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Sepsis Survivors Transitioned to Home Health Care: Characteristics and Early Readmission Risk Factors.

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Conflict of Interest Statement

The Authors have no conflict of interests to disclose

Findings present key risk factors for early readmission among sepsis survivors transitioning from acute care to HHC and indicate the need to affirm the presence of a sepsis diagnosis and risk factors across settings.

Keywords

sepsis; transitional care; hospital discharge; home health care; readmission

Introduction

Hospitals in the United States discharge over 1 million sepsis survivors annually.¹ Sepsis survivors are a vulnerable population that experience substantial morbidity and mortality, with readmission rates rivaling or exceeding those for heart failure (HF), pneumonia and myocardial infarction.² Sepsis survivors are twice as likely to be readmitted by 30 days as non-sepsis patients,³ with 32% of readmissions occurring within seven days.³

After discharge, a substantial proportion of sepsis survivors (32%) receive skilled home health care (HHC) to monitor for reinfection and support continued recovery and rehabilitation.³ However, the characteristics of those who receive HHC and of those who are at risk of readmission are not fully understood.⁴ A published framework for sepsis evaluation and treatment within 90 days after discharge does not even mention HHC.⁴ The resulting information gap presents an untapped opportunity to improve sepsis care.

This paper uses national data to profile the characteristics of sepsis survivors receiving HHC by type of sepsis before, during, and after a sepsis hospitalization and to identify which of these characteristics are significantly associated with 7-day readmission. We focus on readmissions within 7 days because little is known about the large proportion readmitted by that timeframe and the outcome is potentially most affected by clinical factors that may be amenable to care transitions and HHC interventions.^{5,6} Early post-acute care attention – shown to significantly reduce readmission hazard among selected populations,⁷ including 8–7 percentage point rehospitalization reductions among HHC heart failure and sepsis patients^{8,9} provides the opportunity for prompt medication reconciliation, early nursing surveillance, vital sign monitoring, antibiotic stewardship, wound care, patient education, care coordination, and early outpatient assessment.

Others have used acute care electronic record information⁵ or claims data to predict 7-day readmissions. No previous studies have used the detailed acute and post-acute care assessment information that we did to profile patients by type of sepsis during the critical transition from hospital to HHC. The ultimate goal of this paper, therefore, is to produce new knowledge that providers can use to improve community transitions and post-discharge outcomes among the large and growing number of sepsis survivors receiving HHC.

Methods

Study Design and Conceptual Framework

This cross sectional, cohort, descriptive study is a secondary analysis of national data of Medicare beneficiaries who survived sepsis and received skilled HHC services in the United States. The Andersen Behavioral Model of Health Service Utilization, positing the role of “predisposing,” “enabling” and “needs” factors as contributors to service use – guided the analysis.¹⁰ The Institutional Review Board of the Visiting Nurse Service of New York approved this study.

Study Sample

The sample is from a national dataset of Medicare beneficiaries hospitalized for sepsis who were discharged to HHC services between July 1, 2013 to June 30, 2014. For this analysis, we chose the first instance of a sepsis hospital stay (index admission) followed immediately by a HHC episode where there was a complete Outcome and Assessment Information Set (OASIS-C) admission assessment, and prior to any other health care facility use (e.g., an observation unit or skilled nursing facility stay).

Data Sources and Measurement of Individual Health Determinants

Pre-hospital and index stay variables include the Medicare administrative and claims files from the Centers for Medicare and Medicaid (CMS) Chronic Condition Data Warehouse (CCW), and the United States Census. HHC episode data are from OASIS C, a comprehensive CMS-mandated assessment tool, that includes nearly 100 structured data items related to a HHC recipient’s functional status, clinical status, and service needs.¹¹ Item reliability ranges from fair to excellent.^{12–14}

Predisposing Characteristics

Socio-demographics.—Age, race and gender (Medicare administrative data); ethnicity and caregiver availability to assist with equipment/medications/medical procedures (OASIS-C).^{15,16} Enabling Characteristics

Medicaid eligibility and annual median family income in the county where the patient lives (Medicare administrative file, US Census).

