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When Crises Converge: Hospital Visits Before And After Shelter Use Among Homeless New Yorkers

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ABSTRACT People who are homeless use more hospital-based care than average, yet little is known about how hospital and shelter use are interrelated. We examined the timing of emergency department (ED) visits and hospitalizations relative to entry into and exit from New York City homeless shelters, using an analysis of linked health care and shelter administrative databases. In the year before shelter entry and the year following shelter exit, 39.3 percent and 43.3 percent, respectively, of first-time adult shelter users had an ED visit or hospitalization. Hospital visits—particularly ED visits—began to increase several months before shelter entry and declined over several months after shelter exit, with spikes in ED visits and hospitalizations in the days immediately before shelter entry and following shelter exit. We recommend cross-system collaborations to better understand and address the co-occurring health and housing needs of vulnerable populations.

Homelessness is a pervasive problem in the United States and is associated with mortality rates more than double those of the general population.^{1,2} Not surprisingly, prior studies have found that certain people who experience homelessness are high users of hospital-based health care and that for some there exists a “revolving door” between hospitals and homelessness.^{3,4} The time preceding homelessness may also be a period of high risk for hospital use. For example, while it is obvious that people use the emergency department (ED) during health crises, limited research has found that people also access EDs during life crises such as homelessness.^{5,6} Furthermore, a discharge from the hospital may precipitate homelessness for people who lose their housing or income while hospitalized.⁷

Little research has examined combined data from homeless services and health care systems outside the Veterans Health Administration (VHA) system.^{7,8} There has been particularly little published on health services use before peo-

ple become homeless, and existing research is limited to specific subpopulations or types of health care use. For example, studies from Philadelphia and Houston found spikes in the use of health services immediately preceding and following shelter entry, but they examined only behavioral health services.^{9,10} A study of veterans found spikes in health services use in the thirty days before documentation of homelessness,¹¹ and researchers using linked Massachusetts Medicaid and housing data found that hospital use rose in the months before shelter entry among families and children.¹²

Mainstream health care systems have demonstrated a strong interest in addressing patients’ social needs (for example, housing and homelessness) to improve care and reduce costs.^{13,14} A better understanding of the interface of the health care system with homelessness is needed to inform future initiatives. Examining hospital use around the time of homelessness can shed light on how homelessness and housing instability affect health and health services use, as well as the role that health systems may play in prevent-

ing or ameliorating homelessness. The current study fills a critical gap in knowledge by using linked New York City homeless and health services data to identify temporal trends in ED visits and hospitalizations surrounding homeless shelter entry and exit. The study was motivated by a desire not only to create new generalizable knowledge but also to provide practical information to inform collaborations between the health care and homelessness sectors in New York City and help guide efforts to improve health for people experiencing homelessness.

Study Data And Methods

The study was conducted by a unique collaboration of university-based investigators and the New York City Center for Innovation through Data Intelligence (CIDI). CIDI is a research center in the Office of the Deputy Mayor for Health and Human Services. Its research agenda was formulated by the Office of the Deputy Mayor and the commissioners of the city's health and human services agencies. CIDI creates a team of representatives from data-sharing and other agencies to participate in the design and analysis of all projects, including this study. In this way, CIDI maintains the integrity of the shared data, while providing actionable intelligence to the city and other partners.

DATA SOURCES We used administrative records from the nation's largest municipal shelter system and an all-payer claims database of hospital visits in New York City to assess the ED and inpatient hospital use of homeless adults before they entered and after they exited shelters. Shelter data came from the Client Assistance and Rehousing Enterprise System (CARES) database of the New York City Department of Homeless Services (DHS), which tracks shelter entries and exits for the more than 70,000 adults who use the city's emergency shelters each year. Shelters and transitional housing specifically for victims of domestic violence, people with HIV/AIDS, and youth are not included since these are operated by other city agencies—though many people in these categories stay at shelters within the DHS system as well. Overall, CARES captures nearly 90 percent of the shelter use in the city.

Hospital records were obtained from the Statewide Planning and Research Cooperative System (SPARCS), a database maintained by the New York State Department of Health.¹⁵ SPARCS includes ED visit and inpatient admission and discharge dates and diagnoses for all non-VHA hospital visits in New York.

STUDY POPULATION This study included adults (people at least age eighteen) who were first-time users of the DHS shelter system in the peri-

od 2008–15. We created separate analytic samples for the time periods before shelter entry and after shelter exit, since people spend varying amounts of time (from days to years) in shelter. Based on SPARCS data availability (2008–15), we restricted the analytic sample for the period before shelter entry to adults who entered shelter in the period 2009–15 and the sample for the period after shelter exit to adults who exited shelter by December 31, 2014, to ensure a full year before entry and a full year after exit in which to assess hospital use. Because we were interested in new-onset homelessness, and consistent with prior studies that examined shelter and other service use, we included only first-time shelter entrants.^{10,16} For people with multiple shelter stays during the study period, we included only the first stay.

