Prevalence And Correlates of Patient-Directed Discharges Among Admitted Patients Experiencing Homelessness: A Cross-Sectional Study

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Abstract

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Background

Patient-directed discharge (PDD) from the hospital occurs more frequently among people experiencing homelessness (PEH), exacerbating already worse outcomes and higher costs. To our knowledge there are no descriptive studies of PEH who perform PDDs and little is known about the population of PEH admitted to Harborview Medical Center (HMC). This exploratory descriptive analysis aims to describe PEH admitted to HMC and identify the prevalence of and factors associated with PDD.

Methods

This cross-sectional study examined HMC EHR data of adult patients registered as homeless within 1 year of their admission to any hospital unit from 2023-2024. ED visits without admission and records missing information related to the outcome variable of PDD were excluded. Descriptive analysis was performed and strength of association for selected predictors was evaluated via modified Poisson regression with robust standard errors.

Results

Of 1,637 PEH admitted to HMC, 183 performed a patient-directed discharge (11% prevalence). Younger age (≤ 45 years) (aPR 1.47; 95% CI: 1.07–2.04); OUD diagnosis (aPR 1.46; 95% CI: 1.09–1.94); patient-reported daily opioid use (aPR 1.45; 95% CI: 1.05–2.01) and infectious disease admission (aPR 1.76; 95% CI: 1.34–2.31) were all independently associated with higher prevalence of PDD. Being uninsured was associated with an adjusted prevalence more than twice that of insured patients (aPR 2.36; 95% CI: 1.19–4.18). Medical/surgical boarding bed placement was associated with higher PDD prevalence (aPR 1.85; 95% CI: 1.32–2.59). Conversely, psychiatric admission diagnosis (aPR 0.25; 95% CI: 0.13-0.46) and history of psychiatric diagnosis (aPR 0.64; 95% CI: 0.47-0.86) were both protective against PDD. Previously reported associations of male sex and Medicaid insurance with PDD were not replicated in this study population.

Conclusions

This study showed that PDD is highly prevalent among PEH at HMC and confirmed younger age, OUD and insurance status as risk factors. Medical/surgical boarding placement was identified as a hospital-level factor and a potentially worthwhile target for future study and intervention. Additional study is required to better understand the structural risk factors for PDD, and future studies would benefit from evaluating these factors within a multi-level context.

Introduction

Patient-directed discharge (PDD), also known as discharge against medical advice (DAMA), occurs when a patient disengages from hospital care before the goals of hospitalization are met. PDD makes up 2% of discharges nationwide and, relative to planned discharge is associated with higher readmission rates, longer overall time in hospital, increased cost and increased mortality.[1, 2] Readmissions related to PDDs generated an annual cost of around $822 million in 2014.[3] Among providers, qualitative evidence suggests PDDs generate bias against the patient as well as feelings of guilt and futility.[4]

Commonly observed risk factors for PDD include male sex, lack of insurance or Medicaid insurance, and substance use.[5,6] Observational evidence also supports a strong link between PDDs and people experiencing homelessness (PEH). [7, 8, 9, 10, 11, 12, 13] PEH are consistently shown to have higher mortality rates, lower life expectancy and higher burden of chronic disease, addiction, and disability than the general population. [14, 15, 16, 17, 18, 19] Therefore, hospitalized PEH tend to have more complex medical and social needs than the average inpatient, amplifying the harms of incomplete workup and discharge planning that are often associated with PDD.[20]

In a qualitative study of PEH in Ontario, Canada, inequitable treatment was cited as a core reason for dissatisfaction with care, as well as the feeling that hospital systems are not designed to work for them.[21] Likewise, hospital-level factors such as stigmatizing environment, treatment delay, poor provider coordination, limited social service offerings, or limited discharge options are frequently reported by patients who perform PDDs.[22, 23, 24] While cross-sectional studies of PEH or PDDs have been done, existing studies have limited generalizability and to our knowledge, no studies of PDDs among PEH have been attempted.

Harborview Medical Center (HMC) is the de facto safety net hospital and only level 1 trauma center in King County, Washington, where over 16,000 people are experiencing homelessness at any point in time. Thus, data from HMC provides a unique opportunity to describe the specific needs of PEH within King County. Examining a broad range of factors associated with PDD among PEH at Harborview Medical Center would help determine their distinguishing characteristics and highlight opportunities for PDD prevention among PEH. Specifically examining differences in where PDDs occur at HMC may help identify potential hospital-level risk factors. Such details would contribute to conceptual models of PDD, which have not yet considered that PEH may have needs unique to those of stably housed patients.

This cross-sectional study seeks to contribute by investigating PDD among admitted patients experiencing homelessness at HMC. The exploratory study will aim to describe the population of PEH at HMC, identifying the prevalence of PDD, verifying previously reported risk factors and exploring additional associated factors related to the experience of homelessness and hospital environment.

Methods

Study Design & Setting

This is a cross-sectional observational study of PEH admitted to and discharged from Harborview Medical Center (HMC) between 1/1/2023 and 12/31/2024. HMC is an acute care academic safety net hospital, a level 1 trauma center in King County, Washington. While the physical plant is owned by King County, HMC is administered and staffed by University of Washington Medicine.

Data Source

The data source for this study was electronic health record (EHR) data extracted from the Epic Clarity database at HMC using SQL SSMS. Data types included were encounters, demographics, diagnoses (ICD-10 coded), and free text values.

Study Population

All hospital encounters between January 1, 2023 and December 31, 2024 were screened. Adult patients (≥18 years) who disclosed homelessness upon registration in the EHR within one year of eligible admission to Harborview inpatient units were included. The first admission for each unique individual during the study period was included and subsequent admissions were excluded. Encounters without inpatient admission (ED discharges), or those missing primary diagnosis or discharge disposition, were excluded.

Outcome Variable

Patient-Directed Discharge

PDD is logged in the EHR as a "Discharge disposition." The values of discharge disposition describing PDD are "Against Medical Advice," or "left against medical advice or discontinued care." To derive the main study outcome, a binary categorical variable was created to capture these discharge disposition values. This resulted in a dichotomous variable for PDD.

Expiration

The prevalence of in-hospital expiration (death) was a notable secondary outcome. To derive in-hospital death, a binary categorical variable was created for the discharge disposition value of "expired" This resulted in a dichotomous variable for expiration.

Demographic Factors

Observed socio-demographic covariates included age, race (Native Hawaiian or Pacific Islander, American Indian or Native Alaskan, White, Black or African-American, Asian, Multiple Races, and Unknown), ethnicity (Hispanic and non-Hispanic), sex assigned at birth, language, insurance, and homelessness experience. Two individuals were admitted with unknown identities, and thus their age was not available. These individuals were dropped from any analysis that incorporated the age variable.

Age 45 or younger

We derived a dichotomous variable categorizing all individuals age 45 or younger as "yes" values and those 46 and older as the referent "no" category. This category was created to assess a previously reported association in the literature.

Male Sex

We derived a dichotomous variable categorizing all individuals with reported male sex as "yes" values and any other (Female, not disclosed) as the referent "no" category. This category was created to assess a previously reported association in the literature.

Language

We derived a categorical variable for language that included: English, Spanish, Other, and Unavailable/Unknown. Twenty-one languages were collapsed into the "other" category (See appendix) due to low cell counts. If the language option was unavailable in the EHR or the preferred language was unknown, the data were collapsed into an "Unavailable/Unknown" category (see appendix for un-collapsed data).

