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ORIGINAL PAPER

CHARACTERIZING MULTISYSTEM HIGH USERS OF THE HOMELESS SERVICES, JAIL, AND HOSPITAL SYSTEMS IN CHICAGO, ILLINOIS

Jackie Soo, ScD
Leoson Hoay, MA
Benjamin MacCormack-Gelles, MS
Sara Edelstein, MPP
Emily Metz, MPP
David Meltzer, MD, PhD
Harold A. Pollack, PhD

Background. This study investigated the demographic characteristics, service use patterns, and needs of people who were high users of the homeless services, Cook County Jail, or hospital systems in Chicago, Illinois.

Methods. Definitions of “high users” in each system were based on number of stays and days. K-means cluster analysis was performed on the subset of individuals who interacted with all three systems and were high users of at least one system.

Results. Cluster analysis was conducted on 1,232 individuals and revealed three profiles. The largest cluster (N=1,059; 86%) consisted of older single individuals exhibiting high rates of disabling conditions and health issues. A second cluster (N=124; 10%) distinguished a particularly vulnerable subgroup with the highest rates of medical and mental health needs. The final, smallest cluster (N=49; 4%) consisted of predominantly younger Black women with children who exhibited the lowest rates of behavioral health issues, but high hospital use.

Key words: Chicago, homeless people, jails, hospitals, demography, public health systems research, facilities and services utilization.

Access to permanent housing, financial security, and quality health care are foundational for leading a healthy and fulfilling life. For many individuals, lack of stability in such dimensions of life correspondingly promotes repeated cycles of service use between the homelessness, criminal justice, and hospital systems.

Prior studies document the co-occurrence of incarceration, homelessness, and unmet health needs—in particular, mental health needs.^{1,2,3} High health care utilizers, defined as having at least four emergency department (ED) visits or at least three inpatient hospital stays per 12-month period were five times more likely to experience homelessness, and two times more likely to have an interaction with the criminal justice system than those who used health care less frequently.⁴ Individuals who experienced both homelessness and incarceration displayed increased prevalence of mental illness compared with those who experienced either homelessness or incarceration. People who were homeless prior to admission to the criminal legal system were more likely to report symptoms of mania, depression, psychosis, and substance use disorder, as well as use of mental health services or medications for mental illness, compared with people admitted to the criminal legal system who had not been previously homeless.⁵ Homelessness and mental illness also exacerbate negative outcomes once a person becomes involved in the criminal legal system.⁶ People in jail with prior histories of homelessness and co-occurring mental and substance use disorders were held longer than those charged with similar crimes but without prior histories of these experiences.⁷

Considering these documented patterns that affect both individual and societal well-being, this study sought to learn more about the characteristics and specific needs of people who cycle at comparatively high rates between multiple systems in the City of Chicago. Chicago has a sizeable homeless population (estimated at 76,998 as of 2018) and Cook County Jail

(CCJ) is the nation's largest single-site jail, which houses a substantial proportion of individuals experiencing mental illness.⁹

This study sought to identify and describe individuals who had interacted with the city's homeless services, criminal justice, and hospital systems between January 1, 2014 and December 31, 2017. Four years of data allowed us to detect extensive cross-system use that might be missed within a shorter time window. This study distinguished individuals who were considered high users of these three systems, compared with the average homeless person, detained individual, or hospital patient. To further examine a population that illustrated both breadth (interaction with all three systems) and depth (sustained system use), we focused on a subsample who had engaged with each of the three systems at least once over the study period, and who were considered high users of at least one of the systems. We call this group "multisystem high users" (MHUs), and we examined their demographic characteristics and service use patterns.

Finally, this study created a typology of typical profiles within the MHU subgroup. This information may help organizations identify new approaches, improve existing services, and expand capabilities to serve clients, patients, and detainees with specific needs and vulnerabilities.

Previous research has uncovered subgroups of high users, but most studies have characterized clusters only by patterns of service use.^{10,11,12} This study extends prior research by also focusing on characteristics—including proxies for behavioral health challenges, family status, types of criminal charges, and age—that can help providers identify the most beneficial types of care. There is evidence that homeless individuals may be more likely to commit—or be arrested and charged with—misdemeanors¹³ or other non-violent survival and property crimes,⁵

when compared with individuals who have not experienced homelessness. Corroboration of these findings may thus have implications for which individuals to target for services upon leaving jail. Furthermore, as people within families are an important subgroup for housing prioritization in Chicago's homeless services sector,¹⁴ we sought to identify the number of families in this population.