Need Illness Characteristics

Reasons for Medicare eligibility [disability, end-stage renal disease or old age (≥ 65)] (Medicare administrative file).

Prior Health Care Utilization.—Previous hospital stays (0–3 or more) and number of previous hospital days (0–30 or more) in six months prior to index sepsis admission (Medicare claims files).

Sepsis Indicators.—Sepsis is a life-threatening, toxic response to infection that can lead to tissue damage, organ failure, and death.¹⁷ Using ICD-9 codes from the Medicare claims, patients were grouped into three sepsis types. We included all short-term general and critical

access hospital stays with an explicit or implicit ICD-9 sepsis diagnosis code. Explicit sepsis: ICD-9 diagnosis codes 995.91 (*sepsis without acute organ dysfunction*), 995.92 (*severe sepsis*), or 785.52 (*septic shock*). We included *implicit “severe” sepsis*, as defined by Angus¹⁸ and validated by another group;¹⁹ one or more ICD-9 bacterial or fungal infection codes and an acute organ dysfunction code. We include whether sepsis was present on admission and types of infections (e.g. urinary, gastrointestinal).

Index Stay Characteristics.—Main reason for hospital care (medical condition or surgical procedure); length of stay (LOS); days in an intensive care unit (ICU); primary diagnoses and Elixhauser comorbidities (ICD-9) (Medicare claims).²⁰

Home Care Clinical Status.—HHC diagnoses; readmission risk factors; infusion therapy in the home; overall health status, depression, pain, pressure ulcers, dyspnea, incontinence, cognition, anxiety, activities of daily living (ADL), instrumental ADLs (IADL), and fall risk (all from OASIS-C). HHC clinicians are instructed by Medicare to list on the OASIS the ICD codes and diagnosis terms associated with the reason for HHC.

Primary Outcome.—Hospital readmission prior to any other health care facility use (e.g., an observation unit or skilled nursing facility stay) out to 30-days (Medicare claims).

Data Analysis

We used descriptive statistics including frequencies, means, standard deviations, and proportions (%) to summarize patient characteristics six months prior to the index sepsis hospitalization, during the index hospital stay, and upon HHC admission. We described hospital readmission out to 30 days after the index sepsis hospital discharge. Using multivariate logistic regression, we examined the associations between 7-day readmissions and the demographic and clinical characteristics that were highly significant by type of sepsis ($p < 0.05$). Results did not differ by sepsis type through stratification or by including interaction terms in a single model. Therefore, we used multivariate logistic regression to estimate a multivariate model of the average marginal effect²¹ (i.e. the percentage point change in risk) of the selected *predisposing, enabling, need/illness* characteristics on 7-day hospital readmission, including sepsis type as one of the covariates. To account for the large sample size, we used a p-value of 0.001 and a marginal effect of at least 0.5% to highlight the variables with the highest impact. Sensitivity analysis was completed by removing the small number who died before 7 days or readmission ($N=623$, 0.83%). All descriptive statistics were calculated using RStudio version 3.3.3. Marginal effects of the logistic regression model were produced using STATA version 14.2.

Results

The sample consists of 165,228 sepsis survivors discharged to HHC (e-Figure 1 in the supplement). The majority of patients ($N=133,397$; 80.7%) had an *explicit* hospital diagnosis of *severe sepsis* (ICD-9 code of 995.92 in any diagnosis field) or hospital diagnoses indicating *implicit severe sepsis* using the Angus method (i.e., ICD-9 combination of an infection with organ dysfunction); 5.7% had a *septic shock* diagnosis (ICD-9 code

785.52) and the remainder (13.6%) had *sepsis without acute organ system dysfunction* (ICD-9 code 995.91). For simplicity we refer to this final group as “sepsis.”

