Follow-up After Burn Injury Is Disturbingly Low and Linked With Social Factors

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For medical and social reasons, it is important that burn patients attend follow-up appointments (FUAs). Our goal was to examine the factors leading to missed FUAs in burn patients. A retrospective chart review was conducted of adult patients admitted to the burn center from 2016 to 2018. Data collected included burn characteristics, social history, and zip code. Data analysis was conducted using chi-square, Wilcoxon Rank-Sum tests, and multivariate regression models. A total of 878 patients were analyzed, with 224 (25.5%) failing to attend any FUAs and 492 (56.0%) missing at least one appointment (MA). Patients who did not attend any FUAs had smaller burns (4.5 [8]% vs 6.5 [11]% median [inter quartile range]), traveled farther (70.2 [111.8] vs 52.5 [76.7] miles), and were more likely to be homeless (22.8% vs 6.9%) and have drug dependence (47.3% vs 27.2%). Patients who had at least one MA were younger (42 [26] vs 46 [28] years) and more likely to be homeless (17.5% vs 2.6%) and have drug dependence (42.5% vs 19.4%). On multivariate analysis, factors associated with never attending an FUA were distance from hospital (odds ratio [OR] 1.004), burn size (OR 0.96), and homelessness (OR 0.33). Factors associated with missing at least one FUA: age (OR 0.99), drug dependence (OR 0.46), homelessness (OR 0.22), and Emergency Department visits (OR 0.56). A high percentage of patients fail to make any appointment following their injury and/or have at least one MA. Both FUAs and MAs are influenced by social determinants of health.

Patients who suffer from burns often have significant wounds that require multiple follow-up appointments (FUAs) after discharge.[1] Sequelae such as scarring, contractures, and infections can persist and cause physical and psychological distress, leading to lower quality of life.[2] It is important that patients attend FUAs to be evaluated by a physician and minimize these adverse effects. Patients in this population also face challenges with social interactions and self-perception.[3] Attendance of FUAs can help physicians identify such difficulties and assist with finding appropriate resources.

As important as FUAs are, attendance and factors that affect attendance have been minimally studied in the burn surgery population. Low socioeconomic status (SES) has been linked with increased burn injury and graft loss,[4] but not many studies have delved into the effect on FUA attendance. A recent study from South Africa looking at both children and adults found that 33% of patients were not adherent with their follow-up plans and that the factors associated with keeping FUAs were younger age (<12 years old) and requiring an operation during hospitalization.[5] While this study did examine FUAs specifically for medical care, it did not examine the social risk factors associated with adherence to follow-up plans. Other studies in burn-injured patients looked at follow-up as a measure of patients participating in a research study rather than attending appointments to seek burn injury care. A 1998 study found that burn patients with substance abuse and psychiatric comorbidities had higher rates of dropout in a 12-month study[6] but did not explore factors beyond these. Holavanahalli et al[7] followed up patients with burn injuries from four different burn centers and found a decline in follow-up at 6, 12, and 24 months. They defined FUAs as any phone, mail, or physical contact with patients and identified that low education levels and substance abuse were risk factors to not following up with the study and completing self-assessment questionnaires. In other fields of medicine, a study on trauma orthopedic patients has shown that those with lower health scores and lack of postsecondary education were less likely to attend an FUA, totaling 18% of the patients studied.[8] Another orthopedics study found that 33.1% of patients did not show up to their FUA, with tobacco users, non-private insurance owners, and those who lived more than 100 miles away from the clinic being less likely to attend.[9]

While FUAs as they relate to direct medical care have been studied in other areas of medicine, these studies are lacking following burn injury. Most of the studies mentioned above look at follow-up with respect to research studies, not for medical care directly related to the patient's injury. In this study, we strive to examine the rate of FUAs for patients following burn injury and to assess the injury-related factors and social factors that are associated with follow-up. With the link between low SES and burn injury and low SES and FUA

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attendance, we hypothesize that patients with burn injuries will have low clinic attendance after discharge. We further hypothesize that SES and other social factors will play a significant role in a patient's ability to attend an FUA.

