Drug Users Seeking Emergency Care for Soft Tissue Infection at High Risk for Subsequent Hospitalization and Death*

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ABSTRACT. Objective: Although soft tissue infections are common among injection drug users (IDUs), little is known about the health outcomes among those who seek care for these infections. Emergency department visits are an important point-of-health-care contact for IDUs. In this prospective cohort study, we aimed to determine the hospitalization and mortality rates and factors associated with hospitalization or death among IDUs seeking emergency care for soft tissue infection. **Method:** Participants were English-speaking IDUs, 18 years of age and older, who sought initial care for soft tissue infection in an urban emergency department. We conducted semistructured interviews, identified hospitalizations from hospital records, and identified deaths using the National Death Index. Cox proportional hazards regression was used to investigate associations between baseline characteristics and hospitalizations or death. **Results:** Of 211 eligible patients, 156 (74%) participated (mean age = 42 years). There were 255 subsequent hospitalizations over a mean of 3.9 years follow-up. The hospitalization rate was 42 hospitalizations per 100 person-years (95% confidence interval [CI]: 38-48). The mortality rate was 2.0 per 100 person-years (95% CI: 1.1-3.7). Factors associated with increased risk for hospitalization or death included living on the street or in a shelter (adjusted odds ratio [AOR] = 1.75, 95% CI: 1.10-2.79), being recently incarcerated (AOR = 1.90, 95% CI: 1.05-3.44), and having insurance (AOR: 1.98, 95% CI: 1.22-3.23). **Conclusions:** IDUs who sought care in the emergency department for soft tissue infections were at high risk for subsequent hospitalization and death. Visits for soft tissue infections represent missed opportunities for preventive care. (*J. Stud. Alcohol Drugs* **69:** 924-932, 2008)

SKIN AND SOFT TISSUE INFECTIONS (referred to in this article as "soft tissue infections"), such as abscesses and cellulitis, are common among injection drug users (IDUs), but little is known about health outcomes among individuals with these infections (Binswanger et al., 2000; Lloyd-Smith et al., 2005). In a study conducted in San Francisco in 1997, one third of community-recruited IDUs had an abscess or cellulitis verified by physical examination, and two thirds reported a prior history of an abscess (Binswanger et al., 2000). Soft tissue infections represent a common reason for emergency department (ED) visits and hospitalizations in urban hospitals in the United States and Canada (Ciccarone et al., 2001; Kerr et al., 2005; Palepu et al., 2001; Stein and Sobota, 2001). Visits to the ED for soft tissue infections represent an important point-of-health-care contact for IDUs and provide an opportunity to address the health care needs of IDUs and offer preventive services.

Patients with injection-related soft tissue infections are at risk for multiple complications of injection drug use, including methicillin-resistant *Staphyloccus aureus* (MRSA) infection, overdose, HIV/AIDS, and hepatitis B and C infection. Drug users, particularly IDUs, have been found to be at increased risk for death in the United States and abroad (Bargagli et al., 2001; Bartu et al., 2004; Copeland et al.,

Received: January 31, 2008. Revision: May 27, 2008.

*This research was supported by the Health Services Research and Development Service, Department of Veterans Affairs (VA); University of Washington Alcohol and Drug Abuse Institute; the Robert Wood Johnson Foundation Clinical Scholars Program; and the Division of General Internal Medicine at the University of Colorado Denver. Ingrid A. Binswanger was a VA fellow in the Robert Wood Johnson Clinical Scholars Program during the conduct of part of this study. Traci A. Takahashi was supported by National Institute on Drug Abuse grant RO3DA14518 at the time this study was conducted. Katharine Bradley was supported by National Institute of Alcohol Abuse and Alcoholism grant K23AA00313 and was a Robert Wood Johnson Foundation Generalist Physician Faculty Scholar at the time much of this study was conducted. Joseph O. Merrill received support from Harborview Medical Center for this work. The views expressed in this article are those of the authors and do not necessarily represent the position or policy of the Department of Veterans Affairs, Robert Wood Johnson Foundation, University of Washington, Harborview Medical Center, or the University of Colorado Denver. Preliminary findings from this study were presented at the Society for General Internal Medicine Annual Meeting in Toronto, April 2007.

