Published in final edited form as:

Transplantation. 2015 August ; 99(8): 1652–1657. doi:10.1097/TP.0000000000000781.

PEarly Postoperative Emergency Department Care of Abdominal Transplant Recipients¹

Lisa M. McElroy², Kathryn A. Schmidt³, Christopher T. Richards⁴, Brittany Lapin⁵, Michael M. Abecassis⁶, Jane L. Holl⁷, James Adams⁸, and Daniela P. Ladner⁹

Center for Healthcare Studies, Institute for Public Health and Medicine, Feinberg School of Medicine, Northwestern University; Northwestern University Transplant Outcomes Research Collaborative, Comprehensive Transplant Center, Feinberg School of Medicine, Northwestern University; Department of Emergency Medicine, Northwestern Memorial Hospital

Abstract

Background—Research on post-transplant care has predominantly focused on predictors of readmission with little attention to emergency department (ED) visits. The goal of this study was to describe early postoperative ED care of transplant recipients.

Methods—A secondary database analysis of adult patients who underwent abdominal organ transplantation between January 1, 2008 and December 31, 2013 and sought ED care within one year post-transplantation was conducted. Survival was compared using the Kaplan-Meier method with log-rank test. Cox proportional hazards regression analysis was performed to adjust for pertinent covariates.

Results—A total of 1,900 abdominal organ transplants were performed during the study period. Of these, 37% (N=711) transplant recipients sought care in the ED (1,343 total visits) with 1.89 mean ED visits per recipient. Of recipients seen in the ED, 58% received a kidney transplant and 28% received a liver transplant, with 45% of recipients presenting within the first 60 postoperative days. The most common chief complaints were gastroenterological (17%) and abnormal laboratory values or vital signs (17%). In total, 74% of recipients were readmitted and 50% of admitted patients were discharged in less than 24 hours. Transplant recipients with ED visits had lower 3-year graft (81% vs. 87%; $p<0.001$) and patient (89% vs. 93%; $p=0.002$) survival.

Corresponding Author: Lisa McElroy, MD, Postdoctoral Research Fellow, Center for Healthcare Studies, Institute for Public Health and Medicine, Northwestern University Transplant Outcomes Research Collaborative, Northwestern University Feinberg School of Medicine, 633 North St. Clair Street, 20th Floor Chicago, IL 60611, Office (312) 503.5578; Facsimile (312) 503.2777; Mobile (312) 330.0019, lisa.mcelroy@northwestern.edu.

¹Lisa M. McElroy-Participated in research design, data analysis, writing of the paper Kathryn A. Schmidt-Participated in data analysis, writing of the paper Christopher T. Richards-Participated in research design, data analysis, writing of the paper Brittany Lapin-Participated in data analysis, writing of the paper Michael M. Abecassis--Participated in research design Jane L. Holl-Participated in research design, writing of the paper James Adams-Participated in research design, writing of the paper Daniela P. Ladner--Participated in research design, writing of the paper

²lisa.mcelroy@northwestern.edu

³kaschmidt16648@gmail.com

⁴c-richards@northwestern.edu

⁵brittany.lapin@gmail.com

⁶mabecass@nmh.org

⁷j-holl@northwestern.edu

⁸jadams@nmh.org

⁹dladner@nmh.org

Disclosure: the authors declare no conflicts of interest

Conclusion—Transplant recipients have a high frequency of ED visits in the first post-transplantation year and high rates of subsequent hospital admission. Further investigation is needed to understand what drives recipient presentation to the ED and create care models that achieve the best outcomes.

Introduction

Despite significant progress of medical and surgical treatments for end-stage organ disease, long-term outcomes following organ transplantation are influenced by the poly-morbidity associated with end-stage organ disease, chronic immunosuppression, and high rates of postoperative complications and hospital readmissions. These factors may contribute to the significant number of transplant recipients (heretofore referred to as recipients) who seek Emergency Department (ED) care.(1–5)

However, ED care is costly and often subjects patients to long wait times.(6, 7) ED crowding has also been shown to adversely affect patient outcomes.(8) These factors may especially affect patients who require multiple processes of care and complex care coordination, resulting in more costly hospital stays and poorer patient outcomes.(8, 9) Over the past decade ED utilization has risen, and now accounts for 5–10% of the national health expenditures. The increasing demand for ED services and the decreasing number of EDs nationwide further stresses the importance of high-quality, cost-effective care in this setting. (10)

Research on post-transplant care has predominantly focused on predictors of early hospital readmission with little attention to characterizing ED care or improving ED care processes for recipients. As the volume and complexity of transplantation increases, a more thorough understanding of transplant recipients ED use is important to develop more patient-centered care and to mitigate both risks and costs.

