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Comparative Treatment of Homeless Persons With an Infectious Disease in the US Emergency Department Setting: A Retrospective Approach

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ABSTRACT

Background Research has long documented the increased emergency department usage by persons who are homeless compared with their housed counterparts, as well as an increased prevalence of infectious diseases. However, there is a gap in knowledge regarding the comparative treatment that persons who are homeless receive. This study seeks to describe this potential difference in treatment, including diagnostic services tested, procedures performed and medications prescribed.

Methods This study used a retrospective, cohort study design to analyse data from the 2007–2010 United States National Hospital Ambulatory Medical Care Survey database, specifically looking at the emergency department subset. Complex sample logistic regression analysis was used to compare variables, including diagnostic services, procedures and medication classes prescribed between homeless and private residence individuals seeking emergency department treatment for infectious diseases. Findings were then adjusted for potential confounding variables.

Results Compared with private residence individuals, persons who are homeless and presenting with an infectious disease were more likely (adjusted OR: 10.99, CI 1.08 to 111.40, $p<0.05$) to receive sutures or staples and less likely (adjusted OR: 0.29, CI 0.10 to 0.87, $p<0.05$) to be provided medications when presenting with an infectious disease in US emergency departments. Significant differences were also detected in prescribing habits of multiple anti-infective medication classes.

Conclusion This study detected a significant difference in suturing/stapling and medication prescribing patterns for persons who are homeless with an infectious disease in US emergency departments. While some findings can likely be explained by the prevalence of specific infectious organisms in homeless populations, other findings would benefit from further research.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Homelessness and infectious diseases are both important public health issues. There is a gap in knowledge regarding the comparative treatment that persons who are homeless and have an infectious disease receive.

WHAT THIS STUDY ADDS

⇒ Homeless persons with an infectious disease in the USA had higher odds of receiving sutures or staples, 'other procedures', amebicide agents, antimalarials agents, tetracycline agents and glycopeptide agents, and lower odds of being provided medications for infectious diseases compared with privately housed persons during an emergency department visit.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ These findings provide a platform for continual public health research, potentially providing quality improvement measures for the emergency medical care for homeless persons with infectious diseases.

INTRODUCTION

Homelessness is a critical public health concern as 1.5 million individuals spend at least one night in transitional housing or an emergency shelter each year in the USA.[1] As of 2019, over 567 000 individuals were homeless on a single evening in the USA.[2] Homelessness is a complex term with many accepted definitions. The United States Housing and Urban Development definition for homelessness includes any, 'individual or family who lacks a fixed, regular, and adequate night-time residence', among many other qualifiers.[3]

Homelessness is not homogenous in its distribution as California has 53% of all homeless individuals in the USA.[4] Certain racial groups face disproportionately high rates of homelessness; nearly all minority groups face higher rates of homelessness than their respective percentage of the population.[5] In particular, Black Americans represent approximately 13% of the national population, but comprise 40% of individuals experiencing homelessness.[5] This phenomenon is underpinned by systemic inequities facing minority groups, leading to disproportionate poverty, incarceration, healthcare inequity and housing discrimination—all of which can contribute to homelessness.[5]

At its core, homelessness is a public health issue. Homeless individuals have significantly higher morbidity levels compared with their housed peers. In fact, persons facing homelessness die on average 12 years prior to the general US population.[6] Homeless individuals face higher rates of chronic conditions than the general population, ranging from cardiovascular disease to mental illness and

are also at higher risk for violence and injury.[1 7] Despite the need and benefit, homeless persons often face access barriers to healthcare, including lack of health insurance and access to routine primary care.[8] Nearly, 75% of homeless persons experienced an unmet healthcare need in the previous year, ranging from medical or surgical care, need for prescription medications, mental healthcare, eyeglasses or dental care.[9] Factors associated with unmet healthcare needs included lack of insurance, past-year employment and food insufficiency—dilemmas disproportionately facing homeless populations and leading individuals to prioritise basic needs over healthcare.[9] Perhaps as a consequence, homeless persons visit emergency departments approximately four times more often than the general population, have high relapsing rates in the emergency room setting and eventually have more admissions to hospital, longer hospital stays and more costly healthcare stays.[8]