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2004; Hser et al., 2001; Hulse et al., 1999; Oppenheimer et al., 1994; Saitz et al., 2007; Vlahov et al., 2004), but the hospitalization and mortality experience of IDUs who had health care contact for soft tissue infections is unknown. Hospitalization is an important health outcome, and the resources for treating IDUs are frequently borne by hospitals in the form of provision of uncompensated care for uninsured patients. In addition, hospitals have the opportunity to set local norms, define policies, and institute treatment guidelines, which could improve the care of IDUs. Among IDUs who sought emergency care for soft tissue infections, our primary objectives were to determine the rates of subsequent hospitalization and death, the characteristics associated with hospitalization or death, and the characteristics associated with increasing numbers of hospitalizations. Secondary objectives were to explore the provision of recommended diagnostic testing for IDUs with soft tissue infection and testing for HIV and hepatitis C in routine clinical care during the follow-up period.

Based on our previously described conceptual model (Takahashi et al., 2007) and other studies (Binswanger et al., 2007; Laine et al., 2001; Palepu et al., 2001; Saitz et al., 2007; Seal et al., 2001; Solomon et al., 1991; Stein and Anderson, 2003) of health care use or mortality among drug users, we hypothesized that certain demographic, socioeconomic, health, and substance-use characteristics would be associated with hospitalizations or death among IDUs who sought care for soft tissue infections. Among demographic and socioeconomic characteristics, we hypothesized that unstable living situations, recent incarceration, and lack of health insurance would be associated with a greater risk for hospitalization or death and greater numbers of hospitalizations. Health characteristics hypothesized to be associated with a greater risk included lack of a regular health care provider, poor health status, and more severe psychiatric problems. Substance-use characteristics hypothesized to be associated with increased risk included hazardous drinking, increasing severity of drug use, and higher risk skin and needle hygiene practices.

Method

Study design

This was a prospective cohort study of IDUs recruited from an urban medical center in Seattle, Washington. This study was approved by the University of Washington and University of Colorado Denver institutional review boards.

Study setting

Study enrollment took place at Harborview Medical Center, a public, urban, county hospital in Seattle, Washington. Recruitment was conducted in the ED 7 days a week from 9 AM to 10 PM from May 2001 to March 2002 using methods previously described (Takahashi et al., 2007). The ED offered resources for IDUs including drug counseling and pamphlets on syringe cleaning, safer injection practices, and how to prevent abscesses. Seattle has an active needle exchange program, and the reported local prevalence of HIV in IDUs was estimated at 1.2%-4.5% from 2001 to 2004 (Burt et al., 2007).

Harborview is the major provider of indigent care in the Seattle area; therefore, we expected that most of the follow-up care for the IDUs recruited from this medical center would take place at the same medical center. To test this assumption, we also examined subsequent hospitalization and laboratory data from an affiliated hospital, the University of Washington Medical Center. Although these additional data added little to the final analyses, they are included for completeness.

Participants

We recruited English-speaking IDUs, 18 years of age or older, who sought ED care for soft tissue infection, had not received previous medical care for their current infection, and were not currently incarcerated. Participants provided written informed consent for an interview and prospective record review. We included all participants who consented to participate and completed an initial survey, regardless of whether they were seen by a physician in the ED (n = 136; the sample previously described by Takahashi et al., 2007) or left without being seen by a physician (n = 20). Thus the total sample size was 156. Forty-five participants (28.8%) were hospitalized at the time of the index (baseline) ED visit based on billing records; these hospitalizations were excluded from further analysis because we were interested in the risk of *subsequent* hospitalization after emergency treatment of a soft tissue infection.

Data collection

At the index ED visit, trained interviewers conducted in-person structured interviews, including questions about demographic, socioeconomic, general health, and substance-use characteristics hypothesized to be associated with hospitalizations among IDUs.

Baseline measures

Demographic and socioeconomic characteristics measured at baseline included age; gender; self-reported race and ethnicity; educational level; current living situation; lifetime and 30-day incarceration history in jail, prison, or a juvenile facility; and health insurance (Takahashi et al., 2007). Health characteristics were assessed using questions about general health status (“In general, would you say your

health is poor, fair, good, very good or excellent?"), regular health care ("Do you have a regular health care provider or place where you usually go when you need health care?"), hospitalizations in the last year, and soft tissue infections in the last 6 months. Alcohol misuse was assessed with the Alcohol Use Disorders Identification Test-Consumption (AUDIT-C; Bush et al., 1998). Drug use was assessed using selected questions from the Addiction Severity Index (ASI) about heroin, methadone (Dolophine and Methadose), other opiates, sedatives/hypnotics, cocaine, and amphetamines (McLellan et al., 1992). Questions from the ASI assessed receipt of nonsubstance-abuse disability income (pension), chronic medical problems, prior drug treatment, the importance of drug treatment, and psychiatric status (ASI Psychiatric Composite Score). Questions about needle sharing and cleaning, skin cleaning, use of needle exchange, and self-treatment of current infections with antibiotics were asked to address hypotheses that these behaviors might be associated with subsequent health outcomes.