Patient Characteristics Prior to and During Sepsis Hospitalization

Table 1 describes and compares *predisposing, enabling and need/illness* factors of all sepsis survivors and by sepsis type, prior to and during the index sepsis stay. Overall, average age was 75.1 (SD=12.6), 55.3% female, 79.5% non-Hispanic white, 12.4% non-Hispanic black, and 5.6% Hispanic (*predisposing factors*). The median annual family income in the county where the patient lived was on average \$54,100, and 26.5% of patients were eligible for Medicaid-funded services in addition to Medicare (*enabling factors*).

The *need/illness* characteristics describe severe illness burden (not all data shown). Thirty-one percent initially became eligible for Medicare due to disability or end-stage renal disease. A sizeable minority (40.8%) had at least one prior hospital stay in the past 6 months. The most common type of infection was kidney or urinary tract (39.9%), followed closely by pneumonia (37.1%). Average LOS was 8.9 days (SD=7.8). Average number of medical conditions was 4.35 (SD=1.89) out of 15 Elixhauser comorbid conditions.²⁰ Almost 70% of the sample had hypertension and nearly 40%, diabetes mellitus. Medical conditions were the primary reason for 80.8% of hospital stays; surgical procedures for 19.2%.

Home Health Admission Diagnoses.

The primary and five secondary diagnoses listed for the sepsis survivors by HHC clinicians on the OASIS were very diverse. The 5 most common primary diagnoses listed upon admission to HHC were pneumonia (10.2%), other aftercare (9.5%), congestive heart failure (8.4%), urinary tract infection (UTI) (8.4%), and obstructive chronic bronchitis (6.2%) (Table 2). Looking across all six diagnosis categories, and combining all three sepsis ICD-9 codes, the sepsis codes appeared only 4% of the time, an additional 3% noted septicemia or bacteremia.

Characteristics of Sepsis Survivors upon Homecare Admission (Table 3).

The *enabling factor* caregiver availability for equipment use, medications, and medical procedures showed poor caregiver availability for 17.5%, 28.4%, and 24.6% of patients respectively for each task.

The *need/illness* characteristics describe a population with severe illness burden: 98.1% of patients had at least one risk factor for readmission; 89.8% took five or more medications and 41.7% had frailty indicators; 15.4% had a recent decline in mental, emotional, or behavioral status and more than 10% required home intravenous therapy. Thirty-nine percent were classified as fragile health, 20.8% with severe pain, 79.1% shortness of breath, and 87.1% at risk for falls; barely half were alert and oriented (52%). Nearly half (48.1%) reported urinary incontinence and another 8.4% had a urinary catheter while 6.7% had unhealed stage 2 or greater pressure ulcers. The large majority (88.4%) were dependent on human help in three or more activities of daily living, while 51.5% were unable to self-manage their medications.

Differences by Type of Sepsis.

Septic shock patients presented with a significantly different socioeconomic and medical complexity profile compared to the overall sample, and compared to sepsis and severe sepsis survivors (Tables 1 and 3). Compared to the overall sample, septic shock survivors were younger (25.8% versus 16.0% were <65), less likely to be white (77.2% versus 79.5%), and less likely to be female (50.3% versus 55.3%). A higher proportion of septic shock patients were Medicaid-eligible (31.3%) compared to the overall sample (26.5%). A larger proportion of septic shock patients entered the hospital for surgery (23.9%) than overall (19.2%) and they had the longest stays on average at 13 days versus 8.87 days overall.

Fifty percent of the overall sample spent time in the intensive care unit (ICU) compared to 93.1% of septic shock patients. Almost 30% of the septic shock patients spent 8–30 days in the ICU compared to nearly 12% overall having long ICU stays. Septic shock patients presented with the most severe comorbidity profile with higher proportions having fluid and electrolyte disorders, anemia, congestive heart failure, coagulopathy, and weight loss. Septic shock patients had nearly double the incidence of unhealed stage 2 or greater pressure ulcers (11.9%) than the sepsis (7.2%) or severe sepsis (6.3%) patients.

