverse population.

Designs, Settings and Participants: We conducted a prospective cohort study in 2022 of adult general medicine patients at an academic hospital in Chicago, Illinois.

Intervention: None.

Main Outcome and Measures: Patient-reported responses to the HCS (scored 0 [lowest health confidence] to –12 [highest health confidence]), as well as demographic, socioeconomic, and clinical questions, were collected. Primary outcome was LOS and secondary outcomes were 30- and 90-day readmission.

Results: Among 2797 socioeconomically diverse patients who completed the survey (response rate 28.5%), there was an average HCS of 9.19 (SD 2.68, range 0–12). Using linear regression, patients with high HCS (HCS ≥ 9) had a 1.53-day lower LOS ($p < .01$, 95% CI [-2.11, -0.95]) than patients with a low HCS (HCS < 9). This association remained when examining individual HCS questions and controlling for covariates. In logistic regression, HCS was not significantly associated with readmission, but the question "I am involved in decisions about me" (adjusted model: OR 0.83; 95% CI [0.71, 0.96]; $p = .01$) was associated with 90-day readmission.

INTRODUCTION

Length of stay (LOS) is an important measure of efficient and timely hospital care quality.[1] Both system and patient factors may contribute to prolonged LOS. Examples of system-level factors include procedure delays, insurance authorization, and transfers to postdischarge care settings.[2,3] Examples of patient-level factors include diagnosis, the severity of illness, and patient or family agreement with the discharge plan.[2–5]

Patient participation in their care, often described with measures such as health confidence, patient activation, or patient engagement, may be an important patient-level determinant of LOS. Such measures consider a patient's health knowledge, self-management, access to care, and involvement in the shared decision-making process, which are well

known to improve patients' ability to care for their medical issues, navigate the healthcare system, and successfully interact with medical professionals.[6–9] This may explain why patients who score higher on these measures have shown improved health outcomes.[10–14]

Despite this evidence, the effect of health confidence and its related concepts on LOS has not been studied extensively, especially in diverse or vulnerable populations.[15,16] However, it seems possible that patients with high health confidence would be more likely to actively participate in their care, potentially accelerating the receipt of care and resulting in reduced LOS. Therefore, the objective of the study is to examine whether a brief measure of health confidence that has not been widely used, the Health Confidence Score (HCS), is associated with hospital LOS. We hypothesize that hospitalized patients with high health confidence, within a socio-economically diverse population, will have shorter LOS without increased readmissions.

METHODS

This prospective cohort study was performed on data collected from admitted patients on adult general medicine services at the University of Chicago Medical Center (UCMC). The population of UCMC is derived from a regional population that is largely Black/African American and socio-economically diverse representing a wide range of incomes and educational attainment. This study was approved by the UCMC Institutional Review Board.

We measured health confidence with the HCS, a brief, recently created tool to measure health confidence by assessing a patient's health literacy, health knowledge, ability to obtain help, and involvement in shared decision-making processes.[17] The HCS is a validated four-question measure that begins by prompting "How do you feel about caring for your health?" followed by "How much do you agree [with the following statements]." This is followed by four statements: "I know enough about my health," "I can look after my health," "I can get the right help if I need it," and "I am involved in decisions about me." Each statement allows the patient to select one of the four-item Likert options from "Strongly Agree" to "Disagree." These responses generate individual question scores from 0 to 3 which sum to a total score from 0 to 12. Higher scores represent greater health confidence. Within the original description of the HCS, nonresponse was permissible, but our survey administration required an answer to every question. To account for this, we included a "Don't Know" and "Refused" option for each question of the HCS.

Health confidence is a patient characteristic similar to patient engagement,[12–14,17,18] patient empowerment,[19] patient activation,[20] and patient self-efficacy.[21] These terms characterize a combination of a patient's mindset and skillset to obtain their healthcare and have correlated with improved health outcomes.[10,12,14,22] However, prior studies using these tools have not studied hospitalized patients[15] and have not focused on diverse patient populations,[16] which were gaps we sought to address in this present study. Additionally, it is suspected these tools may be too long for clinical use,[23,24] therefore we chose the HCS because of its short format and more accessible reading level.[17] During its validation, the HCS was compared to the "My Health

Confidence" single-question self-assessment of health confidence.[13,14,17] While there are no other comparisons of the HCS to other patient engagement tools, many of its domains are like those of more popular measures.