Outcome measures

Follow-up measures were obtained from hospital electronic billing and laboratory records of Harborview and the University of Washington Medical Centers through September 15, 2005, and from the National Death Index through December 31, 2004. National Death Index data are only made available on a yearly basis, but we were able to access medical records for an additional 9 months. In analyses that used the combined endpoint of hospitalization or death, data were censored at the earlier date of December 15, 2004.

Subsequent outpatient visits and hospitalizations. Follow-up outpatient and inpatient visit data were obtained from billing records through September 15, 2005. ED visits were coded in conjunction with inpatient visits if the ED visit resulted in hospital admission; otherwise, ED visits were considered outpatient visits. Outpatient visits included nurse or physician visits and visits for wound care, primary and specialty care, and urgent care. We used the billing definition of an inpatient stay, which excludes short stays (<24 hours), to be conservative in our estimates of inpatient hospital use. We determined the causes of subsequent hospitalizations using the principal (primary) diagnosis listed on billing records. These were categorized into major causes of admission (e.g., soft tissue infections, cardiovascular diseases).

Mortality. All-cause mortality data were obtained by submitting participants' personal identifiers to the National Death Index (National Center for Health Statistics, 2000) through December 31, 2004. The National Death Index, a computerized database that indexes deaths in all 50 states, the Virgin Islands, and Puerto Rico, provided potential matches for deaths, a probablistic score for each match, a class code based on which personal identifiers matched and the number of matching items, and a status code indicating whether the potential match was a "true match" (deceased) or "assumed alive." The status code was determined from the National Death Index's recommended cutoffs for probablistic scores for each class of potential match (National Center for Health Statistics, 1999).

Infectious diseases. We reviewed laboratory data to document the extent to which care recommended for IDUs presenting with soft tissue infections was provided. We evaluated bacterial cultures done as part of routine clinical care to document testing for and cases of MRSA. Participants were defined as developing MRSA if they had any positive culture for MRSA from wounds, blood, tissue, or the respiratory tract from the index ED visit through September 15, 2005. Likewise, testing for hepatitis C and HIV was identified based on laboratory testing for antibodies as part of routine clinical care. HIV infection was based on primary International Classification of Diseases, Ninth Revision (National Center for Health Statistics, 1990), diagnosis codes at the time of outpatient or inpatient care (042, 079.53, and V08) from the index ED visit through September 15, 2005. Review of laboratory data for HIV testing failed to identify additional cases of HIV.

Statistical analyses

Descriptive statistics and frequency distributions were generated for demographic and socioeconomic characteristics, health characteristics, drug and alcohol use, and ASI Psychiatric Composite Score. Bivariate analyses comparing patients who were subsequently hospitalized with those who were not hospitalized were conducted using chi-square for categorical variables, *t* statistics for continuous variables, and Fisher's exact tests for categories with few observations.

Descriptive statistics and frequency distributions were generated for hospital use variables, including total numbers of inpatient and outpatient visits. To determine the hospitalization rate, the number of hospitalizations was divided by person-years calculated from the index visit through September 15, 2005, or the date of death (if the participant died). To determine the all-cause mortality rate, we calculated the number of deaths over the person-years at risk. Person-years were calculated from the date of the index visit through December 31, 2004, or the date of death.

Cox proportional hazards regression analysis was used to evaluate the association between baseline characteristics and the combined endpoint of time to first hospitalization or death, adjusted for age and gender. The combined endpoint was selected because both outcomes were considered adverse. Thus, examining the association between baseline characteristics and hospitalization without accounting for deaths was thought to be potentially biased, and there was insufficient power to examine deaths alone. Age and gender were included a priori in the model because they are associated with mortality rates in most populations, including drug

users (Bartu et al., 2004; Copeland et al., 2004). For individuals who died before having a hospitalization, the endpoint was the date of death. Follow-up ended on the date of first hospitalization (through December 31, 2004), the date of death, or December 31, 2004, for those survivors who were never hospitalized. The Cox model included variables that were associated with at least one of the following outcomes using Kendall's tau coefficient at $p < .20$: hospitalized during follow-up, death, or time to first hospitalization.