SETTING New York City has the largest homeless shelter population in the US.¹⁷ Members of families and children outnumber single adults. Only around 4 percent of people who are homeless in the city are unsheltered. The DHS employs a variety of strategies to prevent homelessness and help families and individuals successfully exit shelter and return to self-sufficiency as quickly as possible. It meets its legal mandate to provide temporary emergency shelter to people experiencing homelessness via nearly 300 dedicated shelter buildings, plus cluster shelter in apartment buildings and a smaller number of contracted commercial hotels.

New York was an early Medicaid expansion state, so most people experiencing homelessness there are eligible for Medicaid. Multiple Health Care for the Homeless clinics, operated by various organizations throughout New York City, provide primary care and other health services. However, we are unaware of statistics regarding the proportion of the homeless population that is served by these clinics. Most assessment shelters for single adults in the city have clinicians to perform medical assessments as part of the shelter intake system. A relatively small number of other shelters have health care clinics, whose hours and services vary.

DATA ELEMENTS AND VARIABLES OF INTEREST Shelter episodes were based on bed assignment start and end dates in the CARES data. In alignment with the Department of Housing and Urban Development's definition, episodes separated by a break of fewer than seven days were combined and treated as a single episode.¹⁸

“Hospital visits” include inpatient hospitalizations and ED visits. The categories were not mutually exclusive: Visits in which a person was admitted to the hospital after entering through the ED were included as both an ED visit and an inpatient hospitalization. For inpatient hospital-

izations, analyses used discharge dates for the period before shelter entry and admission dates for the period after shelter exit.

Demographic information came from CARES and included race, ethnicity, age, sex, and shelter type. Shelter type was divided into three categories: families with children (at least one household member younger than age eighteen or pregnant), adult families (at least two members in the household, none pregnant or younger than age eighteen), and single adults (unaccompanied adults). Clinical Classifications Software was used to categorize principal diagnoses in SPARCS.¹⁹

MATCHING PROCEDURES SPARCS records include an enhanced unique personal identifier, which is an amalgamation of portions of a person's Social Security number, first and last names, plus sex and birth date. We created a parallel identifier in CARES. Because SPARCS used enhanced unique personal identifiers rather than complete identifiers, we used deterministic matching procedures to link information from the SPARCS and CARES data sets. Of the 118,651 unique first-time shelter users in the period 2008–15 included in the study, 93,292 (78.6 percent) had any matching record in SPARCS.

ANALYSES We examined the timing of hospital visits relative to the onset and conclusion of shelter episodes. Variables of interest included the proportion of adults who had an ED visit or inpatient hospitalization in the year before the beginning of a shelter episode or the year following the end of one. Rates were calculated separately by race, sex, ethnicity, age, shelter type, and year of shelter entry or exit. We used chi-square tests to examine bivariate associations and logistic regression to examine multivariable associations. Temporal trends were visually represented in graphs that depicted rates of ED visits and hospitalizations in the year preceding shelter entry and those following shelter exit.

Analyses were conducted using Oracle SQL Developer and SAS, version 10.4. The Institutional Review Board of CIDI and the Data Protection Review Board of SPARCS approved the study.

LIMITATIONS The study had several limitations. First, SPARCS includes information only on hospitals in New York State, which is a consideration since some people's entry to New York City shelters might be precipitated in part by moves from other states. However, the DHS reported that only a small minority of people entering city shelters come from out of state,¹⁷ so this is unlikely to have substantially influenced our results. And while SPARCS excludes VHA hospitals, veterans account for a very small proportion

Our study suggests the importance of screening hospital patients for housing instability.

of the city's shelter population.¹⁷

Second, CARES includes only homeless shelters in the city that are operated by or otherwise under the DHS's purview. This captures around 90 percent of the city's shelter beds.

Third, SPARCS excludes records that indicate an HIV/AIDS diagnosis, which likely lowered the rate of homeless adults with matching hospital records.

Fourth, our analysis did not include people who lived exclusively on the streets and did not use shelters. Because of its unique "Right to Shelter" laws, however, New York City has very low rates of unsheltered homelessness (around 4 percent), compared to other cities.¹⁷ It is likely that people who stay exclusively on the streets have even higher rates of hospital use than we observed in this study.

Fifth, because ours was an administrative data study, we were limited to examining individual characteristics that were captured in existing databases.

Sixth, race had a high rate of "don't know or refused to answer" responses before 2012. While we imputed race from a subsequent later shelter stay if one existed, our ability to detect differences by race may still have been affected.

Study Results

Of the 102,931 adults who had a first-time shelter entry in 2009–15, 38.0 percent had an ED visit, 15.7 percent had an inpatient hospitalization, and 39.3 percent had either an ED visit or a hospitalization in the year before shelter entry. Of the 97,931 adults who exited shelter in 2008–14, 41.9 percent had an ED visit, 17.0 percent had an inpatient hospitalization, and 43.3 percent had either an ED visit or a hospitalization in the following year.