Part of the increased morbidity facing homeless persons is due to increased rates of infectious diseases. Homeless persons face higher rates of infection by tuberculosis, hepatitis B and C, HIV, scabies, body lice and *Bartonella quintana* (a louse-borne disease).[7 10] The reasons behind these findings are complex and largely dependent on the specific living conditions of the individual, as well as their unique experiences. Homeless persons living in crowded, shared living spaces are at particular risk for airborne pathogens, such as tuberculosis.[10] There are data to suggest that homeless youth in particular are at higher risk for sexually transmitted infections such as *Chlamydia trichamonas*.[11–13] A lack of clothing changes combined with crowded, shared living conditions can be conducive to scabies or lice infestations, with subsequent louse-borne illnesses.[10] Previous studies have also demonstrated increased methicillin-resistant *Staphylococcus aureus* (MRSA) nasal colonisation in homeless individuals using homeless shelters, likely secondary to person-to-person transmission or via fomite transmission.[14] These unique experiences translate to higher rates of particular infectious diseases for individuals facing homelessness.

Interestingly, while there is ample research to demonstrate the high use of emergency department services and infectious diseases among homeless persons, there are little data demonstrating the comparative care that homeless persons receive for these infectious diseases. Our aim was to fill this gap in knowledge by searching for and describing a potential difference in the US emergency department infectious disease treatment between homeless and privately housed persons, by specifically looking for a potential difference in the diagnostic services provided, procedures performed and medication classes prescribed.

METHODS

Study design

In this retrospective cohort study, we analysed the National Hospital Ambulatory Medical Care Survey (NHAMCS) from 2007 to 2010, emergency department data subset. The NHAMCS is administered by the Centers for Disease Control and Prevention, ultimately creating a deidentified, publicly available dataset that spans multiple decades.[15] This study was reviewed by the University Institutional Review Board and deemed to not be human subjects research.

Inclusion criteria

The study population included homeless persons (as denoted via NHAMCS) in the USA who sought emergency department services for an infectious or parasitic disease between the years 2007–2010. This population was compared with non-homeless persons (classified as private residence via NHAMCS). Infectious and parasitic diseases were defined according to the International Classification of Disease 9 codes volumes 1–3; specifically, this included codes 1–139, 176, 320–324, 326, 370, 373, 381–383, 391–392, 420–422, 460–466, 475, 480–488, 510, 513, 522–523, 551, 566, 566–567, 572, 590, 595, 670, 675, 681–682, 684, 686, 730, 771, V01–V06, V08–V09 and V73–V75.[16] There were no specific exclusion criteria but any data not meeting the inclusion criteria were not included in the dataset to be analysed.

Variables

Homelessness status (per NHAMCS) was the dependent variable. Non-homeless was defined as those in a private residence, and all other residency statuses (nursing home, other, missing, etc) were coded as missing, thus not included in analysis. Independent variables included diagnostic service variables: complete blood count, liver function tests, blood culture, other blood tests, HIV test, rapid influenza/influenza test, urinalysis, wound culture, other test/service and any imaging—all of which were converted into dichotomous variables. Procedural variables included intravenous fluids, suture/staples, incision and drainage, foreign body removal, pelvic exam, central line, endotracheal intubation and other procedure (each converted into a dichotomous variable). The total numbers of diagnostic services, procedures and medications provided were also investigated. In regards to medications, specific anti-infective medication classes were investigated, including both those provided and those prescribed, by creating dichotomous variables for each anti-infective medication class listed in the 2010 NHAMCS codebook.

Statistical analysis

Homeless and privately housed persons were compared using a complex sample logistic regression analysis for dichotomous variables and via complex sample linear analysis for continuous variables using SPSS software. Nearly, every variable was converted to a nominal variable, signifying if an individual did or did not receive a diagnostic test, procedure or medication class. Following the initial round of testing, analyses were repeated while controlling for potential confounding variables, including patient age, sex, race, ethnicity, HIV status, length of visit, month of visit and if seen in the emergency department in the last 72 hours. For example, homeless patients tend to be older, disproportionately men, have higher ED relapse and so on. Thus, the adjusted odds ratios (ORs) aim to correct for these factors.