Although Cox proportional hazards regression was used to examine associations with time to first hospitalization or death, it could not be used to determine which factors were associated with increasing numbers of hospitalizations. Therefore, we used Poisson regression to examine the association between baseline factors and the volume of inpatient hospital use. Poisson regression was used because hospitalization outcomes were counts and exhibited considerable right skewness (Myers, 1990). We tested associations between the number of hospitalizations during follow-up and the same independent variables tested in the adjusted Cox proportional hazards model.

We calculated the proportions of patients tested and diagnosed with MRSA, hepatitis C, and HIV during the follow-up period through September 15, 2005. We also calculated the proportions of subsequent hospitalizations related to each cause of hospitalization.

Statistical analyses were performed using SAS, Version 9.1 for personal computer (SAS Institute Inc., Cary, NC). The PHREG and GENMOD procedures in SAS were used for the Cox proportional hazards and Poisson models, respectively.

TABLE 1. Demographic characteristics of total sample ($N = 156$) and participants who were hospitalized ($n = 86$) or not hospitalized ($n = 70$) during follow-up

Characteristic	Total sample *n* (%)[a]	Hospitalized *n* (%)[a]	Not hospitalized *n* (%)[a]	*p*[b]
Age at enrollment				.54
<25	7 (4.5)	4 (4.7)	3 (4.3)	
25-34	26 (16.7)	17 (19.8)	9 (12.9)	
35-44	48 (30.8)	28 (32.6)	20 (28.6)	
45-54	69 (44.2)	33 (38.4)	36 (51.4)	
≥55	6 (3.9)	4 (4.7)	2 (2.9)	
Male	98 (62.8)	56 (65.1)	42 (60.0)	.51
Race and ethnicity				.06
White	99 (63.9)	53 (62.4)	46 (65.7)	
Black	26 (16.8)	11 (12.9)	15 (21.4)	
Latino	6 (3.9)	6 (7.1)	0 (0.0)	
Asian	4 (2.6)	1 (1.2)	3 (4.3)	
Native American	7 (4.5)	4 (4.7)	3 (4.3)	
Mixed	10 (6.5)	7 (8.2)	3 (4.3)	
Other/nonresponse	3 (1.9)	3 (3.5)	0 (0.0)	
Graduated from high school/GED	114 (73.1)	61 (70.9)	53 (75.7)	.50
Current living situation				.002
Own/rent	94 (60.3)	45 (52.9)	56 (80.0)	
Street	29 (18.6)	22 (25.9)	7 (10.0)	
Shelter	19 (12.2)	15 (17.6)	4 (5.7)	
Other/nonresponse	14 (9.0)	3 (3.5)	3 (4.3)	
Ever incarcerated	128 (82.6)	70 (82.4)	58 (82.9)	.93
Incarcerated in prior 30 days	16 (10.3)	15 (17.6)	1 (1.4)	<.001
Insurance benefits				.03
Private	6 (3.9)	4 (4.7)	2 (2.9)	
Medicare/Medicaid	77 (49.7)	49 (57.6)	28 (40.0)	
Veteran's Affairs	2 (1.3)	2 (2.4)	0 (0.0)	
None	68 (43.9)	30 (35.3)	38 (54.3)	
Did not respond	2 (1.3)	0 (0.0)	2 (2.9)	
Nonsubstance abuse disability	27 (17.7)	16 (19.0)	11 (15.9)	.62
Chronic medical problem	84 (54.2)	49 (57.6)	35 (50.0)	.34
Health status				.89
Poor	32 (20.7)	18 (21.2)	14 (20.0)	
Fair	38 (24.5)	19 (22.4)	19 (27.1)	
Good	61 (39.4)	33 (38.8)	28 (40.0)	
Very good	20 (12.9)	12 (14.1)	8 (11.4)	
Excellent	4 (2.6)	3 (3.5)	1 (1.4)	
Regular provider or health care	63 (40.7)	36 (42.4)	27 (38.6)	.63
≥2 hospitalizations in last year	26 (16.7)	21 (24.4)	5 (7.1)	<.001
Soft tissue infection in last 6 months	79 (50.6)	48 (55.8)	31 (44.3)	.15

Notes: GED = General Educational Development credential. [a]For characteristics with missing data due to nonresponses, percentages were calculated using the number of responses to a given item as the denominator; [b]chi-square test except for cells with fewer than five observations, for which Fisher's Exact test was used.