HOSPITAL VISIT TIMING IN RELATION TO SHELTER ENTRY AND EXIT Rates of hospital use per 1,000 adult shelter entrants rose very little from one year to six months before shelter entry (from 2.53 ED visits and 0.61 hospitalizations per

1,000 entrants on day 365 to 2.72 visits and 0.67 hospitalizations on day 182 before shelter entry (exhibit 1). The rates accelerated over the next six months, reaching 7.6 ED visits and 1.9 inpatient hospitalizations per 1,000 entrants at one week before shelter entry and peaking on the day of shelter entry (28.1 ED visits and 15.4 hospitalizations per 1,000 entrants). ED use increased somewhat more gradually compared to hospitalizations, for which the increase was concentrated in the few days prior to shelter entry. These trends were especially pronounced among single adults and members of adult families, while among adults in families with children, ED use increased more gradually over the year preceding shelter entry and inpatient hospitalization rates were steady through the year (subgroup analyses not shown).

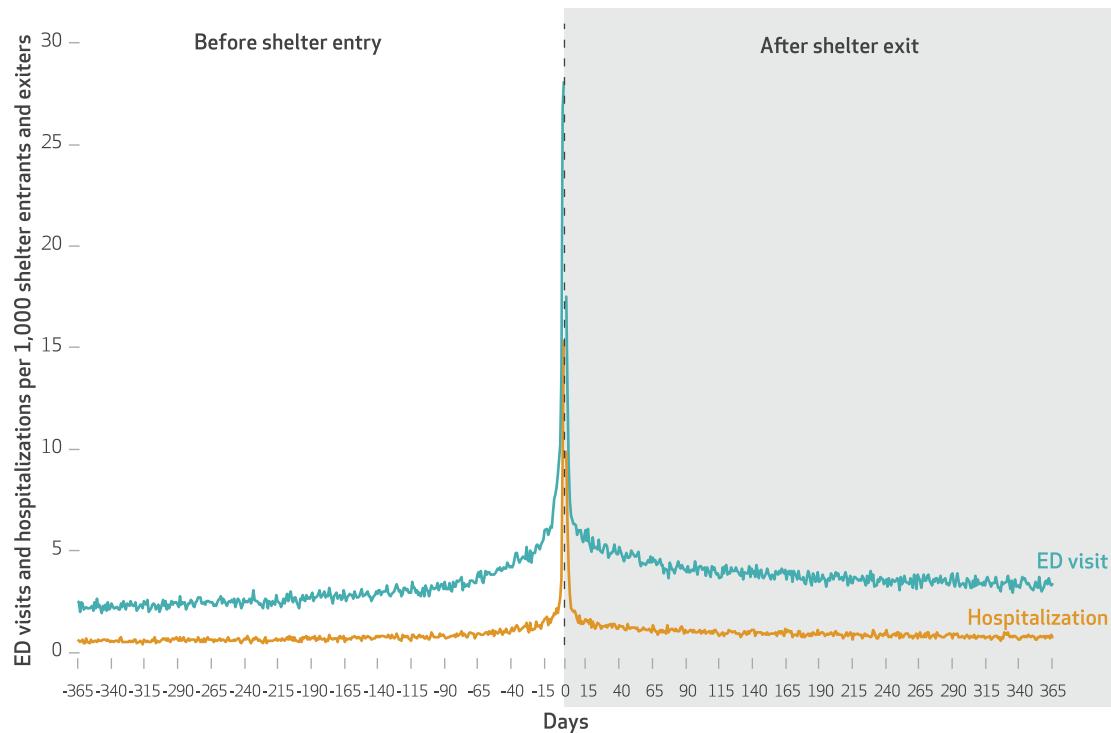
A similar trend was seen following shelter exit. ED visits and inpatient hospitalizations were highest on the day of shelter exit (17.5 and 9.9 per 1,000 exiters, respectively) (exhibit 1). Rates declined rapidly through one week following shelter exit (reaching 6.3 ED visits and 1.9 inpatient hospitalizations per 1,000 exiters at sev-

en days), and by six months, rates had leveled off (3.9 ED visits and 0.8 inpatient hospitalizations per 1,000 exiters). While both ED use and hospitalizations decreased precipitously within a week of shelter exit, ED visits decreased more gradually over time than hospitalizations. Again, these trends were most notable for users of single adult and adult family shelters, compared to adults in families with children (subgroup analyses not shown).

CHARACTERISTICS ASSOCIATED WITH HOSPITAL VISITS AMONG SHELTER USERS Being female, white, and non-Hispanic were positively associated with ED use and inpatient hospitalization in the year before shelter entry (exhibits 2 and 3). Adults in families with children were less likely to have used the ED than those that used shelters for single adults. Increasing age was associated with higher odds of inpatient hospitalization. Generally similar results were found for hospital use in the year following shelter exit. Female and white shelter exiters were more likely than others to have ED visits and inpatient hospitalizations. Young adults were more likely to have ED visits. Users of shelters for single adults, non-

EXHIBIT 1

Emergency department (ED) visits and inpatient hospitalizations before shelter entry among shelter entrants and following shelter exit of shelter exiters in New York City, 2008-15



SOURCE Authors' analysis of linked data for 2008-15 from the New York State Statewide Planning and Research Cooperative System (SPARCS) and the New York City Department of Homeless Services Client Assistance and Rehousing Enterprise System (CARES).