High users of the homeless services, jail, and hospital systems account for disproportionate behavioral health costs and percentage of nights spent in such institutions.^{15,16} By more specifically characterizing this population in Chicago, this study seeks to identify their unmet needs and potential interventions to interrupt repeated multi-system use and provide focused resources to mitigate barriers and address disparities that affect this population, and to support and sustain it.

Methods

Data sources. We linked administrative records from Chicago's homeless services system, CCJ, and hospitals to identify people cycling in and out of these three settings over a four-year period from January 1, 2014 to December 31, 2017. Individuals were included in the sample if they had at least one homeless services encounter, jail detention, or hospital stay within the study period.

Homeless services data. The U.S. Department of Housing and Urban Development requires that each metropolitan area use a standardized Homeless Management Information System (HMIS) to collect and organize data regarding people who experience homelessness and the housing and services that they receive. Since 2012, Chicago's HMIS database has been

administered by All Chicago, encompassing homeless services data from more than 100 partner agencies.

Data were available on number of contact instances with the homelessness system, length of time in emergency shelter or transitional housing, and length of time engaged with service organizations providing outreach to people living on the streets. Information was also available regarding individuals' ability to access permanent housing within Chicago's homeless services system and how long they were able to stay housed.

In addition, upon every encounter with homeless service providers, individuals are surveyed regarding their homeless history and service needs. Individuals self-report whether they have been diagnosed with a disabling condition (such as substance use disorder, serious mental illness, developmental or intellectual disability, or chronic physical illness), are fleeing domestic violence, are currently receiving income from various sources, or are currently receiving non-cash benefits (such as from the Supplemental Nutrition Assistance Program). People are also flagged if they access homeless services as part of a family, and if they are with children under 18 years old.

Cook County Jail data. Cook County Jail booking data were obtained through administrative records maintained by the Cook County Sheriff's Office. Data were available on the number and length of detentions in CCJ, as well as specific charges associated with each detention. In consultation with CCJ, charge data were cleaned and then aggregated into 32 distinct charge categories.

Cook County Jail detainees receive additional services and care if they have an operational "alert" designating specific medical or behavioral health needs. While an alert does not serve as a formal medical or mental health diagnosis, it does reflect an observed or self-

reported need for various services or placements for that person's care. Medical needs are designated by M-alerts, and psychological needs are designated by P-alerts. M- and P-alerts include numerical ratings ranging from 2–4, with higher ratings indicating more intensive need. For example, a P2 alert indicates a mental health need such as requiring access to prescription medication, while P4 indicates need for an institutional level of mental health care. If a person requires detox services upon entry to the jail, s/he receives a detox alert (D-alert).

Hospital data. Data on hospital stays were obtained from Illinois Department of Public Health (IDPH) administrative records. These data include number and length of ED and inpatient stays and causes of stays as indicated by International Classification of Diseases codes (ICD-9 and ICD-10 codes). The Chronic Condition Indicator developed by the Agency for Healthcare Research and Quality¹⁷ was used to categorize reasons for hospital visits into chronic or non-chronic conditions. These reasons were then further categorized into body system indicators corresponding to the ICD code chapters, which include categories such as "mental disorders" and "diseases of the respiratory system."

Due to the large volume of annual hospital admissions, we were unable to obtain data on all individuals who had ever accessed hospitals in Chicago over the study period. Instead, IDPH provided hospital records for all individuals who also accessed homeless services or who were detained in CCJ, or who IDPH considered to be an annual high hospital user (defined by at least seven ED visits in a single calendar year). The implication of analyzing this more limited population is that people who only used hospitals during the study period are not included in this analysis.

Matching across data sources. Individual identifiers were retrieved from each system to perform record linkage across the three datasets. To protect privacy and to maintain security

of Personally Identifiable Information and Protected Health Information, a protocol was developed to ensure that no single analyst could view identifiable information in multiple systems and match records across systems. We also sought to anonymize the data to hinder deductive identification of these sensitive data. To anonymize names, we used a one-way cryptographic function to transform original names into a unique sequence of numbers and letters. These sequences were then used to match across systems. Further information on our deidentifying and matching process can be found in Appendix A.

Defining high users of each system. To define high users of each system, we examined individuals' total number of stays and days in homeless service settings (either in emergency shelter or engaged in street outreach), in CCJ, or in hospitals (either in emergency or inpatient settings) over the four-year study period. Working with partners in each system to prioritize what they deemed important and paying particular attention to individuals in the top 5th and 10th percentiles, we established cutoffs to identify those demonstrating high use in each system compared with the average homeless client, detained individual, or hospital patient (Table 1). Further, to capture high use across all three systems which may not manifest as concentrated use of one system, we also considered a person a high user if their service use was above the mean total number of stays or days in all three systems, even if they did not qualify as a high user of any one system.