Results

ED staff identified 211 eligible patients; 156 (74%) agreed to participate. The mean (SD) age at enrollment was 42 (9) years. The demographic characteristics of the participants are described in Table 1. Among participants, 63% were men and 83% had previously been incarcerated. Most (81%) had been patients at Harborview Medical Center in the past, and 41% reported a regular source of care. Participants had been injecting drugs for a mean of 19 (12) years. Participants were followed over a mean of 3.9 (0.7) years and a total of 600 person-years from the index visit through the end of the study or death. A total of 86 patients were hospitalized during follow-up, not including hospitalizations at the time of the index ED visit. Comparisons between participants who were hospitalized and those who were not, in terms of demographic, socioeconomic, and health characteristics, are provided in Table 1.

Drug- and alcohol-use characteristics and behaviors of the sample and comparisons in drug- and alcohol-use characteristics between participants who were hospitalized and those who were not are described in Table 2. Heroin alone was the most frequently injected drug (88.4%). Most (90.3%) of the sample had used needle exchange programs. Seventy-five percent of the sample reported that drug treatment was considerably or extremely important to them.

There were 247 subsequent hospitalizations at Harborview and only 8 at University of Washington Medical Center. The hospitalization rate was 42 hospitalizations per 100 person-years of follow-up (95% confidence interval [CI]: 38-48; Table 3). Among the 86 (55.1%) participants with one or more hospitalizations after the index visit, the mean number of hospitalizations during the follow-up period was 3.0 (3.7)—6 (7.0%) were hospitalized within 30 days and 49 (57.0%) within 1 year. Of the outpatient visits, 32.8% (1,684/5,139) were associated with an ED visit. Half of

TABLE 2. Drug- and alcohol-use related characteristics among participants overall (N = 156) and by whether hospitalized (n = 86) or not hospitalized (n = 70) during follow-up

Behavior/characteristic	Total sample n (%)[a]	Hospitalized n (%)[a]	Not hospitalized n (%)[a]	p[b]
Years of injection drug use, mean (SD)	18.7 (11.8)	19.2 (11.6)	18.3 (12.1)	.63
Drug injected most frequently, no. (%)				.005
Heroin only	137 (88.4)	76 (89.4)	61 (87.1)	
Heroin and cocaine	6 (3.9)	6 (7.1)	0 (0.0)	
Cocaine only	3 (1.9)	0 (0.0)	3 (4.3)	
Methamphetamine	8 (5.2)	2 (2.4)	6 (8.6)	
Other	1 (0.7)	1 (1.2)	0 (0.0)	
No. days used heroin in last 30 days, mean (SD)	21.2 (11.9)	19.1 (12.7)	23.0 (11.0)	.04
How often injected with previously used needles, no. (%)				.007
Never	122 (78.7)	60 (70.6)	62 (88.6)	
Rarely	19 (12.3)	16 (18.8)	3 (4.3)	
Sometimes/usually	13 (8.4)	9 (10.6)	4 (5.7)	
Always	1 (0.7)	0 (0.0)	1 (1.4)	
Did not clean needle at last injection, no. (%)	21 (13.5)	9 (10.5)	12 (17.1)	.12
Did not clean skin at last injection, no. (%)	66 (42.6)	38 (44.2)	28 (40.0)	.54
Ever used needle exchange, no. (%)	140 (90.3)	77 (90.6)	63 (90.0)	.90
Self-treated with antibiotics, no. (%)	43 (27.6)	22 (25.6)	21 (30.0)	.58
Hazardous drinking (AUDIT-C), no. (%)				.31
Nondrinkers	59 (38.1)	35 (41.2)	24 (34.3)	
Drinkers—screen negative	45 (29.0)	25 (29.4)	20 (28.6)	
Mild alcohol misuse	24 (15.5)	9 (10.6)	15 (21.4)	
Moderate to severe alcohol misuse	27 (17.4)	16 (18.8)	11 (15.7)	
Alcohol/drug composite score,[c] mean (SD)	0.39 (0.15)	0.40 (0.15)	0.37 (0.14)	.23
Importance of drug treatment, no. (%)				.19
Not at all	5 (3.7)	3 (4.0)	2 (3.4)	
Slightly	3 (2.2)	1 (1.3)	2 (3.4)	
Moderately	9 (6.7)	8 (10.7)	1 (1.7)	
Considerably	38 (28.4)	18 (24.0)	20 (33.9)	
Extremely	79 (59.0)	45 (60.0)	34 (57.6)	
No. of prior drug treatment experiences, median (IQR[d])	3.0 (2.0-5.0)	3.0 (2.0-5.0)	3.0 (2.0-6.0)	.21
Psychiatric composite score, mean (SD)	0.38 (0.26)	0.39 (0.25)	0.37 (0.27)	.62