NOTES Hospitalization data for the period before shelter entry are based on the date of hospital discharge, while data for the period after shelter exit are based on the date of hospital admission. Day 0 represents the date of shelter entry.

EXHIBIT 2

Demographic characteristics of people who used the emergency department (ED) or had an inpatient hospitalization in the year before entering and the year after exiting a shelter

Characteristic	Year before shelter entry (n = 102,931)				Year after shelter exit (n = 97,931)			
	Had ED visit		Had hospitalization		Had ED visit		Had hospitalization	
	No (n = 63,809)	Yes (n = 39,122)	No (n = 86,797)	Yes (n = 16,134)	No (n = 56,897)	Yes (n = 41,034)	No (n = 81,314)	Yes (n = 16,617)
All	62.0%	38.0%	84.3%	15.7%	58.1%	41.9%	83.0%	17.0%
Shelter type								
Families with children	29.0	29.8	29.9	25.9	30.8	28.6	31.0	24.3
Adult families	7.6	8.2	8.1	6.6	7.5	8.6	8.1	7.4
Single adults	63.4	62.1	62.1	67.5	61.7	62.9	60.9	68.4
Sex								
Male	58.6	50.0	55.7	53.0	57.3	51.8	55.2	53.5
Female	41.4	50.0	44.3	47.0	42.7	48.2	44.8	46.5
Race								
White	19.6	22.2	19.5	26.5	17.2	19.5	17.0	23.9
Black	54.1	53.3	54.9	47.7	51.7	52.3	52.9	47.4
Other	5.5	5.1	5.3	5.5	5.1	4.5	4.9	4.7
Don't know or refused to answer	20.9	19.4	20.3	20.3	26.1	23.7	25.3	24.0
Ethnicity								
Hispanic	34.3	32.6	34.0	31.7	34.7	33.3	34.6	31.7
Not Hispanic	52.8	54.9	53.4	54.7	52.3	54.0	52.6	54.9
Don't know or refused to answer	13.0	12.5	12.7	13.5	13.0	12.7	12.8	13.4
Age (years)								
18–25	27.8	30.2	29.5	24.3	28.5	31.8	30.6	26.4
26–35	27.1	24.7	27.0	22.2	27.2	24.3	26.7	22.5
36–45	19.2	17.0	18.4	18.1	19.5	18.3	19.0	19.0
46–55	15.8	16.9	15.4	20.6	15.5	16.4	15.2	19.2
56–65	7.5	8.5	7.3	11.1	7.1	7.1	6.6	9.7
66 or more	2.5	2.6	2.3	3.6	2.2	2.0	2.0	3.2

SOURCE Authors' analysis of linked data for 2008–15 from the New York State Statewide Planning and Research Cooperative System (SPARCS) and the New York City Department of Homeless Services Client Assistance and Rehousing Enterprise System (CARES). **NOTES** All between-group comparisons of ED visits and inpatient hospitalizations, before shelter entry and after shelter exit, were significant ($p < 0.001$). Shelter types are explained in more detail in the text.

Hispanics, and older adults had higher odds of inpatient hospitalizations.

HOSPITAL VISIT DIAGNOSES Alcohol-related disorders, mood disorders, drug-related disorders, and schizophrenia and other psychotic disorders were consistently among the five most frequent principal diagnoses for ED visits and hospitalizations (exhibit 4). These diagnoses were particularly concentrated in the week before shelter entry and the week after shelter exit and in adults who used single adult and adult family shelters, while pregnancy or childbirth-related complications were more common reasons for hospital use among adults in shelters for families with children (see online appendix exhibits A1 and A2).²⁰ Our data also suggest that newly homeless adults use hospitals for a wide variety of reasons: The top five diagnosis categories accounted for fewer than half of principal

diagnoses for nearly all categories of hospital use.