A retrospective analysis at a single, high-volume transplant center was conducted to describe utilization of care and characteristics of recipients seeking ED care, their chief complaint at the ED visit, and outcomes of the ED visits.

Methods

A secondary database analysis of adult patients (≥ 18 years) who underwent abdominal organ transplantation (kidney, liver, pancreas, or multi-organ) between January 1, 2008 and December 1, 2013, and who sought ED care at a single, high volume transplant center within one year post-transplantation was conducted. Data were extracted from the Northwestern Medicine® Enterprise Data Warehouse, a single, comprehensive, and integrated repository of all clinical and research data from Cerner PowerChart, PRIMES, Epic, IDX, eNOTIS, and more than fifty other hospital systems. Northwestern Medicine® encompasses the Feinberg School of Medicine and Northwestern Memorial Hospital (NMH), an 860-bed tertiary referral center that includes the Division of Transplantation. The Division of Transplantation also operates a multidisciplinary outpatient clinic all weekdays, open for scheduled and urgent visits with capabilities to perform minor procedures and infusions (e.g., blood transfusions). Recipients are able to contact an on-call transplant

clinician 24 hours a day and 7 days a week. On-call clinicians who direct patients to the ED for evaluation may also notify the ED of the patient's pending arrival.

Variables included age, date of transplant, model for end stage liver disease (MELD) score at transplantation, panel reactive antibody, type of transplant organ, primary vs. non-primary transplant, duration of post-transplant (index) hospitalization, duration from index hospitalization discharge to ED presentation, day and time of ED registration, chief complaint, ED length of stay (time duration from registration to disposition), ED disposition (admission, discharge, against medical advice, transfer), readmission ICU and hospital length of stay, and graft and patient survival.

Data were summarized using descriptive statistics (mean, standard deviation, frequency, and proportions). Chi-square tests were used for categorical variables, and t-tests for continuous variables. Statistical significance was defined as p-values less than 0.05. Overall patient and graft survival were compared between those who visited the ED and those who did not using the Kaplan-Meier method with log-rank test. Cox proportional hazards regression analysis was performed to adjust for pertinent covariates. Statistical analysis was conducted using SAS version 9.3 (SAS Inc, Cary, NC) and Stata version 12 (College Station, TX). Approval was received from the Northwestern University Institutional Review Board prior to data collection.

Results

During the study period, a total of 1,900 liver, kidney, pancreas and multi-organ transplants were performed. Overall, 37.4% (N=711) unique recipients sought ED care for a total of 1,343 visits with a mean of 1.89 ED visits per recipient. In total, 44.4% of liver, 32.6% of kidney, 60.0% of pancreas, and 53.2% of multi-organ transplant recipients sought care in the ED within one year post-transplantation. Table 1 compares the characteristics of recipients who sought ED care with those who did not. Recipients who sought ED care were more often of black or Hispanic race, privately insured, and had a lower BMI than recipients who did not. Although statistically significant, these differences are not likely of clinical significance. There were no differences in sex, age, or MELD score at transplant between recipients who sought ED care and those who did not. More recipients seen in the ED received deceased donor organs (59.2%), had a longer initial postoperative length of stay (5.3 vs. 4.5 days; $p<0.001$), and experienced lower 3-year graft (81.0 vs. 87.4%; $p<0.001$) and patient survival (89.1 vs. 93.2%; $p=0.002$) compared with those not seen in the ED.

The distribution number of postoperative days to ED visit is shown in Figure 1. The median number of days to ED visit was 83, with 22% of recipients presenting within the first 14 days, 33% presenting within the first month, and 45% presenting within the first 60 postoperative days. There was no relationship between index hospital length of stay and days to ED visit ($R\text{-squared}=0.0002$). Visit rates were highest in the evening hours, peaking at 8pm, and lowest in the early morning, with a nadir at 4am (Figure 2). Overall, 56% of recipients presented to the ED during transplant clinic operating hours (8am-5pm) (Figure 2 inset).