Insurance

We derived a categorical variable for insurance which included Medicaid, Medicare, Private, Other, and uninsured/self-pay. Due to low frequencies, Tricare (Veterans Administration), Workers Comp, and Case Rate insurance categories were collapsed into "Other." Due to similarity, uninsured and self-pay were collapsed into a single category (see appendix). Separate dichotomous variables for uninsured/self-pay and Medicaid to assess previously reported associations in the literature.

Homelessness Type

A categorical variable was created for homelessness type. If the patient chooses to disclose homelessness, it can be further defined by the person registering the patient. These categories include “Street” (Unsheltered) and “Shelter” (Sheltered), but also include institutional values like “hospital,” “nursing home”, “jail,” and “transitional housing,” as well as markers of instability like “doubled up,” “motel/hotel self-pay,” and “at risk” (see appendix). These multiple values were collapsed into a simplified set of categories: Street, Shelter/Transitional Housing, Unstable, Time-Limited Institutional, and Unspecified. “Time-Limited Institutional” was defined as jails, hospitals, respite, nursing homes, and other facilities where housing was assumed not to be provided on release.

Admission Characteristics

This study collected information on each patient’s healthcare context, including whether they had prior contact with HMC’s Downtown program, a set of outpatient clinics and services specifically for PEH. The number of prior admissions in the past two years was collected, as well as whether they were able to follow up as an outpatient within two months of discharge from this admission. Data related to the admission included the primary diagnosis for the admission (provided as free text), length of stay in days, presence of addiction consult notes, hospital location at the time of discharge, discharge disposition and discharge destination.

Number of prior admissions

Binary variables were created for number of prior admissions equal or greater than one (Prior Admission to HMC) as well as for number of prior admissions equal or greater than three

(3 or More Prior Admissions). This second binary categorical variable was created to collect individuals with complicated chronic health conditions requiring multiple hospitalizations or patients with high utilization behavior patterns, allowing for one acute hospitalization and re-admission before triggering inclusion.

Primary admitting diagnosis

Admission diagnoses data was obtained as free text and contained 636 unique diagnoses. Free text diagnoses were sorted by keyword classification algorithm into pre-defined categories based on the body system involved or mechanism of illness/injury (Trauma/Burn, Addiction, Cardiovascular, Diabetes/Endocrine, Gastrointestinal, Hematology/Oncology, Infectious Disease, Metabolic/Renal, Musculoskeletal, Neurological, Other/Unclassified, Psychiatric, and Pulmonological). The algorithms output was iteratively evaluated by hand, and the keyword list and priority order were refined until free text diagnoses were satisfactorily sorted. The algorithm was then applied to study data and output was presented as proportions.

Discharge Location

The patient's location at the time of discharge was collected and coded by floor and unit. Subdivisions of floors (e.g. Floor 2, West hospital, Units A, B and C) were collected separately but coded into a single category if the service was the same. For example, 2WA, 2WB, and 2WC were condensed to 2W because all three were mixed Neurological ICU/Medical ICU. These consolidated results were then presented as proportions. Patients that were admitted to Harborview but discharged from another UW Medicine hospital were categorized as "Transfers."

Substance Use Factors

Presence of a substance use diagnosis, including alcohol use disorder (AUD), opioid use disorder (OUD), and stimulant use disorder (StUD) were defined using ICD-10 code groupings and presented as dichotomous categorical variables. A variable was created for "any substance use" that registered any individual with at least one SUD diagnosis (AUD, OUD, or StUD) as "yes" with "no" as the referent group. This was used to assess previously reported associations in the literature.

Substance use screening data

In the EHR, the substance use screening flowsheet is activated by a yes answer to the question: "In the past 3 months, how often have you used an illegal drug or used a prescription medication for non-medical purpose?" The flowsheet then presents a questionnaire assessing the frequency of opioid, stimulant, and sedative use as Never, Once or Twice, Weekly, Daily or Almost Daily. If the initial question is not asked, or the patient is unable to answer, the value is reported as NA. The maximum value for each row of the flowsheet was taken, accounting for multiple screenings during admission. Individuals with NA values were considered unscreened for substance use.

Missing Screening Data

37% of Substance use screening data was NA or labeled "unable to assess," while 44% of AUDIT-C screening data collected was missing. There are multiple reasons for staff to skip data entry including patient mental status and illness severity all of which are unobserved variables. Given being unscreened was found to have a statistically significant effect on PDD, it was decided that it was best kept as a predictor as multiple imputation would have obscured a potentially meaningful effect.

Clinical Factors

All clinical covariates including common chronic medical conditions, chronic pain, and neuropsychiatric conditions were defined using ICD-10 code groupings and presented as dichotomous categorical variables.

Charlson Comorbidity Index (CCI)

CCI was calculated from all available EHR data and output was included in the data set. Given significant skew related to high frequency of 0 values, CCI was converted to a categorical variable. Score categories included were "0," "1-2," "3-4," and "5+." These categories were presented as proportions.

History of Traumatic Brain Injury

All TBI-related ICD-10 diagnostic codes associated with ICD-10 codes for post-concussional syndrome, amnestic diagnoses and cognitive deficits were included.

History of Primary Seizure Disorder

All seizure related ICD-10 diagnostic codes were included except for those related to substance use withdrawal syndromes.

History of Psychiatric diagnosis

All diagnostic code groups for mood disorders, anxiety/stress/trauma, schizophrenia/psychosis, suicidal ideation, autism spectrum disorder, ADHD were collapsed into this binary categorical variable.

Descriptive methods

All statistical analyses were performed using R version 2026.01.1 (R Foundation for Statistical Computing). The distributions of all continuous covariates were assessed for normality. If non-normal, median and inter-quartile range were applied. Variables with numerous categories of single-digit cell counts were recategorized for simplicity (see appendix for original variables) and presented as proportions. Binary categorical covariates were presented as proportions. Descriptive data was then stratified by patient-directed discharge and presented as proportions of the total study population. Differences in continuous variables were assessed using t-test, while differences in the observed proportions of categorical variables were assessed using chi-square test or Fisher's exact test if cell counts were less than 5. For categorical variables with multiple levels like admission diagnosis category and hospital discharge location, an overall and per level p-value were calculated. The overall test (Tables 2 and 3) is a global test of independence between PDD and the categorical variable. In tables 2 and 3, separate per-level p-values were calculated using Chi-square tests for expected cell counts >/= 5, and Fisher's exact tests for expected cell counts < 5. Given the exploratory nature of the analysis, correction for multiple comparisons was not performed. Factors with significant deviations from expected counts were carried forward for regression analysis.

Identifying predictors for further analysis

Dichotomous variables were created to facilitate regression analysis of predictors previously reported in the literature (age 45 and younger, male sex, uninsured/self-pay, Medicaid insurance, and any substance use diagnosis) as well as any plausible predictors identified by significance in our descriptive analysis. Plausible predictive factors were only considered if they had cell counts greater 5. Among categorical substance use screening variables, levels related to substance non-use were not considered. Plausible predictive factors had to logically precede PDD. For example, length of stay, discharge destination, and outpatient follow up would be omitted as they're more likely to follow PDD, even though there were significant differences in descriptive analysis. Plausible predictive factors identified from descriptive analysis were: Opioid Use Disorder Diagnosis, Daily/Almost daily Stimulant Use, Daily/Almost daily Opioid

Use, No Substance Use Screening Data, Addiction Consult Note Present, Any Psychiatric Diagnosis, Psychiatric Admission, Hypertension Diagnosis, 3 or more Prior Admissions, Infectious Disease Admission, Med/Surg Boarding Bed, and Reported Unsheltered Homelessness. Dichotomous variables were created with "no" values as the referent group.