METHODS

Following institutional review board approval, a retrospective chart review was conducted using electronic medical records (EMRs) of all adult patients admitted to the burn center from January 1, 2016 to December 31, 2018. Patients with non-burn injuries (friction, desquamating skin conditions, or cold injuries) were excluded as the demographics and circumstances of these injuries tend to be different. Other excluded patients were those who did not have an FUA scheduled, including those who were transferred and subsequently followed at another hospital, those whose insurance prevented follow-up at our institution, and those who died in the hospital. Prisoners were also excluded.

Data were collected on burn size (%TBSA), days on a ventilator, length of stay (LOS), intensive care unit (ICU) days, discharge disposition, primary payor source, FUA attendance, missed appointments (MAs), Emergency Department (ED) visits related to the burn injury, readmissions, homelessness, substance dependence, major psychiatric illness, SES, and distance from clinic. Poverty level, high school graduation rate, and median household income were used to determine SES and were collected from census data based on patient zip codes using the U.S. Census Bureau estimates. Substance dependence was determined through the inclusion of alcoholism and/or drug dependence in the patient's medical record as a comorbidity. Distance from clinic was calculated based on patient's reported discharge address or address on their medical chart using the shortest mileage route from Google Maps.

FUAs were counted up to a year after the patient's discharge date. MAs were considered those appointments for which the patient did not show up to the clinic without calling to cancel or reschedule. Canceled appointments or rescheduled appointments were not considered MAs since patients had to call the clinic and therefore had some communication with the clinic staff. ED visits were counted using recorded visits at our institution or patient self-reported visits at outside institutions as written in the medical record or documented phone conversations.

SAS statistical software, version 9.4 (SAS Institute, Cary, NC) was used to analyze the data. A Shapiro–Wilk test for normality was used to determine whether continuous variables had a normal distribution. All continuous variables for this study did not have a non-parametric distribution, therefore a Wilcoxon rank-sum test was used for the analysis of continuous variables. Chi-square testing was used to determine significant differences in proportions and categorical data. Univariate analysis was done on all variables in relation to any FUAs, any MAs, number of FUAs, and number of MAs. Multivariate regression analysis was performed to assess factors leading to any FUAs, any MAs, number of FUAs, and number of MAs. All variables that were significant on univariate analysis were included in the multivariate analysis. All mean values are represented as mean ± standard deviation, and all median values are represented as median (interquartile range). Statistical significance was determined by a P value of less than .05.

RESULTS

Of the 1135 patients admitted into the burn surgery ICU from January 1, 2016 to December 31, 2018, 878 patients (mean age 45.1 ± 16.8 years, 646 males [73.6%], mean TBSA 10.16 ± 11.7%) were analyzed. There were 257 patients excluded from the study per the exclusion criteria (Figure 1). Total population demographics showed that 96 (10.93%) patients were homeless, 284 (32.35%) had drug dependence, 128 (14.58%) had alcoholism, and the mean poverty level was 17.7 ± 8.24% (Table 1). In this population, 224 (25.5%) patients failed to attend any FUA and 492 (56.0%) patients had at least one MA.

It was found that the group of patients who did not did not attend any FUAs had smaller burns (4.5 [8]% vs 6.5 [11]%, $P = .0002$), fewer ventilator days (1 [5] vs 4 [18], $P = .007$), shorter LOS (8 [11] vs 10 [16] days, $P = .03$), fewer ICU days (8 [11] vs 9 [15] days, $P = .03$), traveled farther (70.2 [111.8] vs 52.5 [76.7] miles, $P = .02$), were more likely to be homeless (22.8% vs 6.9%, $P < .0001$), have alcoholism (18.8% vs 13.2%, $P = .04$), have a major psychiatric illness (20.5% vs 13.8%, $P = .02$), use tobacco (71% vs 52%, $P < .0001$), and have drug dependence (47.3% vs 27.2%, $P < .0001$) than the patients who did attend at least one FUA (Table 2). There was no difference with respect to age, LOS/%TBSA, high school graduation rate, or poverty rate in those who did or did not attend a FUA. Patients whose primary insurer was Worker's Compensation were more likely to return for at least one FUA, $P < .001$. On multivariate logistic regression, distance from clinic (odds ratio [OR] = 1.004, $P = .04$), %TBSA (OR = 0.96, $P = .002$), and homelessness (OR = 0.33, $P < .03$) were independently associated with not attending any FUAs.