Table 2 shows characteristics of recipients seeking ED care. In total, 58% of ED visits were by kidney transplant recipients and 28% were by liver transplant recipients. Friday and Saturday had slightly higher rates of ED visits compared with the other days of the week, but there is no statistically significant correlation between ED visit rates and day of the week or hour of the day. The most commonly reported chief complaint by recipients seeking ED care were gastroenterology related (17%), abnormal laboratory values or vital signs (17%), and infection-related (15%). ED length of stay (LOS) was less than 3 hours for 588 (44%) recipients, ranged between 3 and 6 hours for 510 (38%), ranged between 6 and 10 hours for 106 (8%) recipients, and exceeded 10 hours for 139 (10%) recipients. In total, 998 (74%) of the ED visits resulted in a hospital admission.

Table 3 shows the disposition of recipients following an ED visit, stratified by organ transplant type. Liver transplant recipients were more commonly admitted to the hospital than kidney transplant recipients (78% versus 72%), but rates of hospital admission were similar between all transplant types (kidney: 72%, liver: 78%, liver/kidney: 75%, kidney/pancreas: 76%). In total, 42% of admitted kidney transplant recipients and 31% of liver transplant recipients were discharged within less than 24 hours after admission.

Figure 3 shows recipient and graft survival between recipients with and without an ED visit. Recipients seeking ED care had significantly lower rates of graft survival at 1, 3, and 5 years ($p < 0.01$). While the trend was the same for patient survival, the results were not statistically significant. Table 4 shows Cox proportional hazard ratios for time to graft and patient failure based on the number of ED visits, age, body mass index (BMI), and MELD score. Age and MELD score were associated with a modest increase in risk of graft failure and death. Additional ED visits were associated with a 16% increase in risk of graft failure (CI: 1.08, 1.24; $p < 0.001$).

Discussion

This study describes characteristics of ED utilization by abdominal-organ transplant recipients in the first year after transplant. The study found that nearly 40% of all transplant recipients presented to the ED within the first year after transplant, and that the majority (74%) of these ED visits resulted in hospital admission. In addition, despite the close proximity of the outpatient transplant clinic to the ED and the availability of same-day urgent visits, 56% of recipients presented to the ED during clinic business hours. These findings are similar to prior studies of transplant recipients, which showed high rates of ED visits as well as ED-related readmissions.(1–5) However, the ED visit and hospital readmission rates are higher than reported for pre-MELD transplant cohorts, as well as for other complex surgical patients, such as those undergoing vascular, cardiac, and oncologic surgeries.(11) This may be explained in part by the increasing medical complexity of transplant recipients over the past decade. For kidney transplant recipients, it may also be due to the recently decreased hospital length of stay after surgery.(12) Characteristics of recipients seen in the ED and those who were not seen in the ED were very similar. However, recipients seen in the ED had longer postoperative hospitalization and also had significantly lower rates of graft and patient survival at 3 years. In addition, 43% of transplant recipients had multiple (range 2–13) ED visits, with a 16% higher risk of graft

failure with each successive visit. While it is unlikely that ED visits cause poor outcome, ED visits may be an indicator of increased risk after abdominal organ transplantation. These patients might therefore benefit from closer postoperative monitoring such as more frequent scheduled clinic visits or lab draws.(8, 9) In addition to the high rates of readmission, nearly half of the recipients (N=649; 48%) remained in the ED for more than 6 hours, and 37% (N=498) of recipients admitted from the ED to the hospital were discharged less than 24 hours after admission. It is possible that many of these long wait times and short admissions may be preventable, particularly those occurring during hours when recipients can be seen in an outpatient transplant clinic rather than the ED. Previous studies have also shown that ED care influences both clinical outcomes and patient satisfaction, and these data suggest the need for prospective, rigorous examination of ED care processes for recipients, particularly the underlying factors influencing long wait times and high readmission rates. Increasing the collaborative relationship between emergency medicine and transplant clinicians may prove beneficial for developing care models that optimize the utilization of resources, increase patient-centeredness and achieve the best outcomes, even if the ultimate solution is a novel model of care.(8, 12) In addition to improving the quality of ED care received by recipients, healthcare costs could potentially be reduced for these resource intensive patients while improving outcomes.(13, 14)