Notes: AUDIT-C = Alcohol Use Disorders Identification Test-consumption. [a]For behaviors/characteristics with missing data due to nonresponses, percentages were calculated using the number of responses to a given item as the denominator; [b]chi-square test except for cells with fewer than five observations, for which Fisher's Exact test was used; t test for continuous variables; [c]adapted composite score does not include all drugs used in the full Addiction Severity Index composite score; [d]IQR = interquartile range, 25th-75th percentiles.

TABLE 3. Inpatient and outpatient visits over a mean follow-up of 3.9 years ($N = 156$)

Variable	Inpatient visits	Outpatient visits
n	255[a]	5,004
Individuals, *n* (%)	86 (55)	146 (94)
Rate per 100 person-years	42	833

[a]8 at University of Washington Medical Center.

TABLE 4. Reasons for subsequent hospitalization ($N = 255$)

Reason	*n* (%)
Skin and soft tissue infections	127 (49.8)
Pneumonia/other respiratory diseases	32 (12.5)
Bone and joint (osteomyelitis and septic arthritis)	16 (6.3)
Alcohol/substance use	16 (6.3)
HIV/AIDS	10 (3.9)
Abdominal process	10 (3.9)
Cardiovascular conditions	9 (3.5)
Psychiatric disorders	6 (2.4)
Neurological disorders	5 (2.0)
Diabetes	4 (1.6)
Other	20 (7.8)

subsequent hospitalizations were related to soft tissue infections, followed by pneumonia and other respiratory disorders (Table 4).

During 497 person-years of follow-up for mortality, there were 10 deaths. The mortality rate was 2.0 per 100 person-years (95% CI: 0.9-3.7), at a mean age of 45 years. Four deaths were coded as overdoses—accidental or of undetermined intent. Three deaths were from other medical causes, including chronic obstructive pulmonary disease; two deaths were from mental and behavioral disorders due to substance use; and one was from a nonoverdose accident.

Factors assessed at baseline that were associated with time to hospitalization or death included living in a shelter or on the street, having been incarcerated in the prior 30 days, and having insurance (private, Medicare, Medicaid, and veterans benefits; Table 5). Reporting two or more prior hospitalizations in the last year was associated with time to hospitalization or death in unadjusted analyses but was no longer associated after adjustment for age and gender. Hazardous drinking based on AUDIT-C scores was marginally associated with hospitalization ($p = .18$) but did not satisfy the proportional hazards assumption and thus was excluded from the final Cox model. Although having insurance was associated with reporting disability income, disability income was not significantly associated with the outcome in the model ($p = .11$) and did not affect the hazard associated with insurance, thus this variable was not included.

Baseline characteristics associated with increasing numbers of hospitalizations in the final Poisson model included having been incarcerated in the prior 30 days, reporting a chronic medical problem, having a soft tissue infection in the previous 6 months, and reporting two or more hospitalizations in the prior year (Table 6). The model was adjusted for age, gender, and duration of follow-up.

In the course of usual clinical care, 112 (71.8%) patients were tested for MRSA at least once during the study period. Of those tested, 41 (36.6%) individuals had at least one episode of MRSA. Forty-five (28.8%) patients were tested by their providers for hepatitis C antibodies, of which 40 (88.9%) tested positive (59 total tests). Forty individuals (25.6%) were tested for HIV antibodies. Of those tested, 12 participants (30.0%) had a diagnosis of HIV.

Discussion

IDUs who presented to the ED for soft tissue infection were at high risk of subsequent hospitalization and death.