Analytic Methods

Choice of binomial or modified Poisson regression with robust standard errors was dependent on the prevalence of the outcome. Using a cut off of 10% PDD prevalence, it was decided that prevalence ratios estimated by modified Poisson regression with robust standard errors were preferable to odds ratio via logistic regression.

Adjusted models were created with the overall goal of limiting the potential for overcorrection. Given the exploratory nature of the study, adjusted models included baseline factors such as age, sex, insurance and CCI score category (Model 1). A second model including presence of any SUD diagnosis was added (Model 2). Among predictors that were collinear with any one of the adjustment variables, an adjusted PR was calculated individually using a model dropping the collinear adjustment variable. Similarly, OUD diagnosis was only adjusted by Model 1 due to collinearity with the "Any SUD diagnosis" adjustment variable in Model 2. All reported regression coefficients were subjected to Wald hypothesis testing with a significance level of $\alpha = 0.05$.

Ethical Considerations

The study protocol was reviewed and approved by the University of Washington Institutional Review Board. Identified data was maintained on HIPAA-compliant servers and workstations. Informed consent was waived due to the use of retrospective EHR data.

Results

Table 1a: Patient characteristics stratified by Patient-Directed Discharge (PDD)

Characteristic	Overall N = 1,637[1]	Discharge As Planned N = 1,454[1]	PDD N = 183[1]	P-value[2]
Age (Years)				<0.001
Median (Q1, Q3)	46.0 (37.0, 60.0)	47.5 (37.0, 60.0)	41.0 (33.0, 51.0)	
Unknown	2	2	0	
Sex Assigned at Birth				0.4
Female	396 (24%)	358 (25%)	38 (21%)	
Male	1,239 (76%)	1,094 (75%)	145 (79%)	
Not Disclosed	2 (0.1%)	2 (0.1%)	0 (0%)	
Race				0.078
Native Hawaiian or Pacific Islander	12 (0.7%)	9 (0.6%)	3 (1.6%)	
American Indian or Native Alaskan	56 (3.4%)	46 (3.2%)	10 (5.5%)	
White	1,001 (61%)	899 (62%)	102 (56%)	
Black or African-American	334 (20%)	297 (20%)	37 (20%)	
Asian	69 (4.2%)	64 (4.4%)	5 (2.7%)	
Unknown	133 (8.1%)	111 (7.6%)	22 (12%)	
Multiple Races	32 (2.0%)	28 (1.9%)	4 (2.2%)	
Ethnicity				0.7
Hispanic or Latino/a or Latinx	161 (9.8%)	144 (9.9%)	17 (9.3%)	
Non-Hispanic or Latino/a or Latinx	1,457 (89%)	1,294 (89%)	163 (89%)	
Unknown	19 (1.2%)	16 (1.1%)	3 (1.6%)	
Insurance				<0.001
Medicaid	1,080 (66%)	938 (65%)	142 (78%)	
Medicare	416 (25%)	391 (27%)	25 (14%)	
Commercial	52 (3.2%)	50 (3.4%)	2 (1.1%)	
Uninsured/Self-pay	44 (2.7%)	33 (2.3%)	11 (6.0%)	
Other	45 (2.7%)	42 (2.9%)	3 (1.6%)	
Language				0.050
English	1,543 (94%)	1,366 (94%)	177 (97%)	
Spanish	43 (2.6%)	40 (2.8%)	3 (1.6%)	
Unavailable/Unknown	6 (0.4%)	4 (0.3%)	2 (1.1%)	
Other	45 (2.7%)	44 (3.0%)	1 (0.5%)	
Homelessness Experience				<0.001
Street/Unsheltered	724 (44%)	628 (43%)	96 (52%)	
Shelter/Transitional Housing	378 (23%)	330 (23%)	48 (26%)	
Unstable	25 (1.5%)	25 (1.7%)	0 (0%)	
Time-limited Institutional	123 (7.5%)	122 (8.4%)	1 (0.5%)	
Unspecified	387 (24%)	349 (24%)	38 (21%)	
Contact with HMC Downtown Programs				0.6
Yes	278 (17%)	250 (17%)	28 (15%)	
Charlson Comorbidity Index Score				0.6
0	1,046 (64%)	922 (63%)	124 (68%)	
1-2	331 (20%)	297 (20%)	34 (19%)	
3-4	195 (12%)	178 (12%)	17 (9.3%)	
5+	65 (4.0%)	57 (3.9%)	8 (4.4%)	
Length of Stay (Days)				<0.001
Median (Q1, Q3)	6.0 (3.0, 12.0)	6.0 (3.0, 13.0)	3.0 (2.0, 6.0)	
Prior Admission to HMC				0.7
Yes	337 (21%)	297 (20%)	40 (22%)	
Three or more prior admissions to HMC				0.054
Yes	96 (5.9%)	79 (5.4%)	17 (9.3%)	
Discharge Destination				<0.001
Home	709 (43%)	680 (47%)	29 (16%)	

Characteristic	Overall N = 1,637[1]	Discharge As Planned N = 1,454[1]	PDD N = 183[1]	P-value[2]
Other Acute Care Hospital	37 (2.3%)	37 (2.5%)	0 (0%)	
Psychiatric Facility	72 (4.4%)	72 (5.0%)	0 (0%)	
Shelter	58 (3.5%)	56 (3.9%)	2 (1.1%)	
Respite	72 (4.4%)	72 (5.0%)	0 (0%)	
Inpatient Rehab Facility (IRF)	11 (0.7%)	11 (0.8%)	0 (0%)	
Expired	70 (4.3%)	70 (4.8%)	0 (0%)	
Jail/Law Enforcement	51 (3.1%)	50 (3.4%)	1 (0.5%)	
Skilled Nursing Facility (SNF)	91 (5.6%)	90 (6.2%)	1 (0.5%)	
Long Term Acute Care Hospital (LTCH)	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Other/Unspecified	465 (28%)	315 (22%)	150 (82%)	
Expired during admission				0.001
Yes	87 (5.3%)	87 (6.0%)	0 (0%)	
Successful Outpatient Follow-up				0.008
Yes	588 (36%)	539 (37%)	49 (27%)	
Alcohol Use Disorder				0.8
Diagnosed	356 (22%)	318 (22%)	38 (21%)	
Frequency of Alcohol Use				0.10
Never	688 (42%)	625 (43%)	63 (34%)	
Less than monthly	79 (4.8%)	74 (5.1%)	5 (2.7%)	
Monthly	36 (2.2%)	32 (2.2%)	4 (2.2%)	
Weekly	32 (2.0%)	29 (2.0%)	3 (1.6%)	
Daily or almost daily	86 (5.3%)	74 (5.1%)	12 (6.6%)	
Not Known	716 (44%)	620 (43%)	96 (52%)	
Stimulant Use Disorder				0.12
Diagnosed	616 (38%)	537 (37%)	79 (43%)	
Frequency of Stimulant Use				0.002
Never	659 (40%)	609 (42%)	50 (27%)	
Once or twice	108 (6.6%)	96 (6.6%)	12 (6.6%)	
Weekly	86 (5.3%)	76 (5.2%)	10 (5.5%)	
Daily or almost daily	181 (11%)	154 (11%)	27 (15%)	
Not Known	603 (37%)	519 (36%)	84 (46%)	
Opioid Use Disorder				<0.001
Diagnosed	597 (36%)	507 (35%)	90 (49%)	
Frequency of Opioid Use				<0.001
Never	680 (42%)	634 (44%)	46 (25%)	
Once or twice	64 (3.9%)	59 (4.1%)	5 (2.7%)	
Weekly	63 (3.8%)	57 (3.9%)	6 (3.3%)	
Daily or almost daily	227 (14%)	185 (13%)	42 (23%)	
Not Known	603 (37%)	519 (36%)	84 (46%)	
Frequency of Sedative Use				0.010
Never	952 (58%)	866 (60%)	86 (47%)	
Once or twice	37 (2.3%)	31 (2.1%)	6 (3.3%)	
Weekly	21 (1.3%)	19 (1.3%)	2 (1.1%)	
Daily or almost daily	24 (1.5%)	19 (1.3%)	5 (2.7%)	
Not Known	603 (37%)	519 (36%)	84 (46%)	
Addiction Consult Note Present				0.004
Yes	368 (22%)	311 (21%)	57 (31%)	