Table 1. Definitions of high users in each system, as determined by a person’s level of interaction with each system during the four-year study period.

Cook County Jail	Homeless services	Hospitals
<ul style="list-style-type: none"> • ≥4 stays in Cook County Jail, or • ≥3 stays in Cook County Jail, and the total number of days detained across all stays exceeds 365 	<ul style="list-style-type: none"> • ≥5 stays in emergency shelter*, or • ≥3 stays in emergency shelter stays and the total number of days across all stays exceeds 120, or • ≥365 days spent in shelter, regardless of the number of stays, or • ≥365 days engaged in street outreach 	<ul style="list-style-type: none"> • ≥16 ED visits, or • ≥21 days spent in the ED across all visits, or • ≥10 hospital inpatient stays, or • ≥76 days spent in an in-patient setting across all visits
Cross-System High Use		
<ul style="list-style-type: none"> • > than the mean level of use in all three systems, or • ≥2 stays in Cook County Jail or ≥32 days in Cook County Jail, <i>and</i> • ≥2 stays in emergency shelter or ≥18 days in emergency shelter or ≥1 days engaged in street outreach, <i>and</i> • ≥8 combined ED and inpatient hospital visits or ≥13 combined days in ED or inpatient setting 		

* The term “emergency shelter” includes transitional housing but excludes Youth Transitional Housing or Permanent Housing with Short-term Supports.

We considered alternative methods for defining high use – one such method was the Jenks Natural Breaks Optimization (details on our methods and select results available in Appendix B). While this method is useful in identifying extreme high users, our percentile-based definitions more accurately capture the population of greatest concern to local social service providers, and most pertinent for effective services given available resources.

Furthermore, we wanted to capture high users who are not immediately obvious in the dataset and in reality – such as clients who may not be at the extremities of service use in specific systems, but still account for a significant amount of use across all systems. Our final definitions of high use in the homeless services and criminal justice systems align with existing cutoffs set by the U.S. Department of Housing and Urban Development (HUD)¹⁸ and other

municipal programs.¹⁹ For example, the HUD definition for chronic homelessness (qualifying individuals receive prioritized access to services and housing opportunities) includes being homeless continuously for at least 12 months or being homeless on at least 4 separate occasions in the last 3 years, with total spells of at least twelve months.

Prior studies have used a lower boundary of one jail episode or more per year to define frequent offenders.^{20,21} In the case of the hospital system, our cutoffs are higher than levels often set in the existing literature,^{15,22} primarily because our subsample of hospital patients comprised those already determined by IDPH to have high annual use. However, other studies have nevertheless used similar cutoffs to define high health care utilizers, or super health care utilizers: at least four ED visits or at least three inpatient hospital stays per twelve months.^{4,23} Importantly, previous research literature suggests that high users being targeted for interventions should account for at least 25% of total visits to produce a meaningful impact on usage²⁴. In our data, the top 10% of individuals accounted for slightly more than 25% of total ED and inpatient stays.

Analysis. To identify profiles and common characteristics among the MHUs (those who had interacted with all three systems and were a high user of at least one system), we used k-means cluster analysis to differentiate the sample into discrete subgroups. Variables used in the cluster analysis included:

- Age at first system entry during the study period
- Proportion of discrete homeless services interactions in which person was part of a family with children under 18 years old
- Total number of ED stays and total number of inpatient hospital stays

- Number of times individuals were charged with the top four most common charges in this sample (possession of narcotics, retail theft, domestic violence, and trespassing)
- Number of times people were flagged for medical and mental health needs while in CCJ

All variables were standardized into z scores prior to the cluster analysis. The optimal number of clusters was determined by comparing the percent of variance explained across a range of 2-10 clusters, looking for an "elbow" in the scree plot. A scree plot is a plot of the within-cluster sum of squares against the number of clusters. The optimal number of clusters should be where this metric is minimized, and where increasing the number of clusters does not substantially improve the model. In deciding between models explaining comparable amounts of variance, the principle of parsimony was adopted, as well as consideration of cluster interpretability and size. K-means cluster analysis has been used in similar populations experiencing homelessness, jail detention, and hospital use.^{10,25,26} To verify the clusters found and to verify the robustness of our findings, we also performed latent profile analysis (LPA) with the same set of variables, using goodness-of-fit statistics to determine the optimal number of profiles.

Cost estimates. To calculate cost estimates based on system use, we obtained per person, per night estimates of cost for stays in emergency shelter (\$24.57), transitional housing (\$43.66), and the CCJ (\$143.00) from representatives in the respective systems. Estimates of hospital costs were taken from charges provided by individual hospitals for each stay.