RESULTS

The full unweighted sample size of the NHAMCS data set from the years 2007–2010 was 139 502 samples and when selecting for only infectious disease cases, it included 26 220 infectious disease patient visits. Of these, 128 patient visits were classified as homeless with an infectious disease (see online supplemental figure 1). According to the data stratification plan, this accounted for the population of the region where each NHAMCS data set was collected from, giving proportionate representation to the diverse regions where these data are collected. Within the infectious disease population, 54% were female and 46% were male. The majority of subjects were adults, with 43.5% of subjects under the age of 18 years old. The majority were non-Hispanic or Latino (66.9%) and identified as white (56%). And 23.4% of subjects identified as Black/African American, followed by Asian (1.7%), American Indian/Alaska Native (0.8%), more than one race (0.7%), and Native Hawaiian or other Pacific Islander

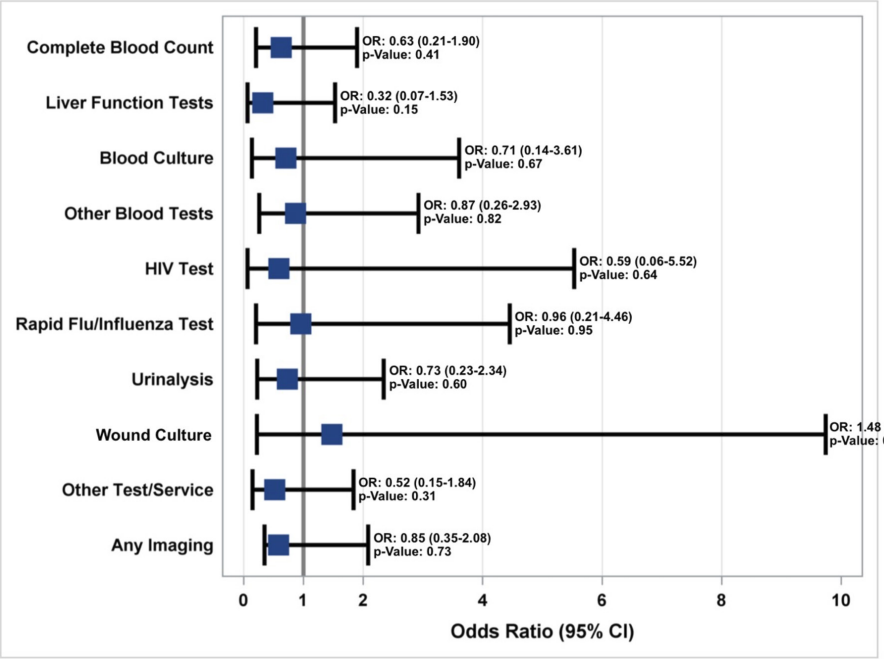

Figure 1 Diagnostic services provided to homeless versus privately housed persons with an infectious disease in US emergency departments. Diagnostic services from the National Hospital Ambulatory Medical Care Survey database with OR shown with 95% CI and p values.

(0.4%). Other study findings, after controlling for potential confounding variables, are described below. Additional demographic data for the total homeless patient visits and the total sample dataset are shown in online supplemental table 1.

There was not a statistically significant difference detected in diagnostic services provided to homeless persons compared with private residence individuals (including complete blood count, liver function tests, blood culture, other blood test, HIV test, rapid influenza/influenza test, urinalysis, wound culture, other test/service and imaging; figure 1), nor in the provision of diagnostic services, nor in the total number of diagnostic services provided.

Homeless persons had increased odds (adjusted OR 10.99, CI 1.08 to 111.40, p value: 0.043) of receiving sutures or staples when presenting to a US emergency department with an infectious disease compared with their housed counterparts (see figure 2). Homeless persons also had increased odds of receiving 'other procedures' (adjusted OR 3.35, CI 1.32 to 8.47, p value: 0.011). Other variables, including intravenous fluids, incision and drainage, and pelvic exam did not demonstrate a statistically