[1]*n (%)*

[2]*Welch Two Sample t-test; Fisher's exact test; Fisher's Exact Test for Count Data with simulated p-value (based on 2000 replicates); Pearson's Chi-squared test*

P-values calculated using t-tests for continuous variables, Chi-square tests for categorical variables with all expected cell counts >/= 5, and Fisher's exact tests for categorical variables with expected cell counts < 5

Descriptive Analysis

Over the 2-year study period, 95,295 encounters were screened and 64,980 unique patients were identified. Of those unique individuals, 1,637 (2.52%) were registered as homeless within one year of admission.

Prevalence of PDD among PEH

The prevalence of PDD was 183 out of 1,637 individuals (11%). This group had a significantly shorter median length of stay than the discharge as planned group (Table 1a).

Overall Demographics

Among PEH admitted to HMC during the study period, the majority were assigned male at birth with a median age of 46 years (See Table 1a). The majority were identified as white, non-Hispanic, and preferring the English language. Despite this, 23 unique preferred languages were represented in the sample (See appendix). The most common form of health insurance in this population was Medicaid and 2.7% of the study population were designated as uninsured/self-pay. Unsheltered homelessness was the most reported form of homelessness at the time of registration (44%) while only 23% were reported to be staying in shelter or transitional housing. Nearly a quarter (24%) of the sample did not have their homelessness described further.

Overall Admission Characteristics

Twenty one percent of admitted PEH had at least one prior admission to HMC and 17% had any prior contact with the Downtown Programs at HMC. The three most frequent categories of admission diagnosis among PEH admitted to HMC were infectious disease, psychiatric and trauma/burn. 301 individuals out of 1,637 were transferred to another hospital over the course of the admission. Discharge to respite among this patient population was 4.4%.

Table 1b: ICD-10 Diagnosis code categories stratified by Patient-Directed Discharge (PDD)

Characteristic	Overall N = 1,637[1]	Discharge As Planned N = 1,454[1]	PDD N = 183[1]	P-value[2]
Any Psychiatric Diagnosis				0.008
Yes	728 (44%)	664 (46%)	64 (35%)	
Psychosis				0.12
Yes	431 (26%)	392 (27%)	39 (21%)	
Dementia				0.2
Yes	31 (1.9%)	30 (2.1%)	1 (0.5%)	
Traumatic Brain Injury				0.7
Yes	679 (41%)	606 (42%)	73 (40%)	
Hemiplegia				>0.9
Yes	31 (1.9%)	28 (1.9%)	3 (1.6%)	
Seizure Diagnosis (Excl. withdrawal)				>0.9
Yes	129 (7.9%)	115 (7.9%)	14 (7.7%)	
Any Chronic Pain Diagnosis				0.2
Yes	690 (42%)	622 (43%)	68 (37%)	
Complicated Diabetes				0.9
Yes	116 (7.1%)	104 (7.2%)	12 (6.6%)	
Chronic Pulmonary Disease				0.13
Yes	174 (11%)	161 (11%)	13 (7.1%)	
Hypertension				0.011
Yes	295 (18%)	275 (19%)	20 (11%)	
Cardiac Arrhythmia				0.7
Yes	255 (16%)	229 (16%)	26 (14%)	
Congestive Heart Failure				0.3
Yes	185 (11%)	169 (12%)	16 (8.7%)	
Pulmonary Circulation Disease				0.11
Yes	37 (2.3%)	36 (2.5%)	1 (0.5%)	
Peripheral Vascular Disease				>0.9
Yes	49 (3.0%)	44 (3.0%)	5 (2.7%)	
Coagulopathy				0.4
Yes	50 (3.1%)	47 (3.2%)	3 (1.6%)	
Deficiency Anemias				0.8
Yes	287 (18%)	253 (17%)	34 (19%)	
HIV/AIDS				0.3
Yes	42 (2.6%)	35 (2.4%)	7 (3.8%)	
Hepatitis C Diagnosis				0.7
Yes	172 (11%)	151 (10%)	21 (11%)	
Any Liver Disease				0.7
Yes	144 (8.8%)	126 (8.7%)	18 (9.8%)	
Fluid/Electrolyte Disorder				0.8
Yes	413 (25%)	369 (25%)	44 (24%)	
Renal Failure				0.2
Yes	120 (7.3%)	111 (7.6%)	9 (4.9%)	
Weight Loss				0.8
Yes	90 (5.5%)	81 (5.6%)	9 (4.9%)	
Any Tumor				0.4
Yes	48 (2.9%)	45 (3.1%)	3 (1.6%)	
Metastatic Cancer				0.7
Yes	17 (1.0%)	16 (1.1%)	1 (0.5%)	

[1]*n (%)*

[2]*Welch Two Sample t-test; Fisher's exact test; Fisher's Exact Test for Count Data with simulated p-value (based on 2000 replicates); Pearson's Chi-squared test*

P-values calculated using t-tests for continuous variables, Chi-square tests for categorical variables with all expected cell counts >/= 5, and Fisher's exact tests for categorical variables with expected cell counts < 5

Overall Substance Use Factors

Thirty six percent of admitted PEH had a documented diagnosis of OUD while 38% had a documented diagnosis of StUD. AUD was present in 22% of the study population. Fourteen percent of the study population reported daily/almost daily opioid use, while 11% of the study population reported daily/almost daily stimulant use and 5.3% reported daily or almost daily alcohol use. Daily/almost daily sedative use was reported by 1.5% of the study population. Thirty-seven percent of the study population did not have SUD screening data available and 44% did not have unhealthy alcohol use screening results.

Overall Clinical Factors

44% carried a psychiatric diagnosis and 26% carried a diagnosis of psychosis (Table 1b). Traumatic brain injury was highly prevalent at 41% of admitted PEH. Chronic pain, cardiac arrhythmias and congestive heart failure were also prominent diagnoses in this population. CCI scores of 3 (moderate 1-year mortality risk) and above made up 16% of the overall population. Among patients that did not perform patient-directed discharges 6% died in the hospital (Table 1a).

Demographic factors associated with PDD

Patients performing PDDs were significantly younger than those who discharged as planned (41.0 vs. 47.5), but groups were similar in terms of race, ethnicity, and sex assigned at birth. Relative to the discharged as planned group, the PDD group had comparatively more Medicaid and uninsured individuals. Unsheltered homelessness was more common among PDDs (52 vs 43%) while those who were admitted from another time-limited institution (jail, hospital, nursing facility, etc.) were more frequently discharged as planned.