Patients who had at least one MA are similar to those who had no FUAs but there are differences (Table 3). Those who had at least one MA were younger (42 [26] vs 46 [28] years, $P = .02$), had smaller burns (5 [10.3]% vs 6.6 [11]%, $P = .05$), had longer LOS/%TBSA burns (1.5 [2.3] vs 1.1 [1.5], $P < .0001$), a lower median income ($50,687 [20,430] vs $53,278 [22,917], $P = .02$), increased rates of poverty (16.6

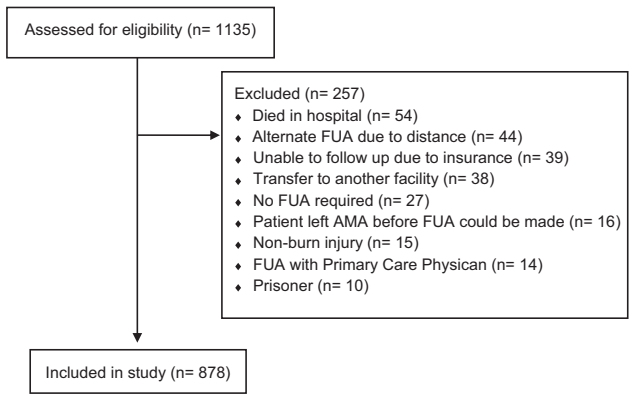

Figure 1. CONSORT diagram of exclusions from the study.

[11.4]% vs 15.3 [11]%, $P = .002$), decreased distance traveled to clinic (52.7 [85.2] vs 58.1 [78.5] miles, $P = .02$), increased ED visits (13.6% vs 5.44%), more likely to be homeless (17.5% vs 2.6%), have alcoholism (17.5% vs 10.9%), have major psychiatric illness (17.7% vs 12.7%), use tobacco (64.2% vs 47.4%), and have drug dependence (42.5% vs 19.4%). In addition, primary payor source was significant for fewer MAs in patients who had Worker's Compensation insurance. There was no association between ventilator days, LOS, ICU days, unplanned readmissions, high school graduation rate, and having at least one MA. On multivariate logistic regression, factors that were found to be independently associated with at least one MA were age (OR = 0.99, $P = .02$), %TBSA (OR = 0.98, $P = .009$), drug dependence (OR = 0.46, $P < .0001$), homelessness (OR = 0.22, $P < .0001$), primary payor (with Worker's Compensation as the comparator: Medicaid OR = 3.33, $P < .0001$, or Medicare OR = 3.39, $P = .0006$), and ED visits (OR = 0.56, $P = .04$).

Analysis of number of FUAs attended showed decreased number of FUAs associated with no ED visits ($P = .01$), no unplanned readmissions($P = .04$), homelessness ($P < .0001$), alcoholism ($P = .02$), drug dependence ($P < .0001$), and major psychiatric illness ($P = .03$; Table 4). There was a weak but significant correlation between number of FUAs and %TBSA (Spearman correlation coefficient [SCC] = 0.16, $P < .0001$), LOS (SCC = 0.18, $P < .0001$), and ICU days (SCC = 0.19, $P < .0001$). A multivariate linear regression was conducted to predict number of FUAs from ICU days, ED visits, homelessness, drug dependence, and major psychiatric illness. Increased number of FUAs were independently associated with increased ICU days ($P < .0001$), ED visits ($P = .0008$), not being homeless ($P = .005$), not having drug dependence ($P < .0001$), and not having major psychiatric illness ($P = .04$).

The factors associated with increased number of MAs were similar to those seen with decreased number of FUAs: homelessness ($P < .0001$), unplanned readmissions ($P = .04$),

Table 1. Total population demographics

	Total Population
	Mean (*SD*)
Age (years)	45.1 (16.8)
TBSA (%)	10.2 (11.7)
Ventilator days (days)	16.5 (31.3)
LOS (days)	15.1 (24.0)
LOS/TBSA (days/%)	2.65 (4.96)
ICU days (days)	14.6 (21.5)
Number of FUAs	2.37 (2.93)
Number of MAs	0.77 (0.92)
High school graduation rate (%)	83.97 (9.69)
Median income ($)	55,986.84 (17,767.73)
Poverty (%)	17.7 (8.34)
Distance from clinic (miles)	74.8 (78.8)
	N (%)
No FUA attended	224 (25.51)
At least one MA	492 (56.04)
ED visits	88 (10.02)
Unplanned readmissions	42 (4.78)
Worker's Compensation	70 (7.97)
Homelessness	96 (10.93)
Alcoholism	128 (14.58)
Drug dependence	284 (32.35)
Major psychiatric illness	136 (15.49)
Tobacco use	499 (56.83)

ICU, intensive care unit; *LOS*, length of stay; *MA*, missed appointment; *FUA*, follow-up appointment; *ED*, Emergency Department.