Discussion

Whereas past research has shown that people who are homeless tend to be high users of hospitals, we demonstrated temporal spikes in ED visits and hospitalizations before and after first-time shelter episodes. The ED use rate of 38 percent in the year before shelter entry in our study was similar to that observed in an older study of 445 New York City homeless shelter entrants, in which 34 percent reported having had an ED visit within the past year.⁶ These rates are higher than the 26.7 percent of the general city population who reported past-year ED use.²¹ We found that ED use was particularly concentrated immediately preceding shelter entry, which is consistent

EXHIBIT 3
Factors associated with emergency department (ED) visits and inpatient hospitalizations in the year before entering and the year after exiting a shelter

Factor	Year before shelter entry		Year after shelter exit	
	ED visit	Hospitalization	ED visit	Hospitalization
Age (years) (ref: 18–25)				
26–35	0.86**	0.98	0.82**	0.96
36–45	0.84**	1.16**	0.83**	1.10**
46–55	1.01	1.56**	0.92**	1.34**
56–65	1.04	1.73**	0.86**	1.52**
66 or more	0.97	1.72**	0.78**	1.68**
Sex (ref: male)				
Female	1.54**	1.33**	1.41**	1.35**
Race (ref: white)				
Black	0.82**	0.61**	0.88**	0.62**
Other	0.77**	0.73**	0.75**	0.67**
Don't know or refused to answer	0.86**	0.82**	0.78**	0.70**
Ethnicity (ref: not Hispanic)				
Hispanic	0.90**	0.80**	1.02	0.85**
Don't know or refused to answer	0.96	0.95	0.93**	0.87**
Shelter type (ref: single adults)				
Families with children	0.91**	0.88**	0.74**	0.70**
Adult families	1.01	0.75**	0.99	0.76**
Shelter entry year (ref: 2009)				
2010	0.98	0.92**		
2011	1.01	0.89**		
2012	1.12**	1.05		
2013	1.13**	1.00		
2014	1.22**	1.04		
2015	1.15**	1.00		
Shelter exit year (ref: 2008)				
2009			1.01	0.89**
2010			0.97	0.82**
2011			0.94**	0.78**
2012			0.98	0.81**
2013			0.95	0.78**
2014			1.06	0.84**

SOURCE Authors' analysis of linked data for 2008–15 from the New York State Statewide Planning and Research Cooperative System (SPARCS) and the New York City Department of Homeless Services Client Assistance and Rehousing Enterprise System (CARES).

NOTES The exhibit shows odds ratios from multivariable models. Some cells are blank because results before shelter entry do not pertain to the period after shelter exit, and vice versa. Shelter types are explained in more detail in the text. Sample sizes are in exhibit 2. ** $p < 0.05$

with research showing that eviction and other forms of housing instability short of literal homelessness are associated with worse health and more hospital visits.^{22–25}

Our study expands on the sparse research on hospital use immediately preceding shelter entry. We corroborated results of the research by Adi Gundlapalli and colleagues that showed bumps in health services use thirty days before recognition of homelessness at VHA facilities.¹¹ By including all shelter entrants, ED visits, and diagnoses, we also expanded upon a New York City study, using 1997 data, that found that 18.2 percent of first-time single-adult shelter entrants had been discharged from a hospital within ninety days of entering the shelter.⁷ Finally,

our study corroborated the results of Robin Clark and colleagues' recent examination of Medicaid records of homeless families in Massachusetts,¹² while adding additional homeless subpopulations. In another recent Massachusetts study, researchers found an independent association of homelessness and pregnancy complications.²⁶ Our finding that pregnancy complications were among the top diagnoses for hospital visits before and after shelter use for members of homeless families (results shown in the online appendix)²⁰ adds impetus for further study and action around this issue.

Findings from this research will be shared with New York City health and human services agencies through efforts led by CIDI. Early conversa-

EXHIBIT 4

Top five principal diagnoses for emergency department (ED) visits and inpatient hospitalizations in the year and week before entering and after exiting a shelter

Diagnosis	Percent of visits							
	Year before shelter entry		Week before shelter entry		Year after shelter exit		Week after shelter exit	
	ED visit	Hospitalization	ED visit	Hospitalization	ED visit	Hospitalization	ED visit	Hospitalization
Alcohol-related disorders	8.3	12.2	8.9	11.4	9.3	13.3	9.9	13.4
Schizophrenia and other psychotic disorders	3.8	9.5	8.3	18.2	4.1	10.6	9.0	18.7
Mood disorders	5.0	10.5	9.2	17.2	4.6	9.8	9.1	16.2
Drug-related disorders	4.4	13.9	7.0	14.3	4.4	13.3	6.4	16.2
Spondylosis, intervertebral disc disorders, or other back problems			3.1		3.2		2.9	
Nonspecific chest pain		2.8		2.5		2.7		
Other complications of pregnancy	3.9							
Diabetes mellitus with complications							2.1	

SOURCE Authors' analysis of linked data for 2008–15 from the New York State Statewide Planning and Research Cooperative System (SPARCS) and the New York City Department of Homeless Services Client Assistance and Rehousing Enterprise System (CARES). **NOTES** Percentages are provided only for the five most frequent principal diagnoses in each category. A blank cell means that the diagnosis was not among the five most frequent principal diagnoses for that time period and visit type. Diagnosis categories are as used by the Healthcare Cost and Utilization Project (HCUP) unless otherwise noted. HCUP refers to drug-related diagnoses as "substance-related disorders"; we use "drug-related disorders" throughout the text to more clearly distinguish them from "alcohol-related disorders." "Other complications of pregnancy" refers to any diagnosis related to pregnancy not specifically indicated by another HCUP Clinical Classifications Software code.