Table 2: Admission Diagnosis Category stratified by PDD

Characteristic	Overall N = 1,637[1]	Discharge As Planned N = 1,454[1]	PDD N = 183[1]	P-value[2]
Admission Diagnosis Category				<0.001
Trauma/Burn	219 (13%)	188 (13%)	31 (17%)	
Addiction	179 (11%)	160 (11%)	19 (10%)	
Cardiovascular	97 (5.9%)	85 (5.8%)	12 (6.6%)	
Diabetes/Endocrine	33 (2.0%)	26 (1.8%)	7 (3.8%)	
Gastrointestinal	63 (3.8%)	57 (3.9%)	6 (3.3%)	
Hematology/Oncology	25 (1.5%)	22 (1.5%)	3 (1.6%)	
Infectious Disease	440 (27%)	366 (25%)	74 (40%)	***
Metabolic/Renal	63 (3.8%)	57 (3.9%)	6 (3.3%)	
Musculoskeletal	11 (0.7%)	10 (0.7%)	1 (0.5%)	
Neurological	90 (5.5%)	86 (5.9%)	4 (2.2%)	*
Other/Unclassified	72 (4.4%)	66 (4.5%)	6 (3.3%)	
Psychiatric	282 (17%)	272 (19%)	10 (5.5%)	***
Pulmonological	63 (3.8%)	59 (4.1%)	4 (2.2%)	

[1]n (%)
[2] Overall p-value calculated by Fisher's Exact Test for Count Data with simulated p-value (based on 2000 replicates). Per diagnosis category p-values calculated by Chi-square tests for expected cell counts >/= 5, and Fisher's exact tests for expected cell counts < 5. Per floor P-values denoted as below:
**** = p <= 0.001*
*** = p < 0.01*
** = p < 0.05*

Admission characteristics associated with PDD

There was no difference between patients performing PDD and planned discharge in proportion of prior admissions to HMC within the last two years. However, significantly more patients who underwent PDD had more than 3 prior admissions in the preceding 2 years. Infectious Disease-related primary diagnoses were significantly more frequent among admissions that ended in PDD relative to discharge as planned (See Table 2). Conversely, psychiatric admitting diagnoses made up 17% of all admissions, but only 5.5% of admissions ending in PDD. There was no significant over-representation of addiction-related primary diagnoses among patients who performed PDDs. However, a significantly higher proportion of PDD cases had addiction consult notes present than patients who discharged as planned. Patients who performed PDDs had lower prevalence of successful outpatient follow up within 2 months of discharge (Table 1a, 27% vs 37%).

Substance Use Factors associated with PDD

There were no significant differences in the number of Alcohol Use Disorder (AUD) or Stimulant Use Disorder (StUD) diagnoses between discharge types. However, the PDD group had significantly higher prevalence of Opioid Use Disorder (OUD) diagnoses than the discharge as planned group. Available substance use screening data showed that there was higher prevalence of self-reported daily opioid use among those performing PDDs compared with those who discharged as planned. However, a higher proportion of PDD cases went unscreened for both unhealthy alcohol use and overall substance use.

Clinical factors associated with PDD

Significant differences were noted in psychiatric comorbidity and hypertension. No other significant differences were noted among the observed diagnosis code groupings. Relative to patients who discharged as planned, a significantly smaller proportion of patients performing PDDs had a psychiatric diagnosis present (Table 1b). There was no significant difference between groups in the proportion of patients with history of psychosis. There were no significant differences between patients who discharged as planned and patients who performed PDDs in neuropsychiatric diagnoses like dementia, TBI, and primary seizures.

There were significantly fewer hypertension diagnoses among patients in the PDD group compared with those who were discharged as planned. However, no other significant differences in diagnosis code groupings were identified and there were no significant differences in the frequencies of CCI scores between PDD and discharge as planned groups.

Hospital Location at time of discharge

The observed distribution of discharge locations for patients performing PDDs was found to be significantly different than that of planned discharges (Table 3). A significantly higher proportion of patients who performed PDDs (18%) were on the first floor of HMC at the time of discharge compared to planned discharges (8.2%). Chi-square testing of the observed vs. expected proportion of patients performing PDDs on the first floor of HMC found a statistically significant difference (p<0.001). Discharges from psychiatric units had a significantly lower prevalence of PDD than expected compared to planned discharges (p<0.05). There were no differences in PDD among patients that were transferred to another hospital during the admission.

Table 3: Hospital location at time of discharge stratified by PDD

Characteristic	Overall N = 1,637[1]	Discharge As Planned N = 1,454[1]	PDD N = 183[1]	P-value[2]
Discharge Department				<0.001
1 - Med/Surg Boarding	152 (9.3%)	119 (8.2%)	33 (18%)	***
2E - MICU	60 (3.7%)	56 (3.9%)	4 (2.2%)	
2W - Neuro ICU/MICU	30 (1.8%)	24 (1.7%)	6 (3.3%)	
3E - Med/Telemetry/Hemodialysis	91 (5.6%)	84 (5.8%)	7 (3.8%)	
3W - Neuro Acute	45 (2.7%)	43 (3.0%)	2 (1.1%)	
4E - Med/Geriatrics	105 (6.4%)	93 (6.4%)	12 (6.6%)	
4W - Rehab Medicine	2 (0.1%)	2 (0.1%)	0 (0%)	
5CT - Surge/Transitional Care Unit	66 (4.0%)	59 (4.1%)	7 (3.8%)	
5E - Med/Surg/Telemetry	121 (7.4%)	105 (7.2%)	16 (8.7%)	
5MB - Psychiatry ICU	58 (3.5%)	57 (3.9%)	1 (0.5%)	*
5W - Psychiatry	167 (10%)	157 (11%)	10 (5.5%)	*
6CT - Transitional Care Unit (TCU)	39 (2.4%)	37 (2.5%)	2 (1.1%)	
6E - Trauma Ortho	62 (3.8%)	53 (3.6%)	9 (4.9%)	
6MB - Planned Procedure Admit	67 (4.1%)	56 (3.9%)	11 (6.0%)	
7E - Trauma Surgery	64 (3.9%)	58 (4.0%)	6 (3.3%)	
8E - Burns/Plastics/Pediatrics	54 (3.3%)	46 (3.2%)	8 (4.4%)	
8MB FLEX CARE - TCU	41 (2.5%)	33 (2.3%)	8 (4.4%)	
9EA - Burn ICU	6 (0.4%)	5 (0.3%)	1 (0.5%)	
9EB - Pediatric ICU	2 (0.1%)	1 (<0.1%)	1 (0.5%)	
9M Trauma SICU	15 (0.9%)	13 (0.9%)	2 (1.1%)	
PAC BDB	33 (2.0%)	28 (1.9%)	5 (2.7%)	
HMC EMERGENCY DEPT	53 (3.2%)	52 (3.6%)	1 (0.5%)	*
HMC Procedural Rooms	3 (0.2%)	3 (0.2%)	0 (0%)	
Transfer	301 (18%)	270 (19%)	31 (17%)	

[1]n (%)
[2] Overall p-value calculated by Fisher's Exact Test for Count Data with simulated p-value (based on 2000 replicates). Per floor p-values calculated by Chi-square tests for expected cell counts >/= 5, and Fisher's exact tests for expected cell counts < 5. Per floor P-values denoted as below:
**** = p <= 0.001*
*** = p < 0.01*
** = p < 0.05*