These results do not reveal if recipients that seek ED care in the first year post-transplant constitute a high-risk patient population or if these risks can be mitigated. Similarly, the influence of preoperative co-morbidities, postoperative complications, socioeconomic status and geographic location as drivers of ED presentation rates remains unclear. It is possible that transplant recipients who present to the ED do so at the suggestion of transplant clinicians over the phone or following an in-person evaluation, and determining precise reasons for ED presentation will require qualitative analysis.(1) In addition, prior retrospective reviews have demonstrated a low incidence of preventable readmissions among kidney transplant recipients, suggesting that improvement in this aspect of post-transplant care may benefit from focus on improving clinical care algorithms and processes rather than seeking overall avoidance of ED visits.(16) Efforts to reduce short (<24 hour) admissions following ED visits have led to the inclusion of this data point in the transplant division quality improvement strategy. Further efforts to increase the collaborative relationship between emergency medicine and transplant clinicians may prove beneficial for developing care models that optimize the utilization of resources, increase patient-centeredness and achieve the best outcomes, even if the ultimate solution is a novel model of care.(8, 17)

Previous studies have shown that ED care influences both clinical outcomes and patient satisfaction, both of which may be improved by decreasing non-urgent ED visits and increasing the quality of care received for patients who require ED care. In addition to improving the quality of ED care received by recipients, rates of readmission and overall healthcare costs could also potentially be reduced for these resource intensive patients while improving outcomes. For example, prior research by Buchanan et al estimated that the post-transplant period accounts for up to 15% of total transplant costs in liver transplant recipients, independent of the MELD score.(13) As many insurance/hospital contracts bundle costs up to three months after surgery, early postoperative readmissions are often not

directly reimbursed. (14, 15) Given the high cost of hospital care, even a small number of those patients with short readmissions is likely to be cost saving for transplant centers.

Medical emergencies cannot be avoided, nor should ED care be discouraged for recipients. This study also does not provide conclusive information as to whether ED use by recipients actually contributes to *improved* outcomes, particularly in an ED associated with a high-volume transplant center and thus more familiar with the patient population. A new care model might not necessarily decrease the overall number of recipients who receive ED care, but rather optimize the care received in tertiary centers and provide those centers with less frequent exposure to transplant recipients with resources to improve triage and disposition. A key component of optimizing care will likely be through improved communication within and across clinical teams and hospitals.(20, 21) ED care redesign for recipients should incorporate cost-effective and efficient care processes, streamlined communication, and result in high levels of patient centeredness and satisfaction.(22, 23) Providing better care at lower cost may involve developing care algorithms to allow for “rerouting” of those recipients without emergent problems to less acute care settings, extending clinic hours to evenings and weekends, or developing specialized emergency services targeted at the transplant population. Other patient populations have benefited from specialized emergency services, including psychiatric and geriatric patients; however, little has been done thus far with complex surgical populations.(24–27) The challenge moving forward is to determine if the present costs and clinical outcomes associated with recipient ED care are such that they warrant redesign of the acute recipient assessment and management. For a subset of recipients, ED care is certainly the best option as it allows for rapid, effective triage and management of post-surgical emergencies. However, for the nearly 60% of recipients who sought ED care during normal business hours, it may be not be the most patient-centered, safest, or highest quality of care nor the least costly setting for care.

Limitations of this study include those inherent to retrospective secondary data analyses. The study, while conducted at a single transplant center, was conducted using data from one of the largest transplant centers in the United States, uniquely positioned to perform a high-quality single center analysis. Further analysis of the medical records of those patients admitted to the ED will provide more detail about factors associated with ED visits. The authors however, intend to bring attention to the high rate of short (<24hours) readmissions is likely a system failure that can be mitigated by center-specific targeted interventions.

These data suggest the need for prospective, rigorous examination of ED care processes for recipients, focusing in particular on the underlying factors that influence long wait times and high readmission rates. Medical record review of recipients with early postoperative readmissions will provide further insight into the predictors of ED visits and potential paths for mitigation, where appropriate. Also, the Centers for Disease Control and Prevention’s new National Hospital Care Survey combine data formerly collected by the National Hospital Discharge Survey with data collected by the National Hospital Ambulatory Medical Care Survey.(19) These data will allow for detailed national analysis of ED utilization of many surgical subspecialties, including transplantation.

Acknowledgments

The authors would like to thank Adela Mizrahi for her opinions and suggestions for this work.

Funding: This work is funded by AHRQ and NIDDK T32 Training Grants (McElroy 5T32HS78-15, T32DK77662-7).