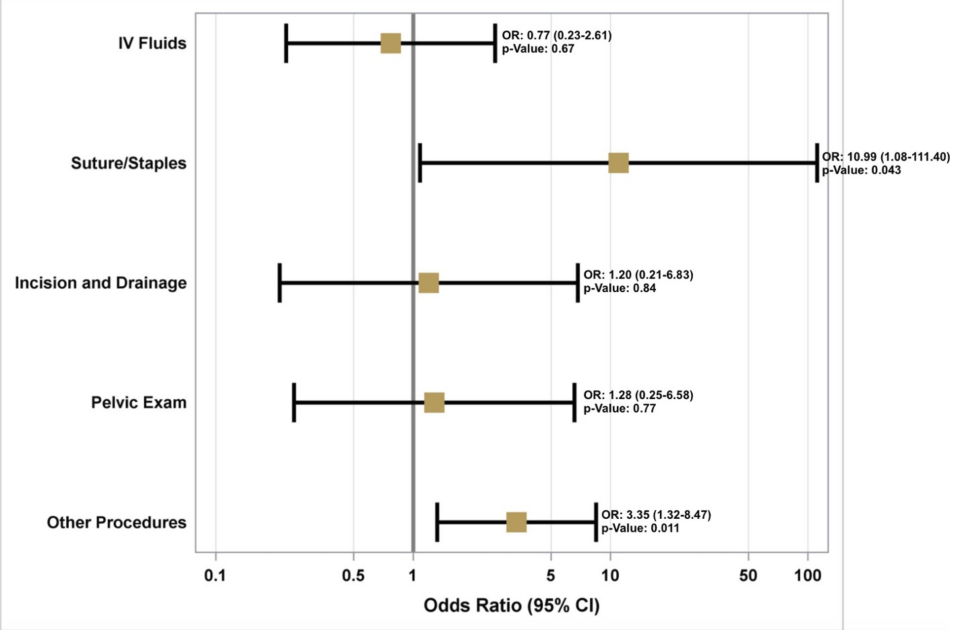

Figure 2 Procedures performed in homeless versus privately housed persons with an infectious disease in US emergency departments. Performed procedures from the National Hospital Ambulatory Medical Care Survey database with OR shown with 95% CI and p values.

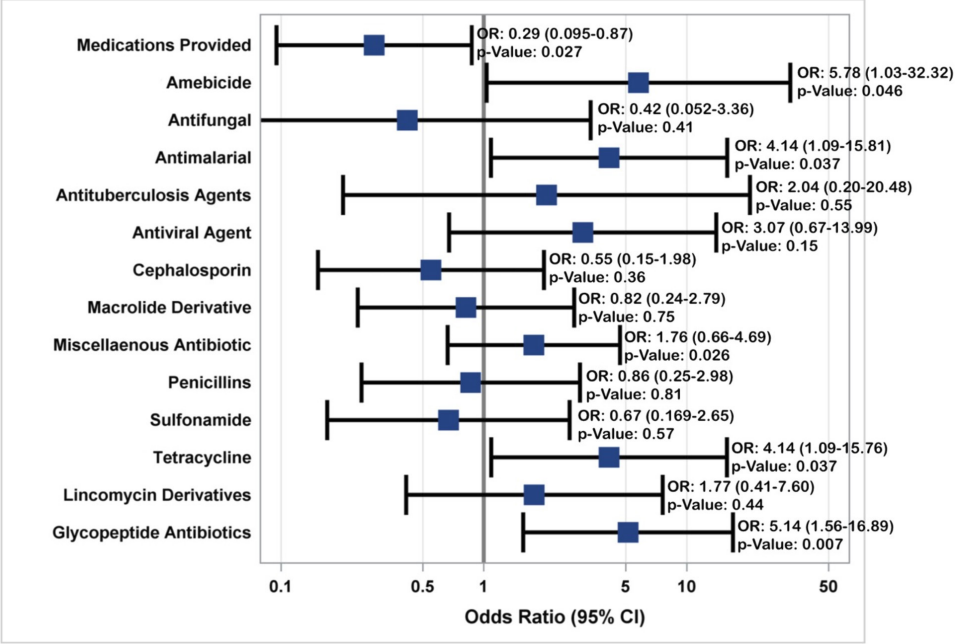

Figure 3 Medications provided to homeless versus privately housed persons with an infectious disease in US emergency departments. Medications provided from the National Hospital Ambulatory Medical Care Survey database with OR shown with 95% CI and p values.

significant difference between homeless and privately housed persons. Certain variables, including foreign body removal, central line placement and endotracheal intubation did not contain enough subjects within test parameters to yield usable test results. Complex linear testing on the total number of procedural interventions did not yield a statistically significant result between homeless and privately housed persons.