Regression Analysis

Table 4: Unadjusted and Adjusted prevalence ratio (aPR) of PDD by variable

Variable	Unadjusted PR (95% CI)	p-value	aPR Model 1* (95% CI)	p-value	aPR Model 2** (95% CI)	p-value	aPR Model 3$ (95% CI)	p-value
Age 45 or Younger	1.79 (1.35–2.37)	**<0.001**	—	—	—	—	1.47 (1.07–2.04)	**0.011**
Male Sex Assigned at Birth	1.23 (0.87–1.72)	0.239	—	—	—	—	1.18 (0.83–1.71)	0.326
Any Substance Use Diagnosis	1.61 (1.17–2.21)	**0.003**	1.51 (1.09–2.08)	**0.013**	—	—	—	
Medicaid Insurance	1.79 (1.28–2.49)	**0.001**	—	—	—	—	1.29 (0.90–1.88)	0.168
Uninsured/self-pay	2.32 (1.36–3.94)	**0.002**	—	—	—	—	2.36 (1.19–4.18)	**0.001**
Opioid Use Disorder Diagnosis	1.69 (1.28–2.21)	**<0.001**	1.46 (1.09–1.94)	**0.011**	—	—	—	
Daily or Almost daily Stimulant Use	1.39 (0.95–2.03)	0.086	1.18 (0.81–1.73)	0.388	1.11 (0.76–1.64)	0.584		
Daily or Almost daily Opioid Use	1.85 (1.35–2.53)	**<0.001**	1.54 (1.12–2.12)	**0.007**	1.45 (1.05–2.01)	**0.024**		
No Substance Use Screening Data	1.42 (1.08–1.87)	**0.012**	1.4 (1.06–1.83)	**0.016**	1.39 (1.06–1.83)	**0.018**		
Addiction Consult Note Present	1.56 (1.17–2.09)	**0.003**	1.28 (0.95–1.72)	0.099	1.21 (0.89–1.64)	0.226		
Any Psychiatric Diagnosis	0.67 (0.5–0.9)	**0.007**	0.69 (0.51–0.93)	**0.015**	0.64 (0.47–0.86)	**0.003**		
Psychiatric Admission	0.28 (0.15–0.52)	**<0.001**	0.24 (0.13–0.45)	**<0.001**	0.25 (0.13–0.46)	**<0.001**		
Hypertension Diagnosed	0.56 (0.36–0.87)	**0.011**	0.72 (0.44–1.17)	0.184	0.7 (0.43–1.14)	0.154		
3 or more Prior Admissions	1.64 (1.04–2.59)	**0.032**	1.68 (1.03–2.75)	**0.038**	1.6 (0.98–2.6)	0.061		
Infectious Disease Admission	1.85 (1.4–2.43)	**<0.001**	1.81 (1.38–2.39)	**<0.001**	1.76 (1.34–2.31)	**<0.001**		
Med/Surg Boarding Bed	2.15 (1.53–3.01)	**<0.001**	1.87 (1.32–2.63)	**<0.001**	1.85 (1.32–2.59)	**<0.001**		
Unsheltered Homelessness	1.39 (1.06–1.83)	**0.018**	1.15 (0.86–1.53)	0.356	1.15 (0.86–1.54)	0.345		

PRs estimated using modified Poisson regression with robust standard errors. '—' indicates adjusted model not fitted due to collinearity with adjustment covariates.
** Adjustment variables used were age, male sex, insurance, and CCI score category*
*** Adjustment variables used were age, male sex, insurance, CCI score category, and any substance use diagnosis*
*$ Adjustment variables same as ** with collinear adjustment covariate dropped*

Demographic factors

The unadjusted prevalence ratio of PDD among PEH 45 or younger compared with those older than 45 was 1.79 (95% CI: 1.35-2.37; $p < 0.001$; see Table 4). After adjusting for male sex, insurance, CCI score category and presence of SUD diagnoses, PDD among PEH age 45 or younger was 47% more prevalent than among those older than 45 years (aPR 1.47; 95% CI: 1.07-2.04; $p = 0.011$). No significant association between male sex and PDD was found in unadjusted regression analysis, nor was any found when adjusting for age, insurance, CCI score category and presence of SUD diagnoses.

In unadjusted models, having Medicaid insurance was associated with 1.79 times greater prevalence than other insurance types (95% CI 1.28-2.49; $p = 0.001$), but the association was attenuated after adjustment for age, male sex, CCI score category and presence of SUD diagnoses (aPR 1.29; 95% CI: 0.90-1.88; $p = 0.168$). Being uninsured was associated with 2.32

times greater prevalence of PDD in unadjusted analysis (95% CI: 1.36-3.94; $p = 0.002$) and the association remained unchanged after adjustment for age, male sex, CCI score category and presence of SUD diagnoses (aPR 2.36; 95% CI: 1.19-4.18; $p = 0.001$). While in unadjusted models, experiencing unsheltered homelessness was associated with 1.39 times higher prevalence of PDD (95% CI: 1.06-1.83; $p = 0.018$), no significant association was found between unsheltered homelessness and PDD after applying adjustment Model 2 (aPR 1.15; 95% CI: 0.86–1.54; $p = 0.345$).

Admission Characteristics

While significantly associated with PDD in unadjusted analysis (PR 1.56; 95% CI:1.17–2.09; $p = 0.003$), addiction consults were not found to maintain that association after applying Model 2 (aPR 1.21; 0.89–1.64; $p = 0.226$). Being admitted to a medical/surgical boarding bed was associated with increased risk for PDD even after applying adjustment Model 2 (aPR 1.85, 95% CI: 1.32-2.59; $p < 0.001$).

Substance Use Factors

After adjustment with Model 1 (due to collinearity as described in methods) having an OUD diagnosis was associated with a 1.46 times higher prevalence of PDD (95% CI: 1.09–1.94; $p = 0.011$). Patient-reported daily or almost daily opioid use on the substance use screen was associated with increased likelihood of PDD after applying adjustment Model 2 (aPR 1.45; 95% CI: 1.05–2.01, $p = 0.024$). Patient-reported daily or almost daily stimulant use was not associated with PDD prevalence in unadjusted or adjusted regression analysis (aPR 1.11; 95% CI: 0.76–1.64; $p = 0.584$). PEH that had no SUD screening data for the entirety of their admission had 1.39 times more PDDs than those who were screened (95% CI: 1.06-1.83; $p = 0.018$) after adjustment with Model 2.

Clinical factors

Infectious disease admission diagnoses were consistently associated with higher PDD prevalence (aPR 1.76; 95% CI: 1.34-2.31; $p < 0.001$). Conversely, psychiatric admission diagnoses were consistently associated with lower PDD prevalence (aPR 0.25; 95% CI: 0.13-0.46; $p < 0.001$). A history of psychiatric diagnosis was also associated with lower PDD prevalence (aPR 0.64; 95% CI: 0.47-0.86; $p = 0.003$).

Discussion

This exploratory cross-sectional study of inpatient PEH identified an 11% prevalence of PDD, reflecting the importance of understanding risks of PDD among a population that is vulnerable to adverse health outcomes. Our findings re-affirm previously reported risk factors for PDD such as younger age, lack of insurance, and opioid use disorder while suggesting other previously reported factors such as male sex and Medicaid insurance may need to be explored further. We identified additional risk factors including admission for infectious concerns and placement in boarding beds on the first floor of HMC. To our knowledge, this is the first study to compare prevalence of PDD among physical locations within the hospital, allowing us to determine whether spatial patterns of PDD exist from the EHR. These results suggest that individual, contextual and hospital-level covariates may be important determinants to consider in future studies of PDD.