TABLE 5. Baseline factors associated with time to subsequent hospitalization or death

Variable	Unadjusted hazard ratio (95% CI)	Adjusted hazard ratio[a] (95% CI)	Fully adjusted hazard ratio[b] (95% CI)
Living on street or in shelter	2.09 (1.37-3.19)	1.95 (1.25-3.05)	1.75 (1.10-2.79)
Has insurance	1.83 (1.18-2.81)	2.08 (1.29-3.35)	1.98 (1.22-3.23)
≥2 hospitalizations in last year	2.18 (1.34-3.57)	1.64 (0.96-2.81)	1.60 (0.93-2.76)
Incarcerated in prior 30 days	2.50 (1.43-4.38)	2.56 (1.46-4.51)	1.90 (1.05-3.44)

Notes: CI = confidence interval. [a]Adjusted for age and gender; [b]adjusted for age, gender, and other covariates on the table.

TABLE 6. Baseline factors associated with number of hospitalizations

Variable	Estimated rate ratio for subsequent hospitalizations (95% CI)[a]	*p*
Chronic medical problem vs none	1.49 (1.12-1.99)	.006
≥2 hospitalizations in last year vs <2	2.43 (1.83-3.23)	<.001
Soft tissue infection in last 6 months vs none	1.60 (1.22-2.11)	.008
Incarcerated in prior 30 days	1.60 (1.12-2.28)	.01

Notes: CI = confidence interval. [a]Adjusted for age, gender, and duration of follow-up. All other covariates set at mean value.

Our results suggest that medical providers and hospital administrators should be aware that IDUs seeking care for soft tissue infections are at high risk for subsequent morbidity and death and should seek to reduce the risk.

More than half the IDUs experienced an inpatient admission during the subsequent 4-year follow-up, with a mean of three hospitalizations per admitted patient. In addition to high hospital use, mortality rates were in excess of what would be expected for a largely young population. We calculated a mortality rate of 2.0 per 100 person-years in a population with a mean age of 42 years; in contrast, mortality rates for men and women ages 35-44 in the general population in Washington State were 0.2 per 100 person-years and for those ages 45-54 were 0.4 per 100 person-years (2001-2004), substantially lower than the rates observed in this sample. In the general population, men and women ages 65-74 have an equivalent mortality rate (National Center for Health Statistics, 2008). A meta-analysis of mortality among heroin users internationally reported a pooled estimate of mortality of 0.86 per 100 person-years, lower than our reported estimates. However, this meta-analysis demonstrated heterogeneity in the estimates of mortality, had limited ability to adjust for age, excluded studies with high rates of AIDS-related deaths, and included only studies published through 1996 (Hulse et al., 1999). Thus, further research is needed to determine if IDUs presenting for care of soft tissue infections are at increased risk compared with IDUs who do not acquire these infections or do not seek care. Research to define the risk of morbidity and mortality attributable to soft tissue infections in a population-based study of IDUs would be a useful next step.

IDUs living on the street or in a shelter had a shorter time to hospitalization and death than other IDUs, consistent with findings from studies of drug users generally (Gossop et al., 2002; Palepu et al., 2001). Incarceration in the 30 days before the index visit was associated with a shortened time to hospitalization or death and an increased number of hospitalizations. These findings support prior studies that demonstrate a vulnerability of former inmates to death (Binswanger et al., 2007; Bird and Hutchinson, 2003), perhaps because of decreased tolerance to drugs or greater social and economic instability or because increased criminal justice involvement signals increased propensity toward risk behavior. The finding that having insurance was associated with shortened time to hospital admission was suprising in light of our hypothesis that lack of insurance would confer a greater risk for hospitalization or death. Insurance status may be related to disability for patients on Medicaid, and eligible patients are frequently enrolled in Medicaid at hospital admission. Indicators of disease burden were associated with an increased number of hospitalizations, including having a chronic illness, prior soft tissue infection, and prior hospitalizations.

Characteristics associated with hospitalizations or death (living in a shelter, recent incarceration, and recent hospitalization) can be used to target interventions toward those at highest risk, such as IDUs presenting with soft tissue infection who have institutional experience including in correctional facilities, hospitals, and shelters. However, the high overall risk of death in this cohort suggests that all IDUs who seek emergency care for soft tissue infections are candidates for interventions to reduce subsequent morbidity and mortality.

