

High Inpatient Health Care Utilization and Charges Associated With Injection Drug Use–Related Infections: A Cohort Study, 2012–2015

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Our study describes the characteristics of patients hospitalized with injection drug use–related infection over a multiyear period in a region highly impacted by the opioid epidemic. Intensive health care needs were common in this young cohort, including high rates of readmission, high hospitalization costs, and prolonged lengths of stay.

Keywords. endocarditis; health care utilization; injection drug use; opioid use disorder; persons who inject drugs.

The opioid use and overdose crisis has had a devastating impact on communities across the United States [1], where it is estimated that >750 000 persons inject drugs annually [2]. Infectious complications in persons who inject drugs (PWID), which result from failure to disinfect the skin, lack of sterile injection equipment, and contamination of the drug itself, are 1 driver of excess health care utilization and cost in this population [3]. A study analyzing a nationally representative sample of US inpatients with opioid use disorder (OUD) and associated infections demonstrated a rise from 3421 hospitalizations in 2002 to 6535 in 2012, with total inpatient charges rising from \$190 million to \$700 million over the same period [4]. Infective endocarditis, a frequent and particularly devastating infectious consequence of injection drug use (IDU), has precipitously risen [5].

The Northeastern United States has been 1 of the regions disproportionately affected, with Massachusetts ranking in the top 10 states nationally for overdose deaths, with 31.8 deaths per

100 000 persons in 2017 alone [6]. Positioned at the heart of 1 of the epidemic's epicenters, we aimed to describe the demographic and health care utilization characteristics in PWID, as compared with the general hospitalized population, over the multiyear period from 2012 to 2015 at a large tertiary care referral center.

METHODS

Study Setting and Population

We conducted a retrospective cohort study of patients hospitalized for IDU-related infection within the Beth Israel Deaconess Medical Center (BIDMC) network from January 1, 2012, to September 30, 2015 (the last day of International Classification of Diseases [ICD]–9 utilization at the medical center). BIDMC's network includes a large, 651-bed tertiary care center in Boston, Massachusetts, as well as 3 additional member hospitals and 6 affiliated hospitals in the greater Boston area.

We used Clinical Query 2 (CQ2), the BIDMC clinical data repository, to identify our cohort of patients. We first generated a patient list that included all adult patients (>18 years) who were hospitalized at BIDMC during the study period and had ICD-9 codes at any point during their medical care for substance use disorder and at least 1 of 5 selected IDU-related infections (sepsis/bacteremia, skin and soft tissue infection, bone or joint infection, pyogenic spinal infection, or endocarditis). Given that there are no ICD-9 codes that explicitly denote IDU, a combination of codes for opioid and general substance use disorders and overdose were employed for this search [7]. We then manually reviewed the electronic medical record (EMR) for the following inclusion criteria: (1) hospitalization within the study period for treatment of ≥ 1 of 5 selected infections and (2) IDU within 6 months preceding the qualifying hospitalization.

Outcomes

Health care utilization was measured by evaluating the total number of hospitalizations, emergency department (ED) visits, and 30-day readmissions at BIDMC over the study period, as well as the length of stay and discharge disposition for each sentinel admission. In addition, total and average hospital charges, length of stay, discharge status, and 30-day readmission data were obtained for all admissions in the study cohort and separately for all other patients who were hospitalized during the study period.

Covariates

We manually abstracted baseline patient characteristics from the EMR, including age, sex, insurance status, and race/ethnicity. We also determined vital status at the time of data abstraction (which commenced in September 2016) by first

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reviewing the EMR and then querying a social security database, provided through Harvard University Libraries, for individuals not indicated as deceased in the EMR.

Analysis

Comparisons were made between admission data for IDU-related infection in PWID and aggregate data for all other admissions that occurred during the same period at the medical center. Individual chart review was not undertaken for admissions not related to IDU-associated infection.

Patient Consent Statement

The study protocol was approved by the Beth Israel Deaconess Medical Center Institutional Review Board. Due to the retrospective nature of the study, informed consent was not obtained.

RESULTS

Demographics and Infection Type

Of 901 patients identified, 234 met inclusion criteria. Excluded patients were those with OUD but without IDU, those with OUD/IDU but without a clear injection-related infection, and those with OUD and IDU-related infection but without qualifying inpatient admission or with insufficient documentation of IDU within the 6 months preceding sentinel admission (as dictated by the study protocol, which stipulated review of admission/discharge notes and all infectious diseases and social work consult notes). The mean age at the time of sentinel admission (SD) was 36 (10.7) years. Fifty-seven percent were male ($n = 134$), 78% identified as White ($n = 183$), 9% identified as Black/African American ($n = 22$), and 6% identified as Hispanic or Latinx ($n = 15$).

Primary infection types treated during sentinel admissions were skin and soft tissue (42%, $n = 99$), infective endocarditis (30%, $n = 70$), pyogenic spinal (12%, $n = 28$), bone or joint (9%, $n = 22$), isolated bacteremia or fungemia (4%, $n = 9$), and acute viral hepatitis (3%, $n = 6$).