Settings and participants

Adult general medicine patients admitted to UCMC between January 21, 2022, and September 20, 2022, were approached for written consent into the University of Chicago Hospitalist Project (UCHP), a long-standing study on the care of patients at UCMC.[25] Consented patients were administered a survey containing the HCS while they were admitted to the hospital. Only a patient's first admission within the study period was considered for analysis and only fluent research assistants, hospital translators, or virtual translator services were used for patients with limited English proficiency. Further details of the UCHP are described elsewhere.[25]

Data collection and measurements

The primary outcome is the association of HCS with LOS. The secondary outcome is the association of HCS with 30- and 90-day readmission. We evaluated the association of 30-day readmission with LOS due to its historical and policy significance. We also evaluated 90-day readmissions because there is evidence that readmissions farther from discharge depend more on longer-term skills such as healthcare knowledge, navigation skills, and follow-up[26] and we were more likely to capture these readmissions within a longer time frame. The LOS and readmission outcomes were obtained through the UCMC electronic health record (EHR) data but were limited to UCMC admissions and readmissions.

Covariates included gender, race, ethnicity, patient age, marital status, the highest level of education achieved, residence before admission, annual income, presence of a prior hospitalization within the last year, number of hospitalizations in the last year, presence of a caregiver, and a calculated self-report generated Charlson Comorbidity Index (srCCI).[27,28] EHR Data included gender, race, ethnicity, and patient age. For the rest of the covariates mentioned in the first sentence of this paragraph, the UCHP survey question data was used.

Data analysis

Standard descriptive statistics were calculated for the HCS, LOS, 30- and 90-day readmission, and covariates. For use in analysis, we dichotomized HCS into "high" (HCS ≥ 9) and "low" (HCS < 9) health confidence scores by the sample average HCS. This threshold was based on the average HCS in its initial development.[17] We performed a sensitivity analysis for this cutoff, repeating the analyses with the cutoff being 8 and 10, ensuring that any significant results did not hinge on this value. Bivariate analysis comparing high HCS (HCS ≥ 9)

versus low HCS (HCS < 9) was calculated using either Pearson's chi-squared testing for categorical variables or analysis of variance (ANOVA) testing for continuous variables.

Patterns of LOS and readmission with HCS were examined using regression analysis. Simple linear regression assessed the relationships between LOS with total HCS as a continuous variable, total HCS as a dichotomized variable, and individual HCS questions for our primary outcome. Multivariate linear regression was used to adjust for gender, race, ethnicity, age, marital status, education, residence, income, presence of a caregiver, srCCI, presence of a prior hospitalization within the last year, and number of hospitalizations in the last year. Logistic regression similarly assessed the relationship between 30- and 90-day readmissions with HCS for our secondary outcome. We presented both unadjusted and adjusted results to highlight the utility of the HCS outside of the research setting when adjustment is not possible.

Data analysis was performed using Stata SE 18 software, and significance was defined as two-sided $p < .05$. Only patients who did not complete the HCS (by marking any or all the questions with "Don't Know") were excluded from data analysis. All other patients, including those who did not respond to the covariate questions, were included. Reporting followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for reporting observational studies.[29]

RESULTS

Participant characteristics

A total of 9816 unique patients were eligible for participation during the study period with 2890 (29.4%) patients consented to the UCHP. Of those that consented to the UCHP, 2797 (28.5%) completed the HCS, 88 (3.0%) completed some of the HCS, but for other questions responded with "Don't Know," and 5 (0.2%) responded "Don't Know" to all items of the HCS. No patients responded with "Refused" to any of the HCS questions. Those who completed the HCS differed from those who did not complete the survey in age ($p = .03$), race (<.01), and ethnicity ($p < .01$) but not gender.

Of those who completed the HCS (Table 1), patients were predominantly female, of Black/African American race, and non-Hispanic or Latino ethnicity. The average age was 59.8 years old. Most were single, had an educational attainment of graduating high school, lived in their own apartment/house, and had a yearly income of <$25,000. Most had a caregiver, had a prior hospitalization within the last year, and the average number of hospitalizations in the last year was 1.4. Clinical comorbidities were captured with an average srCCI of 0.91.