Abbreviations

CIT	Cold ischemic time
DRG	Diagnosis related group
ED	Emergency department
ICU	Intensive care unit
MELD	Model for end stage liver disease
PRA	Panel reactive antibody
NMH	Northwestern Memorial Hospital

References

1. Savitsky EA, Votey SR, Mebust DP, et al. A descriptive analysis of 290 liver transplant patient visits to an emergency department. *Acad Emerg Med*. 2000; 7(8):898–905. [PubMed: 10958130]
2. Tokalak I, Basaran O, Emiroglu R, et al. Problems in postoperative renal transplant recipients who present to the emergency unit: experience at one center. *Transplant Proc*. 2004; 36(1):184–186. [PubMed: 15013341]
3. Trzeciak S, Sharer R, Piper D, et al. Infections and severe sepsis in solid-organ transplant patients admitted from a university-based ED. *Am J Emerg Med*. 2004; 22(7):530–533. [PubMed: 15666255]
4. Unterman S, Zimmerman M, Tyo C, et al. A descriptive analysis of 1251 solid organ transplant visits to the emergency department. *West J Emerg Med*. 2009; 10(1):48–54. [PubMed: 19561769]
5. Turtay MG, Oguzturk H, Aydin C, et al. A descriptive analysis of 188 liver transplant patient visits to an emergency department. *Eur Rev Med Pharmacol Sci*. 2012; 16(Suppl 1):3–7. [PubMed: 22582476]
6. Bamezai A, Melnick G, Nawathe A. The cost of an emergency department visit and its relationship to emergency department volume. *Ann Emerg Med*. 2005; 45(5):483–490. [PubMed: 15855942]
7. Weiss SJ, Derlet R, Arndahl J, et al. Estimating the degree of emergency department overcrowding in academic medical centers: results of the National ED Overcrowding Study (NEDOCS). *Acad Emerg Med*. 2004; 11(1):38–50. [PubMed: 14709427]
8. Sun BC, Hsia RY, Weiss RE, et al. Effect of emergency department crowding on outcomes of admitted patients. *Ann Emerg Med*. 2013; 61(6):605–611. e606. [PubMed: 23218508]
9. Melnick GA, Serrato CA, Mann JM. Prospective payments to hospitals: should emergency admissions have higher rates? *Health Care Financ Rev*. 1989; 10(3):29–39. [PubMed: 10313095]
10. Lee MH, Schuur JD, Zink BJ. Owning the cost of emergency medicine: beyond 2%. *Ann Emerg Med*. 2013; 62(5):498–505. e493. [PubMed: 23623558]
11. Lucas DJ, Haider A, Haut E, et al. Assessing readmission after general, vascular, and thoracic surgery using ACS-NSQIP. *Ann Surg*. 2013; 258(3):430–439. [PubMed: 24022435]
12. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg*. 2004; 240(2):205–213. [PubMed: 15273542]