tions have already suggested additional analyses to help further identify programmatic needs related to health care and homelessness in the city. More broadly, however, our findings have several practical implications that are relevant beyond New York City. First, hospital use preceding homelessness presents an opportunity for interventions to prevent homelessness. Prevention is increasingly seen as an important strategy for reducing homelessness, but challenges remain in targeting resources to those with the greatest need.^{17,27,28} EDs may be promising locations for homelessness risk screening and connection to prevention and rapid rehousing services. Studies have found that ED patients have high levels of housing instability.²⁹ Furthermore, a survey of homeless people in Pennsylvania found that 23.5 percent went to an ED as a "first stop" site soon after becoming homeless.⁵ Consistent with prior literature on risk factors for homelessness, the results of our study suggest that potentially high-risk groups whose members could be targeted for prevention interventions include pregnant women and patients presenting for alcohol- or drug-related diagnoses or mental health diagnoses.^{30–32}

Second, our findings, taken with previous research, suggest that hospitals can do more to prevent discharges into homelessness. Some patients may enter the hospital already unstably housed, and then hospitalization precipitates frank homelessness. For example, a patient liv-

ing doubled up in a fourth-floor walk-up apartment with family members may no longer be able to live there after a surgery. Medical bills and the inability to work while hospitalized and sick can precipitate eviction. In some cases, patients' hospital care teams may be unaware of their patients' housing instability because they do not routinely ask about housing. Our study suggests the importance of screening hospital patients for housing instability. Unstably housed patients could be connected with existing homelessness prevention and other social services while they are in the hospital, to ensure that they do not become frankly homeless after discharge.

For patients who have already lost their housing, hospitals often struggle with a lack of adequate options for discharge.³ Experts have observed that shelters are used "as *de facto* aftercare facilities for a set of public institutional systems," reflecting "inadequacy in the discharge planning process of systems providing institutional care."^{7(p29,35)} Medical respite programs are one evidence-based alternative to hospital discharge to a homeless shelter, and in the best cases, such programs can help connect patients with permanent housing solutions.³³ Some hospitals have developed relationships with providers of permanent supportive housing—in some cases, funding such housing themselves.³⁴ Hospitals could also explore connecting with rapid rehousing programs. One effective model is the Department of Veterans Affairs' Support-

Hospital use preceding homelessness presents an opportunity for interventions to prevent homelessness.

ive Services for Veteran Families program. In cases in which discharge to a homeless shelter cannot be avoided, hospitals should ensure that such discharges are coordinated and appropriate to the patient's condition. New York City's DHS has policies for hospital discharge to the shelter system, including a referral form that outlines medical exclusions to shelter placement.³⁵ Elsewhere, Gov. Jerry Brown recently signed legislation in California that outlines basic requirements for the hospital discharge of homeless patients to shelters.³⁶ As with any discharge, hospitals should also take steps to ensure that patients have access to appropriate and accessible outpatient follow-up care.

Critical time intervention (CTI)—which provides time-limited support to people who transition from institutional settings to the community—is one model that has been used successfully to prevent homelessness after institutional discharge for people with serious mental illness.³⁷ The prominence of psychiatric diagnoses among inpatient hospital discharges for single adults and adult families found in our study suggests the potential need for more CTI. While CTI was originally developed to meet the needs of people with mental illness, our findings suggest the potential benefit of CTI-like interventions for high-risk people after substance use-related and medical hospitalizations.

To our knowledge, no prior studies have examined hospital use after shelter exit. Our study identified the days immediately after shelter exit as a period of higher-than-average hospital use. This finding may have multiple explanations. Moving into and out of shelter is often accompanied by geographic moves, which disrupt any existing health care relationships. New solutions may be needed to foster continuity of care for people experiencing homelessness. Alternatively, in the absence of being in shelter, people may seek an alternative form of “housing” via the hospital. While homelessness itself did not

emerge as a top diagnosis in our analyses, providers may be unaware of housing-related diagnosis codes or feel compelled to code other diagnoses for billing reasons. In addition, housing might not have been the primary problem in the minds of patients themselves. The finding that mental health and substance use diagnoses were disproportionately represented in the week following shelter exit could suggest that the stress of leaving shelter triggers mental health crises and substance use. Conversely, it is possible that the reason for shelter exit was related to substance use or a mental health event requiring hospital admission. While some people exit shelter to their own housing or to live with friends or family, a minority exit to live on the streets or are required to leave for not complying with shelter rules. This group may be at particularly high risk of subsequent hospital use. Analyzing hospital use by type of shelter exit was not within the scope of this study. However, our findings indicate that the period immediately after shelter exit may be a time of continued risk and instability, when people need enhanced support. Future research could examine which shelter exiters need only low-touch case management (or no case management) and which need more intensive supports to prevent hospital use and other negative outcomes.