Readmission Outcomes of Sepsis Survivors Discharged to HHC.

Within 30 days of index discharge, 22.5% of HHC sepsis patients were rehospitalized prior to admission to any other health care facility or a hospice program. Nearly one-third of these readmissions occurred within seven days affecting 6.64% of the overall sample. Septic shock patients had the highest proportion of readmissions across all timeframes (Figure 1).

Associations among Predisposing, Enabling and Need Illness Characteristics and 7-day Readmission.

Given the large sample size, and therefore numerous significant variables in the full model (e-table 1), we present a parsimonious selection of high impact variables in Table 4 to show 17 variables where $p = .001$ with a marginal effect point estimate of at least 0.5%. Several *need/illness* factors significantly increased the early readmission risk above the baseline of 6.64% to a range of 7.15% for patients with fluid and electrolyte disorder to 10.61 % for those with 3 or more previous inpatient stays in the past 6 months. This translates into a 60% relative increase in the risk of 7-day readmission for the latter group. As seen in the last column of Table 4, our model highlights risk factors that present significant increases in relative risk such as dyspnea at rest (47.8% relative increase), 8–9 ADL/IADL dependencies (38.8% relative increase), index length of stay 8 days (29.7% relative increase), intravenous infusion in the home (21.4% relative increase) and a diagnosis of septic shock (17.5% relative increase). Some risk factors are potentially modifiable (LOS, dyspnea, ADL deficits, pain, depression, frailty). Non-modifiable risk factors include diagnosis, and history of previous admissions. There were no differences in results using samples with or without the small number who died prior to readmission or 7 days.

Discussion.

Our study highlights new and important information about risk factors that, if collected, may lead to better identification and earlier intervention for at-risk sepsis patients. We found that although our sample population were all sepsis survivors, the diagnosis codes in HHC noted sepsis only 4% of the time. This information gap puts HHC providers at a disadvantage for recognizing that they are caring for a patient with one of the highest risks for hospital readmission. The CMS instructs HHC clinicians to list each diagnosis for which the patient is receiving HHC in their order of seriousness. We do not know how often sepsis was a diagnoses listed on the referral documents received by the agencies. However, a focus on pneumonia, urinary tract infection, or the ambiguous “other aftercare” may not equate to the same scrutiny and intensity of care afforded to the sepsis survivors who have a high illness burden even when compared to heart failure patients.²² Moreover, the potential of not being aware of the *septic shock* survivors in particular is of concern as 96% experienced an ICU stay, they demonstrate more frequent and severe *illness/need* characteristics, and have higher readmission rates than other sepsis patients. In our model, septic shock increased 7-day readmission risk by 17.5%. HHC clinicians could specifically request the additional information such as ICU stay, organ failure, or shock when receiving a hospital discharge referral after an infection. This may help to identify the septic shock survivors, the youngest and by many measures, the sickest of the sepsis subpopulations.

Our findings may inform improved identification of *severe sepsis*, the majority of sepsis survivors in our sample (80.7%) through systematic documentation and information sharing about infection and organ failure as an indication of the *severe sepsis* diagnoses.¹⁸ Our findings indicate that HHC clinicians note the infections (pneumonia, UTI), but not the life-threatening response to that infection, notably the diagnosis codes for organ failure associated with severe sepsis or septic shock are largely absent. Collecting this information as well as ICU stays, LOS, and number of prior hospitalizations may be helpful. Although non-modifiable by HHC, these “red flag” risk factors can raise the awareness that this is a sepsis survivor and guide the timing and frequency of HHC visits and other interventions.