13. Buchanan P, Dzebisashvili N, Lentine KL, et al. Liver transplantation cost in the model for end-stage liver disease era: looking beyond the transplant admission. *Liver Transpl.* 2009; 15(10): 1270–1277. [PubMed: 19790155]
14. Englesbe MJ, Ads Y, Cohn JA, et al. The effects of donor and recipient practices on transplant center finances. *Am J Transplant.* 2008; 8(3):586–592. [PubMed: 18294154]
15. Machnicki G, Lentine KL, Salvalaggio PR, et al. Kidney transplant Medicare payments and length of stay: associations with comorbidities and organ quality. *Archives of medical science : AMS.* 2011; 7(2):278–286. [PubMed: 22291768]
16. Harhay M, Lin E, Pai A, et al. Early rehospitalization after kidney transplantation: assessing preventability and prognosis. *Am J Transplant.* 2013; 13(12):3164–3172. [PubMed: 24165498]
17. Locke R, Stefano M, Koster A, et al. Optimizing patient/caregiver satisfaction through quality of communication in the pediatric emergency department. *Pediatr Emerg Care.* 2011; 27(11):1016–1021. [PubMed: 22068060]
18. Englesbe MJ, Dimick JB, Fan Z, et al. Case mix, quality and high-cost kidney transplant patients. *Am J Transplant.* 2009; 9(5):1108–1114. [PubMed: 19422336]
19. Control, C.f.D. National Hospital Care Survey.
20. Chang YN, Lin LH, Chen WH, et al. Quality control work group focusing on practical guidelines for improving safety of critically ill patient transportation in the emergency department. *Journal of emergency nursing: JEN : official publication of the Emergency Department Nurses Association.* 2010; 36(2):140–145. [PubMed: 20211406]
21. Venkat KK, Venkat A. Care of the renal transplant recipient in the emergency department. *Ann Emerg Med.* 2004; 44(4):330–341. [PubMed: 15459617]
22. McCarthy DM, Buckley BA, Engel KG, et al. Understanding patient-provider conversations: what are we talking about? *Acad Emerg Med.* 2013; 20(5):441–448. [PubMed: 23672357]
23. McCarthy DM, Ellison EP, Venkatesh AK, et al. Emergency Department Team Communication with the Patient: The Patient's Perspective. *The Journal of emergency medicine.* 2013; 45(2):262–270. [PubMed: 22989697]
24. Arendts G, Fitzhardinge S, Pronk K, et al. The impact of early emergency department allied health intervention on admission rates in older people: a non-randomized clinical study. *BMC geriatrics.* 2012; 12:8. [PubMed: 22429561]
25. Beauchet O, Launay CP, Fantino B, et al. Screening for Elderly Patients Admitted to the Emergency Department Requiring Specialized Geriatric Care. *The Journal of emergency medicine.* 2013
26. Gotlib D, Pullan S. A Web-based system for monitoring patient flow in an emergency department. *Psychiatric services.* 2011; 62(11):1395. [PubMed: 22211230]
27. Conroy SP, Ansari K, Williams M, et al. A controlled evaluation of comprehensive geriatric assessment in the emergency department: the 'Emergency Frailty Unit'. *Age and ageing.* 2013

Figure 1.
Number of Postoperative Days to ED Visit
Frequency of recipients presenting to the emergency department by the number of postoperative days.

Figure 2.
Emergency Department Registration Time of Day
Distribution of ED registration times throughout the day (24 hours military time).

Figure 3a Legend: Kaplan-Meier Graft Survival Curves by ED Status (log-rank $p < 0.01$)

Figure 3b Legend: Kaplan-Meier Patient Survival Curves by ED visit (log-rank $p = 0.051$)

Figure 3.
Patient and Graft Survival by ED Status
Kaplan-Meier Patient Survival Curves by ED visit (log-rank $p = 0.051$)

Table 1

Patient Demographics and Transplant Type (n=1900):

	Recipients Seen in ED N=711	Recipients Not Seen in ED N=1189	p-value
Male Sex, n (%)	424 (60)	749 (63)	0.15
Age (years), Mean (SD)	55.2 (13)	54.4 (13)	0.22
BMI at Transplant, Mean (SD)	27.5 (7)	28.5 (6)	<0.01
Race, n (%)			
White	363 (51)	658 (55)	<0.01
Black	173 (24)	202 (17)	
Hispanic/Latino	115 (16)	164 (14)	
Asian	28 (4)	38 (3)	
Other/Unknown	32 (5)	127 (11)	
Education, n (%)			
Less than HS	39 (5)	48 (4)	<0.01
High School	257 (36)	401 (34)	
College or Above	368 (52)	601 (50)	
Other/Unknown	47 (7)	139 (12)	
Insurance Type, n (%)			
Private	308 (43)	457 (38)	<0.01
Medicare/Medicaid	392 (55)	673 (57)	
Self-Pay	11 (2)	17 (1)	
Other/Unknown	0 (0)	42 (4)	
MELD at transplant, Mean (SD)			
Liver	23 (9)	21 (10)	0.10
Liver/Kidney	29 (8)	32 (8)	0.13
PRA			
<20	357	704	0.163
20–80	96	157	
>80	57	75	
Number of ED Visits per Patient, Mean (SD)	1.89 (1.60)	-	-
Transplant Organ, n (%)			
Liver	199 (44)	250 (56)	<0.001
Kidney	411 (33)	848 (67)	
Pancreas	1 (33)	2 (67)	
Liver/Kidney	44 (50)	44 (50)	
Kidney/Pancreas	56 (57)	42 (43)	
Liver/Kidney/Pancreas	0 (0)	2 (100)	

	Recipients Seen in ED N=711	Recipients Not Seen in ED N=1189	p-value
Deceased Donor, n (%)	421 (59)	593 (50)	<0.001
Initial postoperative hospital LOS, Mean (SD)	5.25 (6.61)	4.52 (7.84)	<0.001
Graft Survival, n (%)			
1-year	89.2%	92.9%	0.004
3-year	81.0%	87.4%	<0.001
Patient Survival, n (%)			
1-year	95.1%	94.8%	0.780
3-year	89.1%	93.2%	0.002