When investigating the medication class provided during an emergency department visit, whether in the emergency department or at discharge, there were several significant differences in the treatment of homeless persons and privately housed persons. As shown in figure 3, homeless individuals had higher odds of receiving amebicide agents (adjusted OR 5.78, CI 1.03 to 32.32, p value: 0.046), tetracycline agents (adjusted OR: 4.14, CI 1.087 to 15.76, p value: 0.037), antimalarial agents (adjusted OR 4.14, CI 1.09 to 15.81, p value: 0.037) and glycopeptide agents (adjusted OR 5.14, CI 1.56 to 16.89, p value 0.007). Furthermore, homeless persons had lower odds (adjusted OR: 0.29, CI 0.095 to 0.87, p value: 0.027) of being provided a medication in general (not specifically anti-infective agents) compared with private residence persons with an infectious disease. Other variables investigated, as shown in figure 3, did not demonstrate a statistically significant difference in provision of medications. Certain anti-infective medication classes, including anthelmintics, leprostatics, quinolones, urinary anti-infectives, aminoglycosides, glycylcyclines and carbapenems did not have enough subjects fall within test parameters to yield usable test output.

Following the investigation of medications provided to homeless and private residence individuals, anti-infective medication prescribing was investigated. Homeless persons had higher odds of being prescribed antimalarial agents (adjusted OR: 4.70, CI 1.23 to 17.94, p value: 0.024) and tetracycline agents (adjusted OR: 4.69, CI 1.23 to 17.88, p value: 0.024; figure 4). Other variables tested did not demonstrate a statistically significant difference in prescribing habits between homeless individuals and privately housed individuals (figure 4). Certain anti-infective agents, including anthelmintics, antifungals, antituberculosis agents, carbapenems, leprostatics, quinolones, urinary anti-infectives, aminoglycosides, lincomycin derivatives and glycyclines, did not have adequate number of subjects fall within test parameters, thus did not yield usable test output.

DISCUSSION

This project sought to detect and describe a potential difference in the management of homeless individuals seeking infection treatment in US emergency departments compared with their housed counterparts. A difference in management (defined as diagnostic services provided, procedures performed and medication prescribed) between these two populations was detected in regards to particular procedures performed, as well as specific medications provided or prescribed.

Diagnostic services

This study hypothesised that there would be a difference in the utilisation of diagnostic services for homeless persons seeking infection treatment in US emergency departments, compared with their housed counterparts. However, a statistically significant difference was not detected (figure 1). These findings do not agree with previous research, which has demonstrated a slight increase in the number of diagnostic services provided to homeless individuals[17]; however, the research did not specifically look at homeless persons with infectious diseases. Repeated studies with more recent data would be beneficial to elucidate an accurate trend.

Procedures

This study hypothesised that there would be a significant difference in the procedures performed between homeless and non-homeless populations seeking US emergency department services with an infectious disease. Previous research has demonstrated that homeless young adults (although not those specifically seeking infectious disease treatment) had lower odds of having procedures performed in US emergency departments.[18] In our study, homeless