Significant between-hospital variation exists in prevalence of PDD with some hospitals having an overall prevalence as high as 12.5%.[25] While this study was unable to determine the overall prevalence of PDD at HMC, a comparable EHR study of another urban safety net hospital found 17.6% of patients with history of homelessness completed PDDs compared to

3.5% of those without history of homelessness.[26] Given we anticipate our marker of homelessness would underreport admitted PEH, the result appears to be within reason. However, a follow up study comparing the prevalence of PDD among PEH with that of the general admitted population would help distinguish whether HMC has high overall prevalence of PDD or whether PEH are performing PDDs more often.

While other studies have examined associations between PDD, admission diagnoses and specific inpatient services,[27, 28] discharge location is useful in that it represents the most likely location in which the patient made the decision to leave the hospital early and may offer clues to factors associated with the hospital environment itself. Admission to a bed on the boarding floor of HMC was strongly associated with PDD even after adjustment. This is potentially because conditions in first floor boarding are materially different than the rest of the hospital floors. Patient beds are separated by curtains, and many beds are not within view of a window to the outside. Being admitted to the hospital boarding floor could be construed as a second-class experience, especially in a population that may be sensitive to such treatment already. In fact, one cross-sectional study found a threshold effect at 24 hours of boarding at which perception of discrimination and dissatisfaction with care increased significantly, especially among people identifying with marginalized groups.[29] These non-private conditions can also cause significant distress while experiencing vulnerability due to illness or withdrawal, especially for individuals that may have prior shelter or carceral experience. These results are congruent with qualitative studies of patients with SUD who perform PDDs where restrictions on behavior in the hospital, inability to go outside or see sunlight, and perceived discrimination were significant factors.[30]

Boarding in the hospital is an increasing problem, especially at US academic medical centers, where persistent understaffing and contraction of post-acute care operations have driven bed shortages in hospitals and nursing facilities respectively.[31] This is especially relevant because boarding for longer than 4 hours is associated with increased patient harm.[32]

Recent study of ED boarding showed significant potential for discrimination in assignment of boarding beds as well as significant effects on patient experience and satisfaction.[33] Further study of whether there are substantive, systematic differences in who is assigned a boarding bed at HMC are required to fully understand which factors are affecting care of vulnerable patients. In addition, review of staffing, patient communication, and procedures within the unit may be helpful to understand this pattern. Ultimately, systemic factors within American healthcare that drive bottlenecks in available acute and post-acute care beds need to be identified and rectified through policy change.

The role of race and ethnicity in PDD remains unclear, and further study is warranted. Race is a historically and socially derived construct conferring differential access to resources and power in American society and there is consistent overrepresentation of historically marginalized and minoritized groups in demographic studies of PEH. With respect to the national inpatient sample, it was found that discharges labeled as "AMA" were more likely to involve non-Hispanic black individuals than those identified as non-Hispanic white.[34] However, more recent evidence demonstrated that this association disappears with adjustment for random effects, suggesting hospital-, neighborhood-, or other higher-level structural effects are in play. For example, it's possible that marginalized populations are more likely to receive care in hospitals that generate higher rates of PDD, and that care inequities (e.g. higher rates of ED boarding) at the hospital level drive the association of PDD with race.[35] For this reason a multi-level analysis involving all admitted patients and designed to detect hospital-level effects as well as those related to social determinants would be better suited than the current study to evaluate this relationship. There was no significant difference identified in the current analysis, likely due to the relatively simple cross-sectional design. This could also be related to systematic differences introduced by our single homelessness measure as well as differences in patient reporting of housing status or cross-level confounding by unmeasured higher-level, contextual variables.

Prior studies of PDD have noted male sex as a key demographic predictor. However, the results of this study of PEH do not corroborate this association. A concurrent weighted survey of PEH in Seattle conducted by members of the UW Department of Sociology's Center for Studies in Demography and Ecology showed a strong predominance of male sex assigned at birth (70%).[36] Given populations of PEH are often found to be male predominant, it is possible that general studies of PDD that found male sex was a predictor were confounded by the skewed demographics of the observed homeless population. Similarly, prior studies reported an association between Medicaid insurance and PDD, while our study found no significant association after adjusting for age, male sex, CCI score category, and any SUD diagnosis. This potential confounding may explain the lack of findings in this study, but given limitations in our measure of homelessness, further study is needed in other populations of PEH.

Consistent with prior studies, PDD in the setting of self-pay status remained twice as prevalent than under any other insurance status, even after adjusting for age, sex, CCI score and substance use.[37, 38] In these cases, fear of medical debt may be a significant driver of the behavior, even though retroactive Medicaid, charity care applications, and self-pay discounts are often potential options for patients in this position. Early clarity and action on payment responsibility may reduce patient inclination toward PDD.

In keeping with previous studies, PDD was 51% more prevalent among PEH with any SUD diagnosis compared to those without after adjustment. This effect is likely to be driven mostly by OUD, which was associated with a 46% higher prevalence of PDD compared with those with no OUD diagnosis. This is supported by 45% higher prevalence of PDD among patients reporting daily or almost daily opioid use. This association is well supported in current literature, suggesting the unique constellation of craving and withdrawal discomfort associated with opioid use is a motivating factor among PDDs.[39] A recent observational study showed reduced odds of PDD with increased cumulative methadone dose in the first 48 hours of admission.[40] In a separate study, medications for OUD (MOUD) were associated with lower risk of PDD. MOUD and opioid analgesics were also associated with longer lengths of stay.[41] This is also consistent with qualitative study of PDD noting untreated pain and withdrawal as motivating factors.[42, 43] Appropriate opioid receptor management is a crucial path toward equitable inpatient care for people who use opioids.

Daily or almost daily stimulant use and sedative use, as well as daily alcohol use as measured by AUDIT-C were not significantly associated with PDD. Studies of PDD among the general population have found StUD and AUD to be independent risk factors for PDD.[44, 45] However, the lack of association in this study may be due to missing screening data from inconsistent screening practice, hospital-level protocols for withdrawal management, or characteristics related to the subpopulation of PEH being observed via registration as "homeless."

Patients who lacked screening for any substance use also had significantly higher prevalence of PDD. This may be due to initial illness severity, necessity of ICU-level care, or persistent altered mental state. Likewise, variation in nursing care patterns and routines between units may also explain absence of screening data. Tracking location within the hospital throughout admission instead of just at discharge may help identify unit-related patterns in screening practices.

Compared with addiction and all other admission diagnosis categories, infectious disease admissions had a persistently higher adjusted PR of PDD among PEH. This is logically consistent with Yeung et al. who found 16% of abscess admissions ended in PDD. Another study of hand infection admissions at a public safety net hospital found 27% ended in PDD.[46] Subgroup analysis of all 440 infectious disease admissions in this group may elucidate further distinctions among infectious diagnoses. There may be factors specific to infections and their treatment that predispose patients to leaving the hospital early.

Studies of PDD have produced mixed results on the relationship of mental health history and PDD.[47] This study identified decreased prevalence of PDD among admissions for psychiatric complaints, admissions to psychiatric units and among PEH with any psychiatric diagnosis in their problem list. This is intuitive when considering potentially more frequent and nuanced capacity evaluations, involuntary admissions, and more structured evaluations of suicide risk. However, there may be subgroup differences in PDD that may provide more specific covariates. For example, Serota et al. found decreased incidence of PDD among patients with depression, while Suzuki et al. found increased incidence among patients with PTSD.[48, 49] Both studies were examining admissions for infectious complaints among patients with SUD which may be confounding factors. Further study is required to understand the circumstances under which the prevalence of PDD among psychiatric admissions is so strongly reduced.