Most of the risk characteristics associated with early readmission in this study are collected during the HHC admission OASIS. Several modifiable risk factors identified in our study are also reported as risk factors for 7-day readmission in other disease conditions (e.g., depression²³, pain^{5,24–26}, dyspnea²⁷, number of functional dependencies^{28,29}). However, because of lags between hospital discharge and HHC referral, and because agencies have up to five days after initial assessment to finalize the OASIS, complete OASIS information may not be available early enough in the HHC stay to maximize its usefulness. There is a need to assess/collect this information earlier, preferably at the time of referral.

Sepsis type, index LOS, and history of previous hospital admissions (also found to be risk factors for 30-day Sepsis readmissions^{3,30–33}) were all risk factors for 7-day readmission in this study, but are largely information unknown by HHC. For other types of patients, lack of information transferred during transitions is associated with increased readmission risk,^{6,34} and could present a serious problem in sepsis. The gaps we have described represent a lost opportunity to intervene early. Sepsis survivors who received a HHC nursing visit within 48

hours of hospital discharge, at least one more visit the first week, and outpatient provider follow-up by 7 days have demonstrated 30-day readmission rates 7 percentage points lower than those without timely nursing and provider follow-up.⁹ However, only 28.1% of sepsis survivors nationally received this intervention.⁹ This early intervention, potentially effective in reducing 7-day readmission as well, makes it critical to identify early on who is at risk to enable receipt of this level of prompt attention.

When interpreting these results, it is important to note that the sample is limited to sepsis survivors who were referred for HHC and received at least one nursing visit within the first week, had complete OASIS-C admission data, and no admissions to other inpatient settings. Sepsis was identified using ICD-9 codes; crosswalks to ICD-10 are available. The OASIS-C was used for the HHC assessments, and the newest OASIS-D contains all risk factors identified by our work.

Building on the work of Graham et al⁵, where 7-day readmissions in a general hospital population were largely preventable by acute care interventions, our study indicates a role for both acute and post-acute providers in preventing early sepsis readmissions. Early knowledge of risk factors may trigger delayed discharge, referral to higher levels of care (eg. skilled nursing facility), preventive interventions such as early home nursing visits, early medical provider follow-up, more intense monitoring, physical therapy, patient education, and having equipment such as oxygen or intravenous supplies and antibiotics ready in the home. In sum, the key information we have identified through this study should facilitate a plan of care and associated interventions that better meet the needs of this vulnerable population to enhance sepsis recovery with reduced need for rehospitalization. Future work will aim to create a validated risk screening tool for use during discharge planning and referral.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Cumulative Readmission Rates Overall and By Sepsis Type Within 30 days of Hospital Discharge

Table 1.