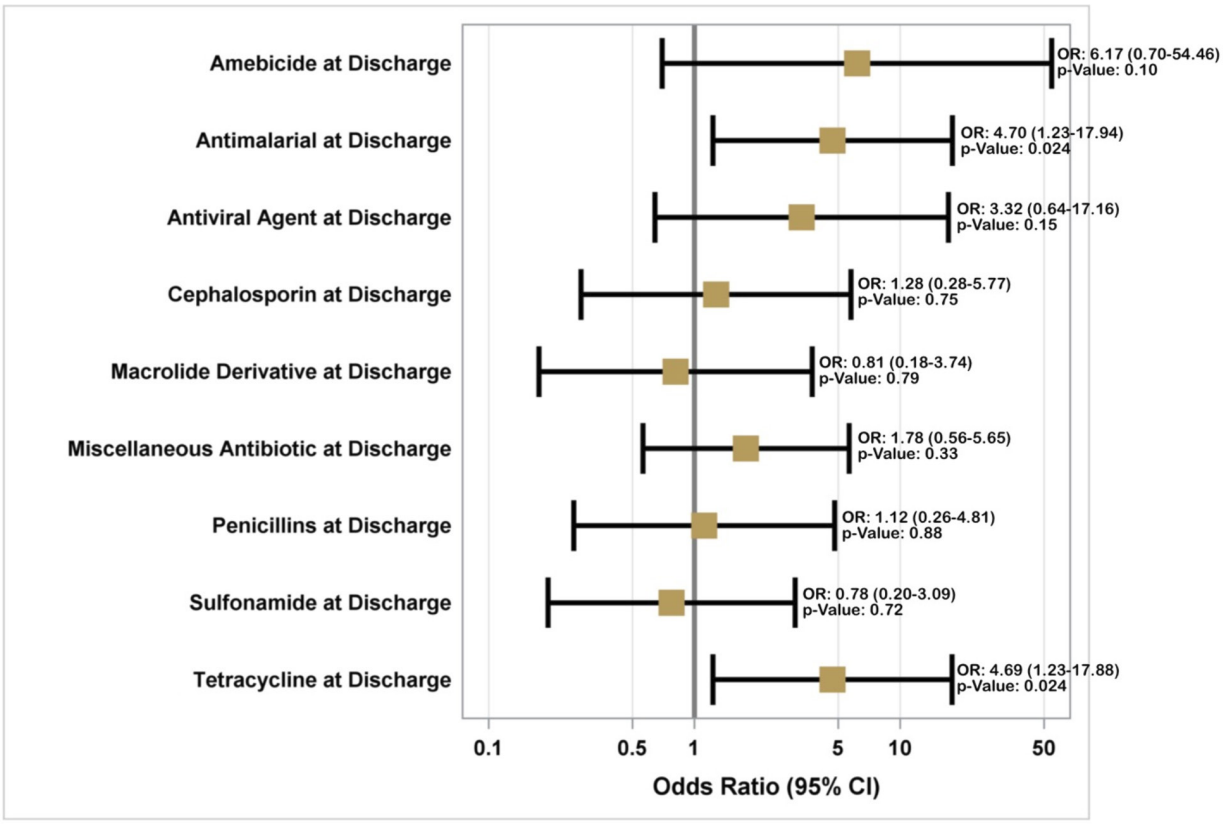

Figure 4 Medications prescribed to homeless versus privately housed persons with an infectious disease in US emergency departments. Medications prescribed from the National Hospital Ambulatory Medical Care Survey database with OR shown with 95% CI and p values.

persons presenting with an infectious disease had higher odds of receiving sutures or staples. This finding is perhaps due to clinicians having concerns over access to wound care, wound exposure on leaving the emergency setting and access to primary care treatment on leaving the emergency department. These concerns might lead clinicians to be more aggressive or comprehensive with wound closure via sutures or staples.

Medication provided and prescribed

This study hypothesised that there would be a significant difference in the medications provided to homeless populations seeking infection treatment in US emergency departments compared with their housed counterparts. Homeless persons had higher odds of being provided amebicide, antimalarial, tetracycline and glycopeptide agents. In general, homeless persons had lower odds of being provided a medication when presenting to an emergency department with an infectious disease. To the best of our knowledge, these findings have not been demonstrated in previous studies; however, we have hypotheses as to why these relationships exist.

In regards to amebicide agents, providers might be more apt to cover for amoeba infections in homeless populations due to a concern over increased exposure in outdoor environments or water sources. Thus, a homeless person presenting with a diarrhoeal illness might be more likely to receive a broader range of coverage compared with a privately housed person without potential increased exposure. It is also possible that there is increased prevalence of amoeba infections in homeless populations, thus leading to more treatment in this population; however, to our knowledge this has not been demonstrated In the literature. In regards to antimalarial agents, the reason behind their increased provision to homeless persons with an infectious disease is not immediately clear. Antimalarial medications are indicated for the treatment of a variety of autoimmune conditions, such as systemic lupus erythematous (SLE). Previous research has demonstrated SLE to be more prevalent in African American or Hispanic individuals—populations that also face higher rates of homelessness.[5 19] The variables of race and ethnicity were controlled for in the data analysis, and so should not be the causal factor of our findings in the absence of bias; however, because of the use of this large database, the contribution of bias is not known. We also explored the possibility that immigrants or refugees who are travelling into the USA—and might be exposed to malaria in countries where this pathogen is endemic, thus requiring malarial treatment—might be more prone to homelessness. However, previous research suggests that immigrants and refugees do not face higher rates of homelessness.[20] Thus, this finding remains incompletely explained and warrants further exploration.