Table 2. Factors associated with attending at least one FUA

	No FUA	FUA	*P*
	Median (IQR)	Median (IQR)	
Age (years)	45 (25)	43 (27)	.37
TBSA (%)	4.5 (8)	6.5 (11)	.0002
Ventilator days (days)	1 (5)	4 (18)	.007
LOS (days)	8 (11)	10 (16)	.03
LOS/TBSA (days/%)	1.43 (2.3)	1.23 (1.8)	.07
ICU days (days)	8 (11)	9 (15)	.03
High school graduation rate (%)	88.3 (10.7)	86.4 (13.2)	.12
Median income ($)	51,569 (20,243)	51,918 (21,760)	.04
Poverty (%)	16.6 (12.2)	15.8 (11.3)	.2
Distance from clinic (miles)	70.2 (111.8)	52.5 (76.7)	.02
	Number (%)	Number (%)	
ED visits	16 (7.1)	72 (11.0)	.1
Unplanned readmissions	8 (3.6)	34 (5.2)	.32
Worker's Compensation	2 (0.89)	68 (10.4)	<.0001
Homelessness	51 (22.8)	45 (6.9)	<.0001
Alcoholism	42 (18.8)	86 (13.2)	.04
Drug dependence	106 (47.3)	178 (27.2)	<.0001
Major psychiatric illness	46 (20.5)	90 (13.8)	.02
Tobacco use	159 (71)	340 (52)	<.0001

ICU, intensive care unit; *LOS*, length of stay; *FUA*, follow-up appointment; *ED*, Emergency Department; *IQR*, interquartile range.

Table 3. Factors associated with missing at least one FUA

	At Least One MA	No MA	*P*
	Median (IQR)	Median (IQR)	
Age (years)	42 (26)	46 (28)	.02
TBSA (%)	5 (10.3)	6.6 (11)	.05
Ventilator days (days)	2 (12)	4.5 (18)	.14
LOS (days)	10 (14)	8 (16)	.08
LOS/TBSA (days/%)	1.5 (2.3)	1.1 (1.5)	<.0001
ICU days (days)	9 (14)	9 (15)	.28
High school graduation rate (%)	86.4 (13)	86.9 (13)	.43
Median income ($)	50,687 (20,430)	53,278 (22,917)	.02
Poverty (%)	16.6 (11.4)	15.3 (11)	.002
Distance from clinic (miles)	52.7 (85.2)	58.1 (78.5)	.02
	Number (%)	Number (%)	
ED visits	67 (13.6)	21 (5.4)	<.0001
Unplanned readmissions	29 (5.9)	13 (3.4)	.08
Homelessness	86 (17.5)	10 (2.6)	<.0001
Worker's Compensation	20 (4.1)	50 (13)	<.0001
Alcoholism	86 (17.5)	42 (10.9)	.006
Drug dependence	209 (42.5)	75 (19.4)	<.0001
Major psychiatric illness	87 (17.7)	49 (12.7)	.04
Tobacco use	316 (64.2)	183 (47.4)	<.0001

ICU, intensive care unit; *LOS*, length of stay; *ED*, Emergency Department; *MA*, missed appointment; *IQR*, interquartile range.

Table 4. Factors associated with the number of FUAs attended

		Mean Number of FUAs	Median Number of FUAs (IQR)	*P*
Sex	Female	2.58	2 (29)	.25
	Male	2.3	1 (24)	
ED visits	No	2.25	1 (25)	.01
	Yes	3.43	2 (29)	
Unplanned readmissions	No	2.33	1 (29)	.04
	Yes	3.17	2.5 (13)	
Homeless	No	2.52	2 (29)	<.0001
	Yes	1.14	0 (8)	
Alcoholism	No	2.46	2 (29)	.02
	Yes	1.86	1 (16)	
Drug dependence	No	2.74	2 (29)	<.0001
	Yes	1.6	1 (16)	
Major psychiatric illness	No	2.43	2 (24)	.03
	Yes	2.07	1 (29)	