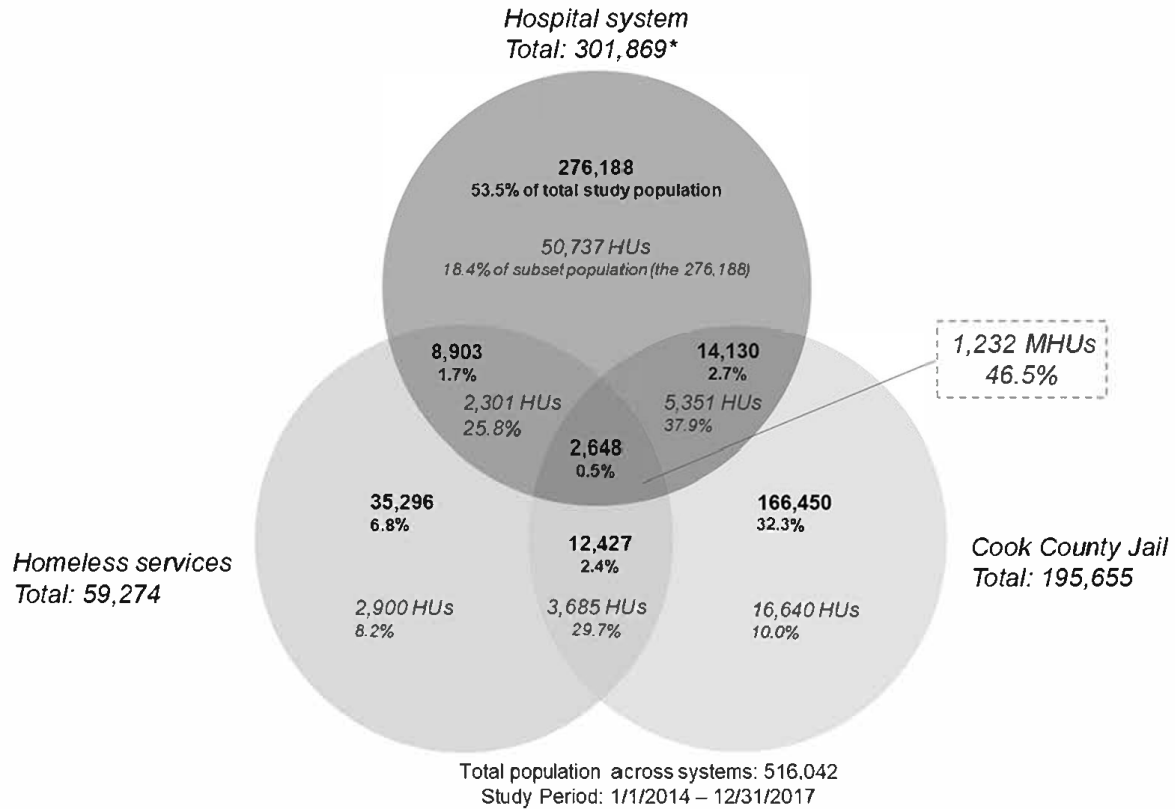
Results

We examined administrative records for 59,274 unique individuals who accessed homeless services in Chicago and 195,655 individuals who were detained in CCJ during the study period. Illinois Department of Public Health shared administrative records for 301,869 individuals who

had interacted with at least one of the other two systems or met their internal definition of a high user of hospital services. In total, the administrative records of 516,042 individuals were examined, comprising those who accessed homeless services, were detained in CCJ, or had at least one ED or inpatient hospital stay during the study period.

Multisystem use. A total of 38,108 people (7.4% of the sample) indicated contacts with at least two of the three systems. A total of 2,648 (0.5%) individuals accessed all three systems (Figure 1). A total of 14,130 individuals had at least one hospital stay and at least one CCJ detention, comprising 4.7% of the total hospital sample and 7.2% of the total jail sample. A total of 12,427 people accessed homeless services and had at least one CCJ detention (21.0% of the total homelessness services sample, and 6.4% of the total jail sample); and 8,903 people accessed homeless services and had at least one hospital stay (15.0% of the total homelessness services sample and 2.9% of the total hospital sample).

Figure 1. Numbers of individuals interacting with the homeless services, CCJ, and hospital systems from 1/1/2014 – 12/31/2017, including numbers of MHUs.



* IDPH only shared records for people who met its own internal definition of a high user or who had at least one stay in the Cook County Jail or accessed homeless services during the study period
Venn diagram is not drawn to scale.

Cross-system engagement was most prevalent in the homeless sample: 40.5% (n=23,978) of homeless clients had at least one hospital stay and/or one jail stay during the four-year period, and 4.5% (n=2,648) of homeless clients interacted with all three systems. Cross-system engagement was less prevalent in the CCJ sample, among whom 14.9% (n=29,205) had at least one hospital stay and/or accessed homeless services. The subsample of 2,648 people who interacted with all three systems represented 1.4% of the CCJ sample.