Patient Characteristics Prior to and During Sepsis Hospitalization^a

	Sepsis Only (ICD-9, 995.91) N=22,382 (13.6%)	Severe Sepsis (ICD-9, 995.92 or Angus) N=133,397 (80.7%)	Septic Shock (ICD-9, 785.52) N=9,449 (5.7%)	[ALL] N=165,228
Predisposing Factors				
Age, mean (SD)	73.5 (14.1)	75.7 (12.2)	70.4 (13.3)	75.1 (12.6)
Female gender	12343 (55.1%)	74239 (55.7%)	4751 (50.3%)	91333 (55.3%)
Race				
Non-Hispanic White	17717 (79.2%)	106400 (79.8%)	7292 (77.2%)	131409 (79.5%)
Non-Hispanic Black	2458 (11.0%)	16362 (12.3%)	1095 (11.6%)	19915 (12.1%)
Hispanic	1423 (6.4%)	6935 (5.2%)	659 (7.0%)	9017 (5.5%)
Other	784 (3.5%)	3700 (2.8%)	403 (4.3%)	4887 (3.0%)
Enabling Factors				
Eligible for both Medicaid and Medicare	6356 (28.4%)	34419 (25.8%)	2958 (31.3%)	43733 (26.5%)
County level annual median family income in dollars, mean (SD)	54007 (14799)	54099 (14796)	54341 (15020)	54100 (14809)
Need/Illness Factors				
Three or more inpatient stays in previous 6 months	1685 (7.5%)	10020 (7.5%)	904 (9.6%)	12609 (7.6%)
Sepsis not present on admission	1282 (5.7%)	26022 (19.5%)	938 (9.9%)	28242 (17.1%)
Type of infection (5 most frequent)				
Kidney, Urinary Tract and Other Genitourinary	8239 (36.8%)	54099 (40.6%)	3573 (37.8%)	65911 (39.9%)
Pneumonia and Other Respiratory	7407 (33.1%)	50485 (37.8%)	3397 (36.0%)	61289 (37.1%)
Other	5005 (22.4%)	38642 (29.0%)	2062 (21.8%)	45709 (27.7%)
Bone, Joint and Skin/Soft Tissue	3863 (17.3%)	19693 (14.8%)	1032 (10.9%)	24588 (14.9%)
Gastrointestinal	2069 (9.2%)	12790 (9.6%)	1489 (15.8%)	16348 (9.9%)
Index Stay - MS-DRG				
Medical	18727 (83.7%)	107637 (80.7%)	7194 (76.1%)	133558 (80.8%)
Surgical	3655 (16.3%)	25760 (19.3%)	2255 (23.9%)	31670 (19.2%)
Index hospitalization length of stay, mean (SD)				
ICU days, mean (SD)	7.69 (5.65)	8.78 (7.38)	13.0 (14.0)	8.87 (7.79)
Number of Elixhauser comorbid conditions	1.84 (3.50)	3.01 (5.49)	6.70 (7.9)	3.06 (5.52)
Select Elixhauser comorbid conditions	3.81 (1.82)	4.42 (1.88)	4.68 (1.89)	4.35 (1.89)

	Sepsis Only (ICD-9, 995.91) N=22,382 (13.6%)	Severe Sepsis (ICD-9, 995.92 or Angus) N=133,397 (80.7%)	Septic Shock (ICD-9, 785.52) N=9,449 (5.7%)	[ALL] N=165,228
Hypertension	15660 (70.0%)	92780 (69.6%)	6071 (64.3%)	114511 (69.3%)
Fluid and electrolyte disorders	9810 (43.8%)	74894 (56.1%)	6549 (69.3%)	91253 (55.2%)
Renal failure	4706 (21.0%)	48503 (36.4%)	2966 (31.4%)	56175 (34.0%)
Congestive heart failure	4546 (20.3%)	33526 (25.1%)	2780 (29.4%)	40852 (24.7%)
Depression	3200 (14.3%)	18187 (13.6%)	1223 (12.9%)	22610 (13.7%)
Coagulopathy	125 (0.6%)	23128 (17.3%)	1929 (20.4%)	25182 (15.2%)
Weight loss	2247 (10.0%)	13630 (10.2%)	1813 (19.2%)	17690 (10.7%)

^a all variables significant at .001 except: annual median family income in dollars p=0.183, depression p=0.003

Table 2.

Top 20 most frequent diagnoses recorded at home care admission

		Frequency	Cumulative Frequency
1	Pneumonia (except that caused by TB or STD)	16810 (10.2%)	16810
2	Other aftercare	15731 (9.5%)	32541
3	Congestive heart failure; non-hypertensive	13939 (8.4%)	46480
4	Urinary tract infections	13801 (8.4%)	60281
5	Obstructive chronic bronchitis	10252 (6.2%)	70533
6	Rehabilitation care; fitting of prostheses; and adjustment of devices	7622 (4.6%)	78155
7	Cellulitis and abscess	6821 (4.1%)	84976
8	Septicemia (except in labor)	4769 (2.9%)	89745
9	Complications of surgical procedures or medical care	3729 (2.3%)	93474
10	Other connective tissue disease	3292 (2%)	96766
11	Decubitus ulcer	3240 (2%)	100006
12	Cardiac dysrhythmias	2894 (1.8%)	102900
13	Diabetes mellitus without complication	2887 (1.8%)	105787
14	Hypertension with complications and secondary hypertension	2728 (1.7%)	108515
15	Complication of device; implant or graft	2069 (1.3%)	110584
16	Late effects of cerebrovascular disease	2015 (1.2%)	112599
17	Genitourinary symptoms and ill-defined conditions	1809 (1.2%)	114408
18	Acute myocardial infarction	1688 (1%)	116096
19	Diabetes with other manifestations	1641 (1%)	117737
20	Essential hypertension	1614 (1%)	119351
21	Remaining Sample	45877 (27.8%)	165228