Table 2

Emergency Department Visit Characteristics (n=1343)

	N (%)
Transplant Organ, n (%)	
Liver	412 (31)
Kidney	706 (53)
Pancreas	3 (0)
Liver/Kidney	108 (8)
Kidney/Pancreas	114 (8)
Time of Presentation	
00:00–07:59	184 (14)
08:00–16:00	555 (41)
16:01–23:59	604 (45)
Day of Presentation	
Monday	197 (15)
Tuesday	176 (13)
Wednesday	175 (13)
Thursday	172 (13)
Friday	213 (16)
Saturday	222 (17)
Sunday	188 (14)
Presentation During Open Clinic Hours (Monday- Friday 8am–5pm)	753 (56)
Days from transplant at presentation median	83
0–30	440 (33)
31–60	161 (12)
61–90	110 (8)
91–120	94 (7)
121–150	88 (7)
151–180	62 (5)
181–210	71 (5)
211–240	67 (5)
241–270	66 (5)
271–300	50 (4)
301–330	60 (4)
331–365	66 (5)
Chief Complaint	
GI complaint	218 (17)
Abnormal Labs/Vitals	207 (17)
Infectious Disease	191 (15)

	N (%)
Post-Surgical Problem	190 (16)
Generalized symptoms	131 (10)
Cardiovascular/pulmonary	130 (11)
Sent for evaluation, infusion	59 (5)
Neurological/psychological	47 (4)
Trauma	25 (2)
Genitourinary complaint	16 (1)
Ear, Nose, Throat	14 (1)
ED Length of Stay	
<3hrs	588 (44)
3–6 hrs	510 (38)
6–10 hrs	106 (8)
10 hrs	139 (10)
ED Disposition	
Admit	998 (74)
Discharge	327 (24)
AMA	13 (1)
Transfer	2 (0.1)

Table 3
Emergency Department Visit Disposition and Hospitalization by Transplant Type

N (%)	Kidney N=705	Liver N=411	Pancreas N=3	Liver/ Kidney N=107	Kidney/ Pancreas N=114
ED Disposition					
Admit	507 (72)	321 (78)	3 (100)	80 (75)	87 (76)
Discharge	187 (26)	88 (27)	0	26 (31)	27 (24)
Transfer	2 (0)				
AMA	10 (2)	2 (0)		1 (0)	
Total	706	411	3	107	114
Post-ED Hospital Length of Stay					
<24 hours	299 (42)	126 (31)	1 (33)	36 (34)	36 (32)
1–3 days	232 (33)	136 (33)	1 (33)	30 (28)	44 (39)
4–7 days	128 (18)	96 (23)	1 (33)	30 (28)	31 (27)
>7 days	46 (7)	53 (13)		11 (10)	3 (3)
Total	706	411	3	107	114
Post-ED ICU Length of Stay					
<24 hours	16 (30)	10 (21)		4 (2)	3 (60)
1–3 days	21 (40)	17 (36)		6 (4)	1 (20)
4–7 days	5 (9)	13 (28)		3 (2)	0
>7 days	11 (21)	7 (15)		4 (2)	1 (20)
Total	53	47	0	17	5

AMA: Against medical advice, ED: Emergency Department, ICU: Intensive Care Unit

Table 4

Cox Proportional Hazards Model for Time to Graft Failure and Death

Table 4a. Graft Failure			
	Hazard Ratio	95% Confidence Interval	P-Value
Number of ED Visits	1.16	1.08, 1.24	<0.001
Age	1.02	1.01, 1.03	<0.001
BMI	1.00	1.00, 1.00	0.210
MELD	1.04	1.02, 1.05	<0.001

Table 4b. Death			
	Hazard Ratio	95% Confidence Interval	P-Value
Number of ED Visits	1.09	0.99, 1.20	0.059
Age	1.06	1.04, 1.08	<0.001
BMI	1.00	1.00, 1.00	0.126
MELD	1.05	1.03, 1.06	<0.001

Cox proportional hazard ratios for time to graft and patient failure based on number of emergency department visits by age, body mass index, and model for end stage liver disease. BMI: Body Mass Index, MELD: Model for End Stage Liver Disease.