High users and multisystem high users. In total, we identified 80,061 high users of at least one system. A total of 5,136 people were high users of homeless services, representing 8.7% of homeless clients, and 20,989 people qualified as high users of CCJ, representing

10.7% of detained individuals. A total of 54,754 people qualified as high users of hospital systems, representing 18.1% of patients that IDPH internally identified as high annual hospital users. (Given the limitations in the scope of IDPH data which did not include the full population of hospital users, it is not surprising that the percentage of high users was higher in the hospital systems sample.)

Engagement with more than one system was associated with a greater prevalence of high use of at least one system. Of people who interacted with two or three systems over the study period, 33.0% experienced high use of at least one system, whereas only 14.7% of people who interacted with a sole system experienced high use of that system (Figure 1).

Among the 2,648 people who interacted with all three systems, 1,232 were also considered MHUs. Two-thirds of MHUs (820 out of 1,232, 66.6%) were high users of only one system. While these individuals did interact with the other two systems during the study period, their engagement with other systems was low. Only 10 out of 1,232 (0.8%) MHUs met the definition of a high user in all three systems, and 153 (12.4%) were high users of two systems. A total of 249 people (20.2%) were not considered a high user of any one system but demonstrated high use cumulatively across systems.

Characteristics of MHUs. The 1,232 MHUs were predominantly male (86%) and predominantly Black (84%), with an average age of 50 at their first observed system encounter during the study period. Their most common charges upon jail detention in CCJ were related to substance use disorders (possession of a narcotic) and “crimes of survival”^{27,28,29} associated with poverty and homelessness (such as retail theft and trespassing). They most commonly accessed the hospital for causes associated with mental disorders (representing 6% of all ED visits and 17% of inpatient stays), but still exhibited a wide range of medical needs. For example,

circulatory disorders represented 5% of all ED visits and 14% of inpatient stays. Over the four-year study period, they spent over 20% of their time, or an average of 315.7 days, engaged with emergency shelters, street outreach, jail, or the hospital.

MHU profiles. Our k-means clustering analysis identified three profiles of MHUs (Table 2). Results with LPA also identified 3 profiles as the optimal number (Appendix C), and profile characteristics and interpretation were qualitatively similar to those found with k-means analysis. We present results of the k-means analysis here (see also Appendix D). Additional details on the profiles found with LPA can be found in Appendix C.

Table 2. Characteristics associated with the three MHU profiles.

Older singles with complex needs	Older singles with highest rates of behavioral health challenges	Younger individuals with families
1,059 people (86%)	124 people (10%)	49 people (4%)
Demographics		
<ul style="list-style-type: none"> • 85% Black and 88% male • Majority older than 45 (81%), average age 51 	<ul style="list-style-type: none"> • 77% Black • Oldest cluster (90% over age 45, average age 53) 	<ul style="list-style-type: none"> • Most likely to be Black (94%) and female (57%) • Youngest cluster, average age 33
Needs & Vulnerabilities		
<ul style="list-style-type: none"> • 66% self-report a disabling condition • 67% self-report receiving benefits • 68% self-report health insurance • When detained in jail: <ul style="list-style-type: none"> - 21% received medical services - 31% received mental health services - 29% required detox upon entry • Most common charge is possession of narcotics 	<ul style="list-style-type: none"> • 70% self-report a disabling condition • Least likely to self-report receiving benefits (58%) • Highest rates of co-occurring behavioral health issues. When detained in jail: <ul style="list-style-type: none"> - 63% received medical services - 64% received mental health services - 59% required detox upon entry • Common charges include “crimes of survival,” like retail theft, trespassing, violation of parole 	<ul style="list-style-type: none"> • Lowest rates of co-occurring behavioral health issues. When detained in jail: <ul style="list-style-type: none"> - 0% received medical services - 20% received mental health services - 16% required detox upon entry • Most common charge is domestic violence • Highest self-reported rates of surviving domestic violence (24%)

System Utilization		
<ul style="list-style-type: none"> • Average of 270 days of cross-system engagement in four-year period (1 out of 5 days in an institutional setting) • Comparatively high number of days in emergency shelter (112) and days engaged in street outreach (29) • 78% accessed emergency shelter, but only 14% ever accessed permanent housing 	<ul style="list-style-type: none"> • Highest average number of days (345) of cross-system engagement in four-year period (1 out of 4 days in an institutional setting) • Most likely to be high users of the jail • Highest number of stays (8) and days (275) detained in jail 	<ul style="list-style-type: none"> • Average of 210 days of cross-system engagement in four-year period (1 out of 7 days in an institutional setting) • Comparatively high number of days in emergency shelter (113 days) • Most likely to be high users of hospital systems • About twice as many ED stays (16) / days (23) and inpatient stays (7) / days (51) than other profiles • Most likely to ever access permanent housing (24%)

* This table presents a descriptive look at the characteristics and qualities of individuals in each of the MHU profiles. For exact values of all profile characteristic percentages and means and tests of statistical difference between the three profiles, see Appendix D.