* For 50% of patients in this category, "other aftercare" includes: aftercare following surgery of the teeth, oral cavity, digestive system, or circulatory system. The remainder are aftercare for a variety of surgical procedures, medication monitoring, or wound care.

Table 3.

Characteristics of Sepsis Survivors Upon Homecare Admission

	Sepsis Only (ICD-9, 995.91) N=22382	Severe Sepsis (ICD-9, 995.92 or Angus) N=133397	Septic Shock (ICD-9, 785.52) N=9449	[ALL] N=165228
Enabling Factors				
Caregiver ability and willingness to provide assistance with medical equipment when needed				
No assistance needed in this area	11616 (51.9%)	73513 (55.1%)	4530 (47.9%)	89659 (54.3%)
Caregiver(s) currently provide assistance	6278 (28.0%)	37488 (28.1%)	2898 (30.7%)	46664 (28.2%)
Poor Caregiver Availability	4488 (20.1%)	22396 (16.8%)	2021 (21.4%)	28905 (17.5%)
Caregiver ability and willingness to provide assistance with Medication Administration				
No assistance needed in this area	4612 (20.6%)	22360 (16.8%)	1576 (16.7%)	28548 (17.3%)
Caregiver(s) currently provide assistance	11586 (51.8%)	72921 (54.7%)	5171 (54.7%)	89678 (54.3%)
Poor Caregiver Availability	6184 (27.6%)	38116 (28.6%)	2702 (28.6%)	47002 (28.4%)
Caregiver ability and willingness to provide assistance with Medical Procedures				
No assistance needed in this area	11704 (52.3%)	73863 (55.4%)	4387 (46.4%)	89954 (54.4%)
Caregiver(s) currently provide assistance	4783 (21.4%)	27596 (20.7%)	2295 (24.3%)	34674 (21.0%)
Poor Caregiver Availability	5895 (26.3%)	31938 (23.9%)	2767 (29.3%)	40600 (24.6%)
Need/Illness Factors				
Signs or symptoms indicating patient at risk for hospitalization				
Taking 5 or more medications	19716 (88.1%)	120228 (90.1%)	8410 (89.0%)	148354 (89.8%)
Multiple hospitalizations (2 or more) in past 12 months	11087 (49.5%)	66558 (49.9%)	4876 (51.6%)	82521 (49.9%)
Frailty indicators (e.g., weight loss, self-reported exhaustion) ^a	9061 (40.5%)	55637 (41.7%)	4245 (44.9%)	68943 (41.7%)
History of falls (2 or more falls - or any fall with an injury-in past year)	5132 (22.9%)	35354 (26.5%)	2003 (21.2%)	42489 (25.7%)
Recent decline in mental, emotional, or behavioral status ^a	3060 (13.7%)	20997 (15.7%)	1408 (14.9%)	25465 (15.4%)
Severe pain based on a standardized assessment	4846 (21.7%)	27390 (20.5%)	2153 (22.8%)	34389 (20.8%)
IV Infusion Therapy in the Home	4089 (18.3%)	11321 (8.5%)	1381 (14.6%)	16791 (10.2%)
Unhealed Pressure Ulcer at Least Stage II	1608 (7.2%)	8358 (6.3%)	1120 (12.0%)	11086 (6.7%)
When is patient dyspneic or noticeably short of breath				
Patient not short of breath	5730 (25.6%)	26760 (20.1%)	2121 (22.4%)	34611 (20.9%)
With moderate exertion	6944 (31.0%)	44710 (33.5%)	3128 (33.1%)	54782 (33.2%)