Health confidence

Overall, the respondents had a mean HCS of 9.19 with SD 2.68 and a range from 0 to 12 (Figure 1a). More respondents had a high (HCS ≥ 9, $n = 1710$; 61.1%) versus low (HCS < 9, $n = 1087$; 38.9%) HCS. For all

individual questions, strongly agree was the most common answer, ranging from 1201 (42.9%) strongly agreeing to "I can look after my health" to 1947 (69.6%) strongly agreeing to "I am involved in decisions about me" (Figure 1b).

Patient characteristics were then stratified by high (HCS ≥ 9) and low health confidence (HCS < 9). There were differences in HCS scores based on gender, race, age, education, residence before admission, income, and presence of a caregiver (Table 1). Within our sensitivity analysis, there were only changes in the significance of race, marital status, prior hospitalization within the last year, and the number of hospitalizations in the last year (Supporting Information S1: Tables S3 and S4).

Association of health confidence and LOS

In patients who completed the HCS, the average LOS was 7.32 days (SD 7.27, min = 0, max = 91) for our primary outcome. The average LOS for patients with high HCS (HCS ≥ 9) was 6.72 days, while patients with low HCS (HCS < 9) had a LOS of 8.25 days for a statistically significant difference ($p < .01$).

On multivariable analyses, each point increase in HCS was associated with a 0.34-day decrease ($p < .01$, 95% confidence interval [CI] [−0.44, −0.24]) in LOS, with patients with a high HCS having a 1.53-day decrease ($p < .01$, 95% CI [−2.11, −0.95]) in LOS compared to patients with a low HCS. After adjusting for demographic, socio-economic, and clinical covariates, these associations remained significant (Table 2). Additionally, there were no differences in significance within our sensitivity analysis (Supporting Information S1: Table S5).

Analysis was also performed on the individual HCS questions and LOS. Each point increase in an individual question response was significantly associated with a decrease in hospital LOS ranging from 0.31 to 1.29 days depending on the question and the model (Table 2).

Association of health confidence and readmission

In patients who completed the HCS, there were 221 (7.9%) patients experiencing 30-day readmission and 504 (18.0%) experiencing 90-day readmission for our secondary outcome. For 30-day readmissions, there were 144 (8.4%) and 77 (7.1%) patients with a high HCS (HCS ≥ 9) versus low HCS (HCS < 9) ($p = .20$). For 90-day readmissions, there were 300 (17.5%) and 204 (18.8%) patients with a high HCS (HCS ≥ 9) versus low HCS (HCS < 9) ($p = .41$).

Multivariable analysis was also used to determine the association between HCS and both 30- and 90-day readmission. However, the HCS was not significantly associated with the odds of readmission, with and without adjusting for covariates (Supporting Information S1: Tables S1 and S2). Additionally, there were no differences in significance within our sensitivity analysis (Supporting Information S1: Tables S6 and S7).

Analysis was also performed to examine the association between individual HCS questions and 30- and 90-day readmissions. Similar to

TABLE 1 Differences in demographic, socioeconomic, and clinical characteristics of patients (n = 2797) with high HCS (HCS ≥ 9) versus low HCS (HCS < 9).