Due to the cross-sectional nature of the study, causality should not be inferred from these results. The EMR data collected was entered for clinical and not research purposes. Given the complexity of PDD as a behavior, as well as the number of interrelated factors assessed, residual confounding is likely to be present, complicating interpretations. The measurement of a patient's experience of homelessness, including whether it is past or current, is subject to significant misclassification due to variation in healthcare worker documentation and practice, acute illness severity and urgency, and the patient's own reporting preferences. This study utilized a single measure of homelessness (registration as experiencing homelessness within 1 year of admission), which is likely to introduce misclassification of PEH. Given the exploratory nature of this analysis, this misclassification bias was tolerated, however, future comparative analyses of the variables identified in this study would benefit from a composite measure of homelessness validated against a gold standard. Such a measure specific to the population at HMC is currently under development.

The measurement of PDD faces similar misclassification bias. The option to mark the patient's discharge disposition as "Against Medical Advice" is problematic for multiple reasons. First, it is hidden within the menu, requiring additional effort to select. Second, the wording of the option is widely recognized as stigmatizing, and providers may prefer choosing a different discharge disposition as a protective measure for their patients. Because of this documentation bias, the total number of PDDs may be undercounted. Like homelessness, PDD may be another factor that could benefit from composite measure.

It is reasonable to question the utility of CCI for the study population. In head-to-head comparison within the VA healthcare system, CCI and comparable indices like Elixhauser Comorbidity Index (ECI) and Functional Comorbidity Index (FCI), had similar predictive value for all-cause mortality, with CCI and ECI performing better than FCI overall. Despite this, they found FCI might be better suited to assess PEH.[50] We chose to use CCI as an adjustment variable in this study because of its broad applicability and potential comparability to the general population in future study. While it serves as a method of comparing and adjusting for individuals' exposure to select, consequential comorbidities, it may not be specific enough to populations of PEH to detect differences.

Lastly, studies involving PEH suffer from limited generalizability due to regional historical, political, economic, and geographic factors. While general concepts surrounding homelessness may remain the same from place to place, these structural pressures generate unique population characteristics. Similarly, as mentioned above, rates of PDD are highly variable between facilities and regions of the USA.

Despite this limited generalizability, this study illuminates the needs of PEH utilizing HMC services, identifying high overall prevalences of conditions like TBI (41%), as well as highlighting a high proportion of in-hospital deaths (6%). It has also supplied new variables to monitor in the context of PDD including location within the hospital, frequency of opioid use, infectious disease admission diagnoses and absent substance use screening.

Current literature on PDD views housing instability and homelessness as covariates of PDD. However, the unique experiences tied to homelessness potentially motivate PDD in ways that inform us better about the phenomenon in general. The fact that nearly one fifth of PDDs among admitted PEH involved boarding beds lends additional weight to the idea that PDD is as dependent on environmental factors and patient experience as it is on individual risk factors.

This knowledge can open the door to targeted quality improvement initiatives within other hospitals. For example, one safety net hospital achieved fewer PDDs and readmissions after developing a specialized team to address some of these factors among patients admitted with co-occurring SUD and infectious disease. This team reduced the risk of 90-day readmission by 45%, with a much lower proportion of PDDs compared with historical controls.[51] More broadly, frameworks exist for responding to care inequities conferred by healthcare institutions.[52] Hospital systems aiming to improve these aspects of their care would benefit from undertaking similar studies of PDD with the aim of identifying the needs and, crucially, experiences of the vulnerable populations they serve.

Next, we plan to validate a composite measure of homelessness against gold standard chart review. Given this study revealed a more refined and focused set of covariates, we plan to then return to the EMR data to compare PDD among all patients admitted during the same time span with those experiencing homelessness by composite measure to identify differences in PDD prevalence, PDD covariates and in-hospital mortality. We hope this will also guide evaluations of experiences of PEH in the hospital, with a focus on decisions to continue care and health outcomes.

Conclusions

PDD and PEH are both independently associated with 30-day readmission and mortality but the specific factors that connect the two have not been examined. This study confirmed PDD is highly prevalent among PEH at HMC and that OUD and insurance status are influential factors. In addition, this study showed variables like hospital location at discharge and infectious admission diagnoses may also be worthwhile targets for future study and intervention. More hospital systems should undertake studies of PDD, PEH and patient experience to generate clearer pictures of how to better serve their most vulnerable inpatient populations through both individual-level and structural solutions.

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Appendix

Characteristic	Overall N = 1,637[1]	Discharge As Planned N = 1,454[1]	Patient-Directed Discharge N = 183[1]	P-value[2]
Preferred Language				0.9
Albanian	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Amharic	2 (0.1%)	2 (0.1%)	0 (0%)	
Cambodian/Khmer	2 (0.1%)	2 (0.1%)	0 (0%)	
Cantonese	1 (<0.1%)	1 (<0.1%)	0 (0%)	
English	1,543 (94%)	1,366 (94%)	177 (97%)	
French	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Italian	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Korean	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Kurdish	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Lingala	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Marshallese	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Panjabi/Punjabi	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Portuguese	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Russian	3 (0.2%)	3 (0.2%)	0 (0%)	
Samoan	2 (0.1%)	2 (0.1%)	0 (0%)	
Sign Language	7 (0.4%)	7 (0.5%)	0 (0%)	
Somali	5 (0.3%)	5 (0.3%)	0 (0%)	
Spanish	43 (2.6%)	40 (2.8%)	3 (1.6%)	
Tagalog	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Tibetan	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Tigrinya	2 (0.1%)	1 (<0.1%)	1 (0.5%)	
Turkish	1 (<0.1%)	1 (<0.1%)	0 (0%)	
Unavailable Or Unknown	7 (0.4%)	5 (0.3%)	2 (1.1%)	
Vietnamese	8 (0.5%)	8 (0.6%)	0 (0%)	
Insurance Type				<0.001
Medicaid	1,080 (66%)	938 (65%)	142 (78%)	
Medicare	416 (25%)	391 (27%)	25 (14%)	
Commercial	52 (3.2%)	50 (3.4%)	2 (1.1%)	
Uninsured	0 (0%)	0 (0%)	0 (0%)	
Self-pay	44 (2.7%)	33 (2.3%)	11 (6.0%)	
Tricare	4 (0.2%)	3 (0.2%)	1 (0.5%)	
Workers Compensation	2 (0.1%)	1 (<0.1%)	1 (0.5%)	
Case Rate	0 (0%)	0 (0%)	0 (0%)	
Other	39 (2.4%)	38 (2.6%)	1 (0.5%)	
Homelessness Experience				0.005
Street	724 (44%)	628 (43%)	96 (52%)	
Shelter	348 (21%)	304 (21%)	44 (24%)	
Doubled Up	8 (0.5%)	8 (0.6%)	0 (0%)	
Transitional Housing	30 (1.8%)	26 (1.8%)	4 (2.2%)	
Jail	64 (3.9%)	63 (4.3%)	1 (0.5%)	
Motel/Hotel-self pay	6 (0.4%)	6 (0.4%)	0 (0%)	
Nursing Home	53 (3.2%)	53 (3.6%)	0 (0%)	
Respite	3 (0.2%)	3 (0.2%)	0 (0%)	
Other	24 (1.5%)	23 (1.6%)	1 (0.5%)	
Unspecified	377 (23%)	340 (23%)	37 (20%)	

[1]*n (%)*
[2]*Fisher's Exact Test for Count Data with simulated p-value (based on 2000 replicates)*
P-values calculated using t-tests for continuous variables, Chi-square tests for categorical variables with all expected cell counts >/= 5, and Fisher's exact tests for categorical variables with expected cell counts < 5

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