In sum, our findings suggest the interdependence of the health care and homeless services sectors and the need for closer collaboration between these oft-siloed systems. Cross-system data linkage and analysis such as that performed for the current study can provide an impetus for discussion between the sectors, as it reveals a shared population of concern and provides a shared knowledge base to facilitate collaborative discussions. Future research—particularly qualitative research that includes interviews with leaders from the two sectors—could help identify barriers to and facilitators of meaningful collaboration. Other research that examines various subgroups of homeless people in more depth could enhance our understanding of related health and housing vulnerabilities and help refine potential interventions.

Conclusion

The days and weeks immediately before homeless shelter entry and after shelter exit represent vulnerable periods in which people make high use of hospital-based health care. Our findings highlight the necessity of collaboration between homeless services and health care systems to best address the needs of their shared client-patient population. ■

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NOTES

- 1 Hibbs JR, Benner L, Klugman L, Spencer R, Macchia I, Mellinger A, et al. Mortality in a cohort of homeless adults in Philadelphia. *N Engl J Med.* 1994;331(5):304–9.
- 2 Baggett TP, Hwang SW, O'Connell JJ, Porneala BC, Stringfellow EJ, Orav EJ, et al. Mortality among homeless adults in Boston: shifts in causes of death over a 15-year period. *JAMA Intern Med.* 2013;173(3):189–95.
- 3 Doran KM, Ragins KT, Iacomacci AL, Cunningham A, Jubanyik KJ, Jenq GY. The revolving hospital door: hospital readmissions among patients who are homeless. *Med Care.* 2013;51(9):767–73.
- 4 Kushel MB, Perry S, Bangsberg D, Clark R, Moss AR. Emergency department use among the homeless and marginally housed: results from a community-based study. *Am J Public Health.* 2002;92(5):778–84.
- 5 O'Toole TP, Conde-Martel A, Gibbon JL, Hanusa BH, Freyder PJ, Fine MJ. Where do people go when they first become homeless? A survey of homeless adults in the USA. *Health Soc Care Community.* 2007;15(5):446–53.
- 6 Schanzer B, Dominguez B, Shrout PE, Caton CL. Homelessness, health status, and health care use. *Am J Public Health.* 2007;97(3):464–9.
- 7 Metraux S, Byrne T, Culhane DP. Institutional discharges and subsequent shelter use among unaccompanied adults in New York City. *J Community Psychol.* 2010;38(1):28–38.
- 8 Vickery KD, Bodurtha P, Winkelmann TNA, Hougham C, Owen R, Legler MS, et al. Cross-sector service use among high health care utilizers in Minnesota after Medicaid expansion. *Health Aff (Millwood).* 2018;37(1):62–9.
- 9 Culhane DP, Avery JM, Hadley TR. The treated prevalence of mental health and substance use disorders among adults admitted to the Philadelphia shelter system: results from the integration of longitudinal data on shelter and mental health services utilization [Internet]. Philadelphia (PA): University of Pennsylvania; 1996 [cited 2019 May 24]. Available for download from: http://works.bepress.com/dennis_culhane/55
- 10 Spellman B, Khadduri J, Sokol B, Leopold J (Abt Associates). Costs associated with first-time homelessness for families and individuals [Internet]. Washington (DC): Department of Housing and Urban Development; 2010 Mar [cited 2019 May 24]. Available from: https://www.huduser.gov/portal//publications/pdf/Costs_Homeless.pdf
- 11 Gundlapalli AV, Redd A, Carter ME, Palmer M, Peterson R, Samore MH. Exploring patterns in resource utilization prior to the formal identification of homelessness in recently returned veterans. *Stud Health Technol Inform.* 2014;202:265–8.
- 12 Clark RE, Weinreb L, Flahive JM, Seifert RW. Health care utilization and expenditures of homeless family members before and after emergency housing. *Am J Public Health.* 2018;108(6):808–14.
- 13 Spillman BC, Blumenthal P, Lallemand N, Leopold J, Allen EH, Hayes E. Housing and delivery system reform collaborations: environmental scan [Internet]. Washington (DC): Urban Institute; 2016 Apr [cited 2019 May 24]. Available from: https://www.urban.org/sites/default/files/publication/89576/hh_environmental_scan_final.pdf
- 14 Health Research and Educational Trust. Housing and the role of hospitals [Internet]. Chicago (IL): HRET; 2017 Aug [cited 2019 May 24]. (Social Determinants of Health Series). Available from: <https://www.aha.org/system/files/hpoe/Reports-HPOE/2017/housing-role-of-hospitals.pdf>
- 15 New York State Department of Health. Statewide Planning and Research Cooperative System (SPARCS) [Internet]. Albany (NY): The Department; [revised 2018 May; cited 2019 May 24]. Available from: <https://www.health.ny.gov/statistics/spars/>
- 16 Wong Y-LI, Culhane DP, Kuhn R. Predictors of exit and reentry among family shelter users in New York City [Internet]. Philadelphia (PA): University of Pennsylvania; 1997 Sep [cited 2019 May 24]. Available from: https://repository.upenn.edu/cgi/viewcontent.cgi?article=1089&context=spp_papers
- 17 City of New York. Turning the tide on homelessness in New York City [Internet]. New York (NY): Department of Homeless Services; 2017 [cited 2019 Jun 17]. Available from: <https://www1.nyc.gov/assets/dhs/downloads/pdf/turning-the-tide-on-homelessness.pdf>
- 18 Housing and Urban Development: regulations relating to housing and urban development, definitions,