| Variable | n (%) | | | p-Value |
	Total (n = 2797)	High HCS (n = 1710)	Low HCS (n = 1087)	
Gender				.03*
Male	1258 (45)	729 (43)	529 (48)	
Female	1538 (55)	981 (57)	557 (51)	
Missing	1 (0)	0 (0)	1 (0)	
Race				<.01*
Black/African American	1944 (70)	1139 (67)	805 (74)	
White	456 (16)	310 (18)	146 (13)	
More than one race	75 (3)	48 (3)	27 (2)	
Asian/Mideast Indian	35 (1)	24 (1)	11 (1)	
American Indian or Alaskan Native	4 (0)	3 (0)	1 (0)	
Native Hawaiian/Pacific Islander	2 (0)	1 (0)	1 (0)	
Declined	19 (1)	15 (1)	4 (0)	
Unknown	49 (2)	29 (2)	20 (2)	
Missing	213 (8)	141 (8)	72 (7)	
Ethnicity				.135
Not Hispanic or Latino	2,420 (87)	1463 (86)	957 (88)	
Hispanic or Latino	124 (4)	81 (5)	43 (4)	
Declined	13 (0)	11 (1)	2 (0)	
Unknown	26 (1)	14 (1)	12 (1)	
Missing	214 (8)	141 (8)	73 (7)	
Mean age in years (SD)	59.84 (17.17)	58.40 (17.26)	62.11 (16.81)	<.01[a],*
Marital status				.11
Married or living as if married	733 (26)	460 (27)	273 (25)	
Divorced or separated	452 (16)	283 (17)	169 (16)	
Widowed	336 (12)	187 (11)	149 (14)	
Single	1199 (43)	739 (43)	460 (42)	
Missing	77 (3)	41 (2)	36 (3)	
Highest educational attainment				<.01*
Some or all grade school (grades 1–8)	93 (3)	46 (3)	47 (4)	
Some high school (grades 9–11)	345 (12)	188 (11)	157 (14)	
Graduate high school (grade 12)	852 (31)	504 (29)	348 (32)	
Some college	775 (28)	509 (30)	266 (24)	
Graduated college	412 (15)	271 (16)	141 (13)	
Beyond college	257 (9)	169 (10)	88 (8)	
Unknown, declined, or missing	62 (2)	23 (1)	40 (4)	
Residence before admission				<.01*
Own an apartment or house	2107 (75)	1338 (78)	769 (71)	

(Continued)

TABLE 1 (Continued)

Variable	n (%) Total (n = 2797)	High HCS (n = 1710)	Low HCS (n = 1087)	p-Value
Relative or friend's apartment/house	331 (12)	196 (11)	135 (12)	
Nursing home or long-term housing	243 (9)	125 (7)	118 (11)	
Homeless shelter	14 (1)	6 (0)	8 (1)	
Other	57 (2)	28 (2)	29 (3)	
Unknown, declined, or missing	45 (2)	17 (1)	28 (3)	
Yearly income				<.01*
<$25,000	429 (15)	240 (17)	189 (14)	
$25,001–50,000	212 (8)	121 (8)	91 (7)	
$50,0001–100,000	194 (7)	128 (6)	66 (7)	
>$100,001	153 (5)	111 (4)	42 (6)	
Unknown, declined, or missing	1809 (65)	1110 (64)	699 (65)	
Presence of a caregiver				<.01*
Yes	2444 (87)	1538 (90)	906 (83)	
No	281 (10)	141 (8)	140 (13)	
Unknown, declined, or missing	72 (3)	31 (2)	41 (4)	
Prior hospitalization within the last year				.05
Yes	1423 (51)	844 (49)	579 (45)	
No	1336 (48)	846 (49)	490 (53)	
Unknown, declined, or missing	38 (1)	20 (1)	18 (2)	
Mean hospitalizations in last year (SD)	1.37 (3.24)	1.29 (2.82)	1.50 (3.81)	.11[a]
Self-report generated CCI (SD)	0.91 (1.36)	0.95 (1.37)	0.85 (1.35)	.06[a]

Note: Chi-squared testing unless otherwise specified.

[a]Analysis of variance test used.

*statistical significance at $p < .05$.

the total HCS, most of the individual questions were not significantly associated with readmissions (Supporting Information S1: Tables S1 and S2). However, the question "I am involved in decisions about me" was associated with reduced odds of 90-day readmission both in the unadjusted model (odds ratio [OR]: 0.85; 95% CI: [0.74, 0.97]; $p = .01$) and adjusted model (OR: 0.83; 95% CI: [0.71, 0.96]; $p = .01$).

DISCUSSION

To our knowledge, this is the first analysis to find that higher HCS is significantly associated with lower LOS. We also found little evidence to support the fact that HCS was associated with readmissions. We identified this finding within a largely Black/African American, non-Hispanic, and socio-economically diverse population, including a wide range of incomes and educational attainment, which is a novel contribution to the LOS literature.[16] This association may simply reflect an association with socioeconomic variables that were

significantly associated with HCS. However, because this relationship remained after adjusting for a wide range of variables, it demonstrates the utility of using the HCS as a standalone measure to identify patients at risk for longer hospitalizations both within and outside of research settings and in socio-economically diverse populations. With this finding, we hope that future studies may be able to define causality, leading to health confidence interventions to improve LOS and other important health outcomes.