FUA, follow-up appointment; *ED*, Emergency Department; *IQR*, interquartile range.

alcoholism ($P = .0005$), and drug dependence ($P < .0001$; Table 5). Additionally, there were increased MAs associated with patients who had an ED visit compared to those who did not have an ED visit ($P < .0001$). There was a weak but significant correlation between number of MAs and age (SCC = −0.07, $P = .04$), LOS (SCC = 0.10, $P = .002$), LOS/%TBSA (SCC = 0.16, $P < .0001$), and ICU days (SCC = 0.1, $P = .02$). A multivariate linear regression was conducted to predict the number of MAs from ED visits, homelessness, and drug dependence. Increased number of MAs was independently associated with having an ED visit ($P < .0001$), being homeless ($P = .0003$), and having drug dependence ($P < .0001$).

DISCUSSION

More than half of the patients admitted to our institution's burn unit had at least one MA and a quarter of the patients failed to attend any FUA at all. Homelessness and %TBSA are key factors in both of these outcomes. Other contributing factors to no FUA attendance include distance traveled to follow-up clinic while associated factors with at least one MA include younger age, drug dependence, primary payor, and more ED visits. These results indicate the impact that social determinants of health have on patient attendance at FUAs.

In our study, homelessness is a significant risk factor for any missed FUA. A 2018 study found that homeless adults

Table 5. Factors associated with the number of MAs

		Mean Number of MAs	Median Number of MAs (IQR)	*P*
Sex	Female	0.76	1 (1)	.93
	Male	0.78	1 (9)	
ED visits	No	0.71	1 (5)	<.0001
	Yes	1.35	1 (9)	
Unplanned readmissions	No	0.75	1 (6)	.04
	Yes	1.17	1 (9)	
Homeless	No	0.71	1 (6)	<.0001
	Yes	1.26	1 (9)	
Alcoholism	No	0.75	1 (9)	.005
	Yes	0.92	1 (5)	
Drug dependence	No	0.65	0 (5)	<.0001
	Yes	1.04	1 (9)	
Major psychiatric illness	No	0.76	1 (9)	.1
	Yes	0.83	1 (4)	

ED, Emergency Department; *MA*, missed appointment; *IQR*, interquartile range.

receiving surgery had a higher risk of postoperative readmission or ED visit within 30 days after discharge and a common reason for these actions was wound complication.[10] This study did not look at FUA attendance in the homeless population, which is a major contributor to wound examination and wound care. Another study looking at homeless patients with orthopedic trauma found that they had more ED visits and attended fewer FUAs.[11] These combined results suggest that the decrease in FUA attendance in the homeless population may be a risk factor for readmission and increased rates of ED visits.

Our study also showed drug dependence and primary payor source to be a factor in patients having any MAs. This is similar to a study on patients with heart failure which found that a history of drug abuse was one of the factors leading to and a predictor of MAs.[12] However, they defined an MA as one not attended within 14 days after discharge, while we looked at any MA with our clinic over the span of a year. Analysis on primary payor source indicated that Worker's Compensation insurance is associated with more patients attending at least one FUA and fewer patients having MAs. Although this is statistically significant, we do not know how important these results are for any steps moving forward, as patients with Worker's Compensation are required to attend FUAs to continue getting coverage and this may have been a contributing factor.

Smaller burn size and increased distance needed to travel from place of discharge to follow-up clinic were other important contributing factors to patients failing to attend any FUAs. This suggests that patients with a smaller burn size healed faster or had fewer complications and thus may have felt less inclined to attend their FUA. They could also have attended an FUA with their primary care physician (PCP), but we had no record of this in their chart and they never canceled their scheduled FUA with our institution. Our analysis shows that those who had to travel farther were less likely to attend any FUA at our clinic. Possible reasons for this could be that patients do not find the drive worth it if their wounds are healing well or find alternatives to follow-up, such as appointments with their PCP or ED visits. Patients who did not cancel their appointment with our institution or inform us of alternate FUAs were counted as those who did not attend any FUAs.