Our results suggest that all medical visits with IDUs should be considered opportunities to reduce the risk of subsequent morbidity and mortality. Risk-reduction strategies include referral to substance-dependence treatment. The vast majority of IDUs in this study were motivated for drug treatment. Rapid access to methadone or buprenorphine (Buprenex, Suboxone, and Subutex) maintenance may decrease hospital use and mortality among IDUs, based on observational studies that suggest that current drug treatment was associated with a lower hazard of death among drug users (Bartu et al., 2004; Langendam et al., 2001). Interventions to decrease accidental overdose, the most common cause of death in this study, are needed. The distribution of naloxone to IDUs to prevent overdose is a promising intervention that warrants further investigation (Dettmer et al., 2001; Seal et al., 2005; Strang et al., 1996). Training individuals likely to come into contact with heroin users to perform cardiopulmonary resuscitation before the arrival of emergency response services is another approach that may reduce hospitalizations (Dietze et al., 2002). Surveillence studies have shown significant regional variations in rates of drug overdoses within cities, and the use of such data may be an efficient way to allocate risk-reduction resources and substance-abuse treatment (Davidson et al., 2003; Dietze et al., 2003). Additional interventions to consider include counseling about overdose risks and tobacco use and hepatitis A and B immunizations.

Effective prevention, diagnosis, and treatment of IDUs with soft tissue infections are particularly important in light of the high percentage of participants who acquired MRSA and rates of subsequent hospitalization for soft tissue infections. Hospitals should consider ways to reduce the rate of repeat hospitalizations. Abscess or wound clinics (Harris and Young, 2002) may reduce the burden on ED providers and allow for specialized services for IDUs. In Seattle, a wound care/abscess clinic has been established in conjunction with the needle exchange program. Preventive interventions for IDUs with soft tissue infections may decrease morbidity and mortality.

Contacts with the medical system for soft tissue infections represent potentially missed opportunities for delivery of preventive services and interventions to decrease the risk of subsequent adverse events. We found that many patients did not have hepatitis C and HIV testing during their routine clinical care, despite numerous inpatient and outpatient medical visits. Likewise, 28.2% of the patients in our study

did not have culture data. MRSA is now the most common cause of purulent soft tissue infections among patients presenting to urban EDs in the United States. In 11 university-affiliated EDs, MRSA was isolated from 59% of patients and accounted for 78% of all *S. aureus* isolates (Moran et al., 2006). The recruitment of our cohort from 2001-2002 predated the more recent dramatic increase in community-associated MRSA in Seattle; however, 37.5% of participants had at least one episode of MRSA. The increased prevalence of MRSA signaled a change in approach to the management of soft tissue infections, including the need for MRSA risk factor assessment, obtaining cultures at the time of incision and drainage, and the use of empiric regimens that cover MRSA based on local antimicrobial susceptibility patterns (e.g., trimethoprim-sulfamethoxazole [Bactrim and others], minocycline [Minocin and others] or doxycycline [Atridox and others], or clindamycin [Cleocin and others]) (Dellit and Duchin, 2007).

The hospitalization and mortality experience of IDUs who sought care for soft tissue infections in other cities with little or no access to needle exchange and higher HIV prevalence may be even greater. Our hospitalization rate was conservative, and our analyses on factors associated with hospitalization or death may have been biased toward the null because we could not measure hospitalizations for participants who moved out of the city or were incarcerated. Although we used the National Death Index, which currently provides the best available means to determine deaths, we could not ascertain deaths that occurred out of the country, and this underascertainment would result in a conservative estimate of mortality rates. Although our study involved a small, nonrandom sample of IDUs who sought care for soft tissue infections, the strengths of this study included detailed baseline demographic, socioeconomic, and behavioral data on a hard-to-reach population, the prospective cohort design, the use of hospital records rather than self-reports to determine hospitalizations, and ascertainment of mortality outcomes using the National Death Index.

We have described poor outcomes among IDUs who sought care for soft tissue infections. Substance dependence is a chronic disease. Hospitalizations for soft tissue infections may represent "sentinel events" similar to hospitalizations in other chronic diseases such as asthma (Bundy, 2007). The development and evaluation of efficacious and effective prevention strategies and the identification of key components of high quality care for drug users are warranted.

Acknowledgments

We thank John F. Steiner, M.D., M.P.H., and Jean S. Kutner, M.D., M.S.P.H., for their thoughtful reviews of this article. We also acknowledge the assistance of Susan Onstad in data acquisition and Susanne Felton, M.A., in study coordination.

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