Our study demonstrates that patients with high HCS spend an average of 1.5 days less in the hospital compared to patients with low HCS. Prior research connecting health confidence or its similar concepts (e.g., patient engagement) to LOS is sparse, however, there does appear to be some agreement with our findings. A similar concept, low patient activation, is associated with both increased elective hospitalization LOS in outpatients[30] and thoracic and abdominal surgery patients.[31] Both our data and similar constructs like patient activation suggest that patient health confidence concepts are associated with LOS for surgical and medical patients.
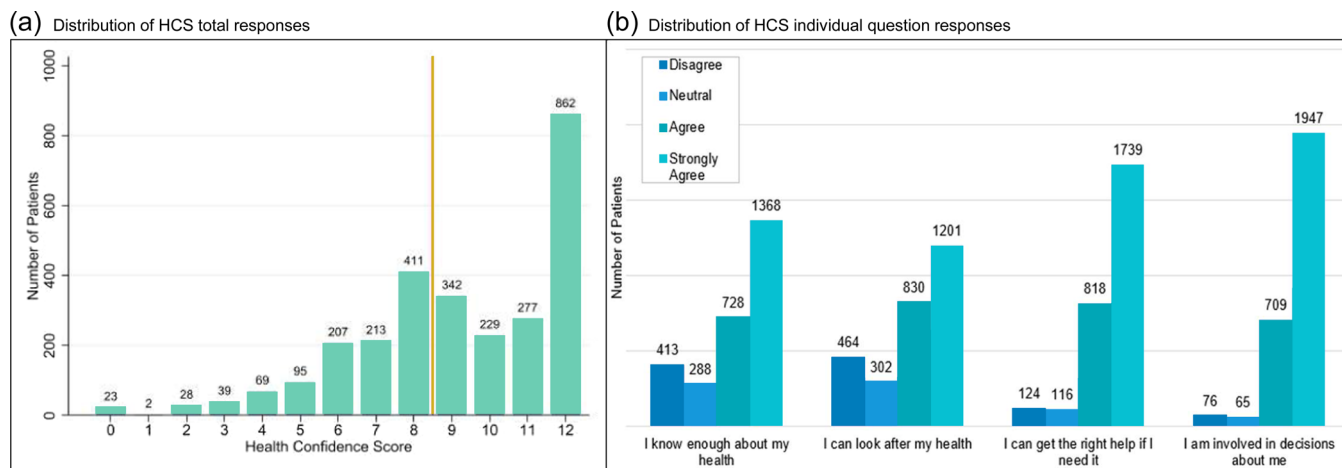
FIGURE 1 (a) Distribution of Health Confidence Score (HCS) total responses. (b) Distribution of HCS individual question responses among those who completed the HCS. Vertical line in (a) demonstrating average HCS for the population, scores to the right are "high HCS" and scores to the left are "low HCS."

TABLE 2 Association of Health Confidence Score (HCS) with length of stay (LOS).

Variable	Unadjusted model		Adjusted model[a]	
	Coefficient [95% confidence interval [CI]]	p-Value	Coefficient [95% CI]	p-Value
Total HCS (1-point increase)	−0.34 [−0.44, −0.24]	<0.01*	−0.33 [−0.44, −0.22]	<.01*
Dichotomized HCS (HCS ≥ 9 vs. HCS < 9)	−1.53 [−2.11, −0.95]	<0.01*	−1.56 [−2.17, −0.96]	<.01*
Individual questions				
Know	−0.31 [−0.56, −0.05]	0.02*	−0.36 [−0.63, −0.10]	<.01*
Look	−0.80 [−1.05, −0.54]	<0.01*	−0.67 [−0.94, −0.41]	<.01*
Help	−0.72 [−1.07, −0.36]	<0.01*	−0.65 [−1.03, −0.27]	<.01*
Decide	−1.29 [−1.70, −0.88]	<0.01*	−1.27 [−1.71, −0.84]	<.01*

Note: Know: "I know enough about my health," Look: "I can look after my health," Help: "I can get the right help if I need it," Decide: "I am involved in decisions about me."