Analysis of numbers of both FUAs and MAs showed that homeless people attended fewer FUAs and had more MAs. This is similar to the findings of Kay et al[11] who demonstrated decreased FUA attendance in the homeless population. We additionally found that having an ED visit was associated with an increased number of both FUAs and MAs. One possible explanation for this is that patients who attended their FUAs were evaluated and sent to the ED if a complication was found. Likewise, patients who missed more appointments were likely to develop more complications and therefore needed to visit the ED and subsequently needed more FUAs.

In an effort to understand the effects of SES on burn outcome, we examined zip code data to determine median income, percentage of people living in poverty, and high school graduation rate. Although we found that lower median income was associated with a decreased likelihood of attending any FUA and higher levels of poverty and lower median income were associated with missing at least one appointment, these variables were not significant on multivariate analysis. This may indicate that more specific factors based on individual disparities have a stronger effect on patients' ability to attend FUAs than the SES indicators derived from zip code data.

A limitation of this study is its retrospective nature. This method limits our full knowledge of patient demographics to the information provided in the medical record. Its retrospective nature requires us to depend on EMR accuracy with respect to labeling appointments as missed vs canceled and rescheduled. Additionally, our determination of SES and distance to clinic were based on patients' addresses as they were listed in the patients' demographics information or as determined by the discharge planner in their note. Also due to the retrospective nature of the study, we were only able to gather information from our EMR system. This limited our study in that we were only able to obtain information from patients' appointments at our institution and other institutions to which our EMR is linked. Thus, data on ED visits and readmissions were only available if these visits happened at our institution

or if the patient reported visits to outside institutions to our nursing staff or physician. This necessitates trust in patients self-reporting and misses any outside visits that patients did not report. Finally, we did not have access to FUA information on patients who were transferred to other health institutions which caused a large number of otherwise eligible patients to be excluded from our study.

Our study identified the many complex factors associated with patients being lost to follow-up in our burn surgery patient population. Our burn service has a dedicated discharge planner as well as a social worker to aid in determining the optimal discharge disposition for our patients. They have established relationships with nursing facilities, board and care facilities, and shelters in the area. Additionally, they aid in setting up postdischarge services for patients, such as street nursing, home healthcare, and outpatient therapy services. Despite this, these results indicate that there may be a subset of patients who need even more intensive intervention or more support to attend FUAs. Targeted outreach plans to address the needs of this at-risk patient group may improve patient outcomes.

Steps to resolve this problem should be initiated before patients are scheduled for their FUA. Associated factors can be found in patient chart data or by directly asking the patient. If homelessness or travel is a barrier to attending FUAs, finding temporary housing for patients may be crucial in improving appointment attendance and therefore outcomes. If lack of transportation is the problem, programs can be implemented to provide patients with vouchers or reimbursements for ride services. If patients live too far from the burn clinic, it may be more beneficial to schedule them an FUA with an institution that can provide burn care nearer to their home. It is also possible that lack of education on FUA importance is a cause of MAs so instructing discharge staff to spend more time emphasizing this point may lead to better attendance results, especially in the group of patients with smaller burn sizes who may perceive less serious consequences of not attending follow-up.

With the widespread implementation and use of telemedicine due to the COVID-19 pandemic, FUAs may now be even more accessible. Although many appointments are essential for in-person assessments, telemedicine may be implemented to evaluate wounds and discuss with patients if they need to come to the clinic to get treated or if they can continue to care for their wounds at home. Virtual visits save on travel and time and could be a step in improving FUA attendance.

Future work is necessary to determine what patients view as obstacles to attending appointments and what resources may be of use to them in their recovery as well as encouraging attendance at FUAs. Based on this study, we have created a discharge planning survey which will be administered to patients prior to discharge. Our hopes are that this will illustrate the patient-perceived barriers to clinic follow-up. This information and the results of our study can then be used to organize initiatives in our institution with the goal of improving postdischarge follow-up attendance not only at our institution but at other burn centers as well.

CONCLUSIONS

Lack of follow-up in the burn clinic is a significant problem. While this is a single-center study, we believe the issues experienced at our burn center are not unique, and likely postdischarge follow-up is of concern in most burn centers. Our study demonstrates the influence of social determinants of health on patient follow-up in the burn population. Both homelessness and drug dependence play a role in the lack of patient follow-up after discharge, emphasizing the importance of identifying these patient factors and ensuring patients have the resources required to either attend their FUAs or make alternative arrangements for follow-up.

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