Older single adults with complex needs (1,059 people; 86.0%). The first profile is the largest group, and revealed the varied medical, behavioral health, and unmet social needs of MHUs. This cluster was 84.7% Black and 87.6% male, and the majority (80.5%) was older than 45 years old, with an average age of 51 upon first system entry.

This subgroup demonstrated multiple needs, with 67.6% reporting a disabling condition and 69.5% reporting receiving non-cash benefits. When detained in CCJ, 20.7% received medical services, 31.2% received mental health services, and 29.3% required detox upon entry. The most common charge in this group was narcotics possession.

Individuals with this profile spent a high number of days in emergency shelter (111.7) and days engaged in street outreach (29.1). Although 78% accessed emergency shelter over the study period, only 14.4% ever accessed permanent housing.

Older single adults who have the highest rates of behavioral health challenges (124 people; 10.1%). The second profile represents a particularly vulnerable subset of MHUs, who

displayed the highest prevalence of behavioral health issues. Within this cluster, 77.4% of individuals were Black and 89.5% were over age 45, with an average age upon first system entry of 53 years old.

This profile was the least likely to report receiving non-cash benefits (60.0%). They also had the highest rates of co-occurring behavioral health issues. When detained in jail, 62.9% received medical services, 63.7% received mental health services, and 58.9% required detox upon entry. Their common charges included retail theft, trespassing, and parole violations. Individuals in this profile were most likely to be high users of CCJ, spending an average of 275.3 days detained in jail over the four-year period.

Younger individuals with families (49 people; 4.0%). The last, smallest profile included younger individuals in families with children. Compared with the first two clusters, this cluster had the largest majority of Black people (93.9%), and it was predominantly female (57.1%). This was the youngest cluster, with the majority younger than 45 years old and an average age upon first system entry of 33 years old.

Members of this group were the least likely to report having a disabling condition (42.6%) and demonstrated the lowest rates of co-occurring behavioral health issues. When detained in jail, none required medical services, 20.4% received mental health services, and 16.3% required detox upon entry. One quarter (26.1%) of this group self-reported surviving domestic violence.

Individuals in this profile were most likely to be high users of hospital systems, spending an average of 22.8 days in the ED and 51.4 days as an inpatient over the four-year period. They also demonstrated high emergency shelter use, with an average of 113.0 days over the

study period. This profile was the most likely to access permanent housing (24.5% of individuals).

Health needs of MHU profiles. For inpatient stays, mental disorders were the most common cause for older singles with complex needs and younger individuals with families (representing 14.9% and 33.1% of stays, respectively). In both profiles, schizoaffective disorder and alcohol dependence were the most prevalent disorders. By contrast, older singles, the profile with the highest prevalence of behavioral health conditions, presented most often with circulatory disorders.

The main reasons for ED visits involved a broad category of symptoms such as coughing and various pains (e.g., chest pain, abdominal pain). However, ED visits due to musculoskeletal afflictions were more prevalent among both older single profiles, while ED visits due to mental and substance use disorders were more prevalent among the younger profile with families.

Costs associated with MHU profiles. Over the four-year study period, the cost of providing direct services to this group of MHUs through hospital stays, emergency shelter, and time spent in CCJ alone was just over \$305 million.

Hospital visits drove the largest percentage of costs across all three systems (Table 3), representing 91.2% of the total per person cost in older singles with complex needs, 80.3% in especially vulnerable older singles, and 96.8% in younger individuals with families. Due to their high hospital use (mostly due to mental disorders), younger individuals with families incurred the highest total per person cost across all three systems. Even though there were only 49 individuals in this group, they incurred almost \$24 million dollars in total costs for these services over the four-year period.

Table 3: Estimated per person and total group costs associated with serving multisystem high users in each system.