At the time of chart review, 12% were deceased ($n = 28$). Five died during the sentinel hospitalization, and 3 died during subsequent hospitalizations within the study period. Public insurance programs (Medicaid/Medicare) were the primary payers responsible for charges accrued in this cohort (77%), in contrast to just over half (53%) across the medical center in the general admitted population over the same period.

Admission Characteristics/Health Care Utilization

Over the study period, 234 patients had 488 hospitalizations, of which 338 (69%) were either for IDU-related infection or ≤ 30 -day readmission, all-cause. Fifty-eight percent ($n = 136$) of patients had 1 admission during the study period. Among the patients who were readmitted, the mean number of inpatient hospitalizations

(SD) was 3.6 (2). Twenty-nine percent of the cohort ($n = 68$) had at least 1 ED encounter without subsequent hospitalization (mean [SD] = 1 [2.9]) following the sentinel admission. The PWID cohort had a higher 30-day all-cause readmission rate compared with the general admitted population over the same time period (27% vs 15%). Average length of stay in the PWID cohort was 9 days vs 5.3 days in the general admitted population.

Of 338 admissions, 50% ($n = 171$) resulted in discharge to another health care facility for ongoing medical treatment (60% of these were to 1 of the 2 state-run public health hospitals in Eastern Massachusetts; $n = 102$). There was a higher proportion of discharges against medical advice among the PWID cohort (12% vs 0.05%) and discharges to another facility for ongoing treatment (50% vs 15%) when compared with all hospital admissions. See [Table 1](#) for a comparison of aggregate admission characteristics over the study period at the medical center.

Charges for Hospitalization

Total charges for the PWID cohort during the study period were \$17 317 722, representing 0.46% of total charges for hospitalizations at the medical center during the same period. The average charge per hospitalization for the PWID group was nearly twice that of the average admission charge at the medical center over the same period (\$51 236 vs \$27 253) ([Table 1](#)).

DISCUSSION

Our study describes the demographic characteristics, health care utilization, infection types, and costs among a cohort of PWID with hospitalization for IDU-related infection at a large tertiary care institution located in a region highly impacted by the opioid crisis. Our findings reveal a longer average length of stay with subsequent higher cost, a higher percentage of 30-day readmissions, disproportionate public payer mix representation, and higher rates of discharge to alternate facilities for ongoing care as compared with the total inpatient cohort.

While these data focus on the economic impact of caring for this patient population, they may provide an argument for changing our approach to PWID in clinical settings. Despite recognition of substance use being the fundamental driver of IDU-related infection, opportunities to address addiction are often overlooked, including, but not limited to, psychiatric comorbidity management, linkage to addiction and after-care services, and initiation of medication-based treatments such as buprenorphine. The prolonged lengths of stay seen in this patient population and frequent contact with the emergency department without hospital admission only underscore the missed opportunities to intervene and attenuate the profound harm wrought by syndemic substance use and infection. Lastly, we are in need of strategies to avoid discharges against medical advice, which have been associated with higher rates of 30-day mortality [8].

Table 1. Aggregate Insurance Status, Charges, Hospitalization, and Discharge Status at BIDMC Comparing PWID With General Inpatient Cohort, 1/1/2012 to 9/30/2015

	PWID Cohort	Total Inpatient Cohort
Insurance status, payer mix in %		
Public	77	53
Private	21	43
Other	1	4
Self-pay	2	1
Charges, \$		
Total charges	17 317 722	3 816 608 593
Average charge per admission	51 236	27 253
Charge, range	1387–521 787	375–4 349 709
Hospitalization		
Total No. of admissions	448	140 044
Total No. of discrete patients	234	97 540
Average length of stay, d	9 ^a	5.3
≤30-d readmission rate, %	27 ^a	15
Discharge, No. (%)		
To another facility	224 (50)	21 896 (15)
Against medical advice	54 (12)	738 (0.05)

Abbreviations: BIDMC, Beth Israel Deaconess Medical Center; IDU, injection drug use; PWID, people who inject drugs.

^aAmong admission for IDU-related infection or ≤30-day readmission.

Several important study limitations merit discussion. Although significant geographic diversity was seen in the cohort (ascertained through analysis of home zip code; analysis not included), reflecting the medical center's large regional catchment area, this was a single-center study, and therefore the generalizability of our findings to other PWID cohorts hospitalized for serious infection may be limited. Similarly, as ED visits and hospitalizations at other sites were not captured, we are unable to ascertain the intensity of total health care utilization, and therefore costs associated with caring for these patients over the study period are likely to be underestimated. In addition, given that the end of the study period was defined based on institutional transition to ICD-10 coding rather than a standardized follow-up period, readmissions in the cohort may have been undercounted, particularly if population rates of injection opioid use increased over the later part of the study period when follow-up times were shorter. Though the average illness severity for IDU-related infection may exceed that generally observed in hospitalized patients nationally, the highly specialized and complex care delivered at the study site means that the relative illness severity may not have been highly disparate between the study and comparator groups. Lastly, the study design did not allow for accounting of admissions not related to IDU-related infection, which may have occurred in the study population over the period examined.

Our study highlights the frequent and intensive health care needs seen among PWID with infectious complications of their substance use disorder and the imperative for targeted health policy and harm reduction initiatives to offset the significant morbidity and mortality associated with IDU.

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