24 C.F.R. Sect. 578.3 (2015).

19 Healthcare Cost and Utilization Project. Clinical Classifications Software (CCS) for ICD-9-CM [Internet]. Rockville (MD): Agency for Healthcare Research and Quality; [last modified 2017 Mar 6; cited 2019 May 24]. Available from: <https://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp>

20 To access the appendix, click on the Details tab of the article online.

21 New York City Department of Health and Mental Hygiene. Community Health Survey 2004, public use data codebook [Internet]. New York (NY): The Department; [cited 2019 Jun 17]. Available from: <https://www1.nyc.gov/assets/doh/downloads/pdf/episrv/chs2004-codebook.pdf>

22 Kennedy MC, Kerr T, McNeil R, Parashar S, Montaner J, Wood E, et al. Residential eviction and risk of detectable plasma HIV-1 RNA viral load among HIV-positive people who use drugs. *AIDS Behav.* 2017;21(3):678–87.

23 Berkowitz SA, Kalkhoran S, Edwards ST, Essien UR, Baggett TP. Unstable housing and diabetes-related emergency department visits and hospitalization: a nationally representative study of safety-net clinic patients. *Diabetes Care.* 2018;41(5):933–9.

24 Lim S, Chan PY, Walters S, Culp G, Huynh M, Gould LH. Impact of residential displacement on healthcare access and mental health among original residents of gentrifying neighborhoods in New York City. *PLoS One.* 2017;12(12):e0190139.

25 Sandel M, Sheward R, Ettinger de Cuba S, Coleman SM, Frank DA, Chilton M, et al. Unstable housing and caregiver and child health in renter families. *Pediatrics.* 2018;141(2):e20172199.

26 Clark RE, Weinreb L, Flahive JM, Seifert RW. Homelessness contributes to pregnancy complications. *Health Aff (Millwood).* 2019;38(1):139–46.

27 Culhane DP, Metraux S, Byrne T. A prevention-centered approach to homelessness assistance: a paradigm shift? *Hous Policy Debate.* 2011;21(2):295–315.

28 Shinn M, Greer AL, Bainbridge J, Kwon J, Zuiderveen S. Efficient targeting of homelessness prevention services for families. *Am J Public Health.* 2013;103(Suppl 2):S324–30.

29 Malecha PW, Williams JH, Kunzler NM, Goldfrank LR, Alter HJ, Doran KM. Material needs of emergency department patients: a systematic review. *Acad Emerg Med.* 2018;25(3):330–59.

30 Shinn M, Weitzman BC, Stojanovic D, Knickman JR, Jiménez L, Duchon L, et al. Predictors of homelessness among families in New York City: from shelter request to housing stability. *Am J Public Health.* 1998;88(11):1651–7.

31 Thompson RG Jr, Wall MM, Greenstein E, Grant BF, Hasin DS. Substance-use disorders and poverty as prospective predictors of first-time homelessness in the United States. *Am J Public Health.* 2013;103(Suppl 2):S282–8.

32 Curtis MA, Corman H, Noonan K, Reichman NE. Life shocks and homelessness. *Demography.* 2013;50(6):2227–53.

33 Doran KM, Ragins KT, Gross CP, Zerger S. Medical respite programs for homeless patients: a systematic review. *J Health Care Poor Under-served.* 2013;24(2):499–524.

34 Bryan M. ER use goes down as hospital program pays homeless people's rent. *NPR Morning Edition* [serial on the Internet]. 2018 Jan 30 [cited 2019 May 24]. Available from: <https://www.npr.org/2018/01/30/581778796/er-use-goes-down-as-hospital-program-pays-homeless-peoples-rent>

35 New York City Department of Homeless Services. HCF-DHS referral form, screening tool for referral from health care facilities: single adult [Internet]. New York (NY): The Department; [cited 2019 Jun 17]. Available from: <https://www1.nyc.gov/assets/dhs/downloads/pdf/DHS-Institutional-Referral-Form.pdf>

36 Bean M. California law to regulate homeless patient discharges: 5 things to know. Becker's Healthcare Hospital Review [serial on the Internet]. 2018 Oct 9 [cited 2019 May 24]. Available from: <https://www.beckershospitalreview.com/quality/california-law-to-regulate-homeless-patient-discharges-5-things-to-know.html>

37 Herman D, Conover S, Felix A, Nakagawa A, Mills D. Critical time intervention: an empirically supported model for preventing homelessness in high risk groups. *J Prim Prev.* 2007;28(3–4):295–312.