	Older singles with complex needs (n=1,059)	Older singles with highest rates of behavioral health challenges (n=124)	Younger individuals with families (n=49)
Mean cost per person within each system over study period			
Emergency shelter	\$2,172 (0.9%*)	\$941 (0.5%)	\$987 (0.2%)
Transitional housing	\$934 (0.4%)	\$323 (0.2%)	\$3,120 (0.6%)
Cook County Jail	\$18,172 (7.5%)	\$38,264 (19.1%)	\$11,560 (2.4%)
Hospital system	\$221,097 (91.2%)	\$161,080 (80.3%)	\$472,508 (96.8%)
Total per person cost across all 3 systems	\$242,335	\$200,608	\$488,175
Total sum group cost across all 3 systems	\$256,632,765	\$24,875,392	\$23,920,575

* Percentages in parentheses represent the percentage of each system cost out of total per person cost across all three systems.

Discussion

Among individuals who had interacted with Chicago’s homeless services, jail, and hospital systems over a four-year period, we found that a very small percentage—only about 0.5%—had interacted with all three systems (here, we note once again that our hospital data are not complete, which affects this estimate). Furthermore, fewer than 50% of those who interacted with all three systems demonstrated high use in at least one system—comprising a group of about 1,200 people in total. Nevertheless, this MHU group exhibited notable heterogeneity. The three main profiles included a predominant group of Black men with various needs and vulnerabilities, a group of older men with particularly high prevalence of mental health and substance use needs, and a small group of young Black women with families. Despite this combined MHU group of only about 1,200 people, it nevertheless incurred service provision costs in these domains alone of over \$305 million over the four-year study period.

The MHU sample observed in this study was disproportionately Black, potentially reflecting racial disparities present in each of the three individual systems and structural racism.³⁰ As of October 2020, 72.5% of individuals detained in CCJ were Black (approximately 3,983 people), despite Black people comprising only 23.8% of the Cook County population.³¹ Drug-related charges were among the most prevalent charges in the MHU sample. This result supports the persistent finding that Black people face higher risks of drug-related arrests compared with White people, despite the two groups using drugs at similar rates.³² In housing, factors such as the racial wage gap, mass incarceration, and disproportionate eviction filing rates contribute to Black people being nearly six times more likely to experience homelessness in Chicago than White people.³³ Finally, access to mental health services in Chicago decreased in the last decade in predominantly Black communities, with only 1.7 clinicians serving every 10,000 residents, compared with over 40 clinicians per 10,000 residents in predominantly White neighborhoods.³⁴ These factors across the three systems all help contextualize the disproportionate use of public and social services among Black populations.

Improved access to mental health services is likely to be especially important for these individuals. Within this MHU population, mental health disorders were one of the most common reasons for an ED or inpatient stay, especially among younger women with families. ED and inpatient hospital costs, which may partly reflect lack of access to preventative or ambulatory care, also represented the largest percentage of service provision costs across all three systems for MHUs, and was again particularly striking for younger women with families. Previous research has corroborated that patients with high levels of chronic and mental illness account for a disproportionate amount of health care costs,³⁵ with utilization and cost especially high among patients who have experienced homelessness and past incarceration.³⁶

We also found other chronic health conditions and acute injuries associated with hospitalization of MHUs, highlighting the complex interplay between mental and physical health. Older men with the highest rates of behavioral health conditions somewhat surprisingly presented most often with circulatory disorders. This finding could be a result of their increased age but may also reflect physical complications directly or indirectly associated with substance use.

Many interventions have been shown to help stabilize populations with high systems use, including providing more supportive and affordable housing,^{37,38,39} and free primary care services;²² and expanding access to health insurance,⁴⁰ peer-to-peer support, and peer recovery coaching during moments of transition. We found that a small proportion of individuals accessing homeless services, the jail, or hospital systems over this four-year period accessed all three systems, and an even smaller proportion concurrently demonstrated high use. This relatively small population experiencing the deepest need and incurring high service use and costs presents an opportunity for focused, individualized interventions tailored to specific vulnerabilities and needs. Interventions have already begun to focus on care coordination to help people with multiple medical and social needs access different services, including housing, legal supports, and income assistance.⁴¹ Knowing whether certain MHUs need more behavioral health supports, housing specifically for families, or specialized clinical care can help further tailor these coordination efforts.

New York City's Frequent User Service Enhancement (FUSE) initiative provided permanent supportive housing, but also allowed housing providers to use a pot of discretionary funds to provide flexible services catered to individuals, such as clinical supervision, case management with lower client-to-case manager ratios, and more intensive support when needed. The second iteration of this program resulted in fewer shelter days, days incarcerated,

days hospitalized for psychiatric reasons, and reduced costs overall.⁴² Similarly increased flexibility in spending could allow providers and organizations to develop more specialized services for different subgroups of MHUs.