Tetracycline agents were more likely to be provided to homeless persons presenting to US emergency departments with an infectious disease. Tetracycline antibiotics are first-line agents for *Chlamydial* sexually transmitted infections and while previous studies have yielded varied findings on the prevalence of sexually transmitted illnesses in homeless populations, there are data to suggest increased prevalence particularly among homeless youths, who are at increased risk for such illnesses.[12 21] This increased risk for sexually transmitted infections is multifaceted and can be associated with increased likelihood of unprotected sexual intercourse, drug and alcohol use and multiple sexual partners.[12] An increased prevalence of *Chlamydial* illnesses could explain the increased prescribing of tetracycline agents in this population. Furthermore, several studies have demonstrated

serological exposure of homeless persons to a broad range of zoonotic pathogens, including *Rickettsia* spp and *Borrelia* spp.[22 23] Tetracycline antibiotics are indicated for many zoonotic infections, infections that homeless persons are perhaps exposed to more frequently due to the sheer nature of being outdoors more than housed populations, as well as living in crowded shelter conditions.[22 23] Beyond this, tetracycline antibiotics are generic (thus relatively inexpensive), effective and avoid the potential for cross-reactivity with penicillin allergies, making them an alluring drug choice in general.[24] Thus, the reasoning behind increased prescribing of tetracycline agents in homeless populations is likely multifaceted.

Glycopeptide antibiotics were provided more frequently to homeless individuals presenting to US emergency departments with infectious diseases. This may be related to the high efficacy in treating MRSA infections.[25] Previous studies have demonstrated that homeless persons face higher rates of MRSA colonisation compared with their housed peers.[14 26–28] This is likely related to the transmissibility of MRSA in crowded living environments; there is also an increased risk of MRSA infections with intravenous drug use, a phenomenon with a significant presence within the homeless community.[26] We hypothesise that the increased prevalence of MRSA exposure and colonisation in the homeless population is what accounts for increased prescribing of glycopeptide agents.

When specifically looking at the differences in the medications *prescribed*, rather than provided, to homeless persons presenting with an infectious disease, some medication classes (figure 4) did not demonstrate statistically significant differences, including glycopeptide and amebicide agents. Vancomycin (a glycopeptide agent) is given intravenously, thus is more commonly provided within the hospital setting versus as an outpatient.[29] This likely contributes to this change in significance when looking only at prescribed medications. In regards to amebicide agents, it is possible that homeless persons are more likely to be initiated on amebicide therapy while in the emergency setting secondary to concerns over prescription access in the outpatient setting. Previous studies have demonstrated the significant barriers that homeless individuals face in regards to prescription access and medication adherence, which could perhaps lead providers to provide these more in the emergency setting for those facing homelessness.[9 30 31]

There are several limitations in this study. By using a database collected by other individuals, there is potential for error and bias in the data collection process outside of our knowledge. This includes the inherent bias of differential likelihood of different populations presenting to the emergency department for care. Furthermore, residency status data may contain errors as it is self-reported by patients and could underestimate the true homelessness rate.[17] Because residency status records recorded as 'other' or 'missing' were not included in the analyses, this could have introduced some selection bias. Several tests conducted on this project did not have subjects fall within the test parameters and so in these instances, analysis could not be completed. However, given that so many tests were conducted and the majority of them produced valid results, this was deemed acceptable. Many of the findings in this study have not been demonstrated in the literature, and some findings contradict previously reported findings. Given this, repeated studies would be beneficial to support the findings demonstrated.

In conclusion, this study sought to fill a gap in the medical literature regarding the specific care that homeless individuals receive for infectious diseases in US emergency departments compared with privately housed counterparts. Through the use of a retrospective cohort study design using the NHAMCS-ED 2007–2010 database, this study sheds light on the differences in care for homeless persons with infectious diseases in US emergency departments. Homeless persons had higher odds of receiving sutures or staples, 'other procedures', amebicide agents, antimalarials agents, tetracycline agents and glycopeptide agents compared with privately housed persons. Homeless persons had lower odds of being provided medications during their emergency department visit. Other variables tested did not demonstrate significant differences. These findings provide a platform for continual public health research with more recent data, potentially providing quality improvement measures for the emergency medical care for homeless persons with infectious diseases.

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Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. The dataset used in this study was from the National Hospital Ambulatory Medical Care Survey (NHAMCS) from 2007 to 2010, emergency department subset, administered by the Centers for Disease Control and Prevention (CDC). reference: [dataset] 15. Centers for Disease Control and Prevention. NAMCS/NHAMCS—Ambulatory Health Care Data Homepage. https://www.cdc.gov/nchs/ahcd/index.htm. Published 2017. Accessed 20 December 2017.

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