Linear multivariate regression used.

[a]Adjusted for gender, race, ethnicity, age, marital status, education, residence, income, presence of a caregiver, srCCI, hospitalization in last year, and number of hospitalizations in last year.

*Statistical significance at $p < .05$.

This association may reflect a relationship between health confidence and LOS and/or between some other interacting factors. Patients with low HCS could take longer to discharge simply because they are not confident in their ability to manage their health, however, the observed association of HCS with LOS could have other explanations. For example, patients with fewer resources might have lower health confidence and could take longer to discharge because it is harder to arrange discharge support for them, or sicker patients could report less health confidence because there is more uncertainty in their prognosis. Further work should be done to identify causality before designing potential interventions because interventions to increase HCS itself may be impactful if health confidence is the

modifiable factor. If other factors such as financial resources or clinical health status are the cause of the HCS and LOS relationship, then targeting those other factors for intervention may be important. In these cases, assessing and using the HCS to target interventions may still be valuable, even if it only acts as a marker for the patients who need additional support.

Our patient sample comprised of vulnerable populations including Black/African Americans, low levels of educational attainment, and low income. The socio-economically diverse nature and our analyses suggest that race and socioeconomic factors may play a role in both HCS and LOS. Data suggest that racial minorities and socio-economically vulnerable patients experience prolonged LOS[32–35] but

the bulk of LOS research focuses on average-risk patients undergoing elective procedures.[16] Furthermore, prolonged hospitalization increases distressing emotional and financial burdens, which may worsen healthcare experiences for socio-economically vulnerable patients.[36,37] The association between health confidence and LOS remained even after we adjusted for the patient's demographic, socioeconomic, and clinical characteristics. Tools that can identify patients who may experience prolonged LOS within diverse populations are valuable and may provide a way to identify patients who could benefit from additional support and services to escalate their care.

We also were able to find that patients with higher HCS experienced lower LOS without increased 30- or 90-day readmissions. We wanted to ensure that patients with high health confidence were not leaving the hospital prematurely only to be readmitted again. While there is evidence that patients with shorter LOS can experience increased readmissions in specific populations,[38,39] these results are not conclusive.[40,41] Similar studies looking at large adult hospitalized patient populations have found no increased risk and even suggested that those who have a shorter LOS experience a lower risk of all-cause mortality and readmission.[42–44] The relationship between LOS and readmission is likely complex and related to the overall clinical and surrounding socioeconomic factors.

This study has several limitations. First, our study was performed within a racially and ethnically homogenous population, though socio-economically diverse, which could limit generalizability within other populations. Second, much of the covariate data was self-reported which could have increased nonresponse, recall, and reporting bias. However, we utilized a survey administrator who minimized nonresponse. Third, the cross-sectional study designs by nature can lead to issues with both internal and external validity. However, we attempted to choose a wide range of demographic, socioeconomic, and clinical covariates to adjust the regression models. Fourth, while we were only able to get the gender, race, ethnicity, and age of those who did not consent to be a part of the UCHP, we found that they were significantly different than our study population in age, race, and ethnicity. While it is well known that survey participants are often different than those who declined to participate, this could limit our generalizability. Fifth, we were only able to sample the population of the UCMC, and our readmission data is based only on admissions to the UCMC; no outside hospital data were collected. This could bias our results, however, we feel that completing this work within our patient population is important due to the diverse and vulnerable populations it represents. Finally, the HCS, despite being a validated tool with good psychometric properties and construct validity,[17] has not been widely used and was validated in the general public, not in the healthcare setting. While this limits comparison, the novelty is necessary to identify new tools to impact hospitalization outcomes.

CONCLUSIONS

Our study identified a significant association between high HCS and lower LOS. We were able to identify this relationship within a largely Black/African American, non-Hispanic, and diverse socioeconomic population. These findings highlight the clinical utility of health confidence to identify patients at risk for prolonged LOS in diverse groups of adult general medicine hospitalized patients. Future work could identify whether the HCS can be used in clinical environments to identify whether providing additional support to patients with lower HCS could reduce LOS.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

ETHICS STATEMENT

This study was approved by the University of Chicago Institutional Review Board under IRB#16-1131. Written consent from participants was obtained and no individual data was presented in this document.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.