	Sepsis Only (ICD-9, 995.91)	Severe Sepsis (ICD-9, 995.92 or Angus)	Septic Shock (ICD-9, 785.52)	[ALL]
	N=22382	N=133397	N=9449	N=165228
With minimal exertion	3898 (17.4%)	26103 (19.6%)	1780 (18.8%)	31781 (19.2%)
At rest (during day or night)	1106 (4.9%)	7945 (5.9%)	563 (5.9%)	9614 (5.8%)
Multi-factor risk assessment conducted and risk of falls indicated	18888 (84.4%)	116888 (87.6%)	8074 (85.4%)	143850 (87.1%)
Patient requires a urinary catheter	2062 (9.2%)	10697 (8.0%)	1117 (11.8%)	13876 (8.4%)
Alert/oriented	12223 (54.6%)	68572 (51.4%)	5186 (54.9%)	85981 (52.0%)
Sum of Activities of Daily Living (ADL) dependencies ^b (mean, SD)	4.93 (2.7)	5.09 (2.59)	5.45 (2.67)	5.09 (2.62)

^a all variables significant at .001 except: Frailty Indicators, p=0.082 and Recent decline in mental, emotional, or behavioral status, p=0.002

^b ADL dependencies included: grooming, bathing, upper and lower body dressing, toilet transfer, toilet hygiene, feeding, transferring and ambulation

Table 4.
Incremental Effects of Sepsis Patient Risk Factors on Hospital Readmission within 7 Days

Overall Sample Readmission Risk = 6.64%	Percentage Point Change in Risk ^a		Adjusted Risk of Readmission with Factor ^b	Relative Percent Change in Readmission Risk ^c
	Point Estimate	95% Confidence Interval		
Sepsis Type (Ref = Sepsis without Organ Failure 995.91)				
Severe Sepsis (995.92 or Angus)	0.651%	0.290%	1.012%	7.29%
Septic Shock (785.52)	1.163%	0.558%	1.767%	7.80%
Number of Inpatient Stays in Past 6 Months (Ref = 0)				
1–2 Stays	1.395%	1.131%	1.658%	8.03%
3+ Stays	3.975%	3.449%	4.501%	10.61%
Sepsis Not Present on Hospital Admission	0.825%	0.478%	1.172%	7.46%
Hospital LOS 8+ Days	1.973%	1.704%	2.242%	8.61%
Elixhauser Comorbidity: Fluid and Electrolyte Disorder	0.508%	0.264%	0.753%	7.15%
Diagnosis of Depression	0.708%	0.445%	0.970%	7.35%
Risk for Hosp- Recent Decline	0.650%	0.292%	1.007%	7.29%
Risk for Hosp- Frailty	0.779%	0.524%	1.035%	7.42%
Pain Assessed, Severe Pain	0.759%	0.454%	1.064%	7.40%
IV Infusion on Admission to Home Health Care	1.709%	1.235%	2.182%	8.35%
When Dyspneic (Ref = Not Short of Breath)				
With Minimal Exertion	1.422%	1.014%	1.830%	8.06%
At rest, during the day	3.176%	2.530%	3.822%	9.81%
Count of number of ADL dependencies ^d (Ref = 2)				
6–7	1.326%	0.844%	1.807%	7.96%
8–9	2.576%	2.052%	3.100%	9.21%

^a all variables significant at .001

^b adjusted risk of readmission with risk factor = overall risk + point estimate risk

^c Relative percent change in readmission risk = point estimate/overall readmission risk × 100

^d Activities of Daily Living dependencies include: grooming, bathing, upper and lower body dressing, toilet transfer, toilet hygiene, feeding, transferring and ambulation