Elsewhere, two targeted programs providing housing support to formally incarcerated individuals, Returning Home Ohio⁴³ and Washington State's Reentry Housing Pilot Program,⁴⁴ similarly reduced rearrests and emergency shelter use. The MHU profiles described in this study may also be useful and applicable to other large communities with diverse populations. Importantly, studies consistently demonstrate reduced service costs in return for addressing high user need.⁴⁵ Given the large financial and human expenses for this MHU population, focused preventive and follow-up care may result in important cost reductions as well as improved housing, health, and criminal justice outcomes.

Study limitations. Our study benefits from the large sample size of high users, as we were able to obtain data for everyone who had interacted with the homeless services and CCJ systems over this four-year period. We were able to categorize high use by looking at overall system interaction patterns and develop a comprehensive description of the MHU population. However, our definitions of high use are arbitrary, and reflect in part how service organizations locally in Chicago conceptualize high use. Even though these definitions align with prior definitions of high use in the research literature, other projects with different aims and focus could nevertheless delineate high use in many different ways, using different methods. Our analysis also takes advantage of clustering methods, of which k-means is but one technique. Other methods such as LPA, as well as regression trees and spectral clustering, may also be applicable to our aims and dataset. Previous studies assessing high users have used a variety of these methods, either as a singular strategy or multiple approaches in tandem. However, comparing between the methods is still challenging. Future research should carefully consider

research aims, data, and setting to choose the relevant machine learning technique. In addition, given our reliance on administrative data, our study carries associated limitations. We were not able to directly verify individual-level data, so our analysis is subject to errors arising from data duplication, collisions, and aggregation. In particular, the metric used for being in a family likely undercounts the number of individuals with children, since individuals may access services without children present. Additionally, our IDPH data included few inpatient or ED visits individuals experienced during periods of detention in CCJ. Finally, costs for hospital stays were taken from charge data, which may be an overestimate of true hospital marginal costs or actual payments.

Conversely, there is reason to believe that the per person, per night costs reported by the other two systems may underestimate actual costs, since those estimates do not include costs associated with arrest, or time in prison (if relevant), paramedic or other emergency crisis services, 911 emergency crisis response and dispatch, court processing and other legal expenditures, outreach services, homelessness prevention services, or daytime services in the homeless service system. More important, these numbers do not reflect the non-tangible and unobserved human costs stemming from unaddressed mental and physical health needs borne by individuals, families, and the larger community.

Implications and Recommendations. This study provides a comprehensive summary of Chicago's MHU population and suggests concrete responses. Multisystem high users in Chicago are a small subgroup, which affords an important opportunity for effective and meaningful system redesign and improvement to address their needs. Screening for cross-system involvement (or investing in shared data infrastructure across social systems) can identify those most likely to experience high system use – namely, those most likely to become

an MHU. If such individuals are quickly identified, additional case management services can be offered to determine specific needs and halt repeated system usage.

Data sharing across systems entails many challenges, including the lack of a standardized process for sharing, exporting, or storing data, privacy and confidentiality concerns, the difficulty of uniquely identifying and matching individuals across data sources, and the funding and resources necessary to maintain and evaluate database quality. However, homeless service leaders in Chicago have begun to develop plans for an integrated health and human services data hub comprising data from HMIS and other community and service systems.⁴⁶ Building on successful data sharing systems across the nation, pilots have been conducted in Chicago to share HMIS data with electronic health records from hospital systems and health care data systems.⁴⁷ By building databases that reside in each institution but have standardized structures and connect through a shared query platform, and by using novel privacy-preserving record linkage methods to join data across institutions⁴⁸, such data sharing infrastructure can ensure homelessness information is available to healthcare providers at the moment of care.

If MHUs, or people likely to soon become an MHU, are properly identified, additional services and support can be focused on this population to improve outcomes and to reduce repeated system usage. Especially as MHUs were predominantly Black, a finding which has been echoed in other studies of high users,⁴⁹ identifying MHUs early and providing support services will address prevailing racial disparities in the homeless, criminal justice, and health systems. Offering discharge or transition planning before release from institutional settings and providing focused immediate-, medium- or long-term case management and other linkage services after release⁵⁰ can lessen challenges to community reentry and equip people with specific tools and resources for living independently, thus reducing the likelihood of future

interactions with social service institutions. This study also continues to highlight the need for more affordable and permanent housing, as only a small fraction of MHUs, presumably those who would benefit the most from being stably housed, was able to successfully access permanent housing within Chicago's homeless service organizations. Improved knowledge about the characteristics, needs, and barriers confronting MHUs in the current study provides important implications for stakeholders in Chicago and beyond to serve high users more effectively, to spur and guide new investments and collaborative approaches to interrupt repeated system use, to remove barriers to stability, to redistribute costs and benefits, and to improve disparities in the health, criminal legal, and medical systems.

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