HHS Public Access

Author manuscript

Acad Emerg Med. Author manuscript; available in PMC 2018 November 01.

Published in final edited form as:

Acad Emerg Med. 2017 November ; 24(11): 1349–1357. doi:10.1111/acem.13304.

Patients Visiting Multiple Emergency Departments: Patterns, Costs and Risk Factors

Todd W. Lyons, MD[1,2], **Karen L Olson, PhD**[1,2], **Nathan P. Palmer, PhD**[3], **Reed Horwitz**[1], **Kenneth D Mandl, MD MPH**[1,2,3], and **Andrew M. Fine, MD MPH**[2]

[1]Computational Health Informatics Program, Boston Children's Hospital, Boston, MA

[2]Division of Emergency Medicine, Boston Children's Hospital, Boston, MA

[3]Department of Biomedical Informatics, Harvard Medical School, Boston, MA

Abstract

Objective—We sought to characterize the population of patients seeking care at multiple EDs and to quantify the proportion of all ED visits and costs accounted for by these patients.

Methods—We performed a retrospective, cohort study of de-identified insurance claims for privately insured patients with ≥ 1 ED visit between 2010 and 2016. We measured the number of EDs visited by each patient and determined the overall proportion of all ED visits and ED costs accounted for by patients who visit multiple EDs. We identified factors associated with visiting multiple EDs.

Results—8,651,716 patients made 16,390,676 ED visits over the study period, accounting for $26,102,831,740 in ED costs. A significant minority (20.5%) of patients visited more than one ED over the study period. However, these patients accounted for a disproportionate amount of all ED visits (41.4%) and all ED costs (39.2%). A small proportion (0.4%) of patients visited 5 of more EDs but accounted for 2.8% of ED visits and costs. Among patients with two ED visits within 30-days, 32% were to different EDs. Having at least one ED visit for mental health or substance abuse related diagnosis was associated with increased odds of visiting multiple EDs.

Conclusions—A substantial minority of patients visit multiple EDs, but account for a disproportionate burden of overall ED utilization and costs. Future work should evaluate the impact of visiting multiple EDs on care utilization and outcomes and explore systems for improving access to patient records across care centers.

Keywords

emergency department; care fragmentation; utilization

Corresponding Author: Todd W. Lyons, MD, Division of Emergency Medicine, Boston Children's Hospital, 300 Longwood Avenue, Boston, MA 02115. Todd.Lyons@childrens.harvard.edu. Phone: 617-355-6624. Fax: 617-730-0335.

Prior Presentations: This work has not been previously presented at any research meetings.

Conflicts of Interest: No conflict of interest – TL, KO, NP, RH, KM and AF all report no conflicts of interest

INTRODUCTION

Background

In the United States, $48 billion are spent annually on emergency department (ED) care, and costs are rising.[1–5] Cost containment and quality improvement efforts typically target patients who use the ED with high frequency,[6–20] but little is known about the population of patients whose care is fragmented across multiple EDs. Patients visiting multiple EDs pose unique challenges to clinicians, who frequently lack access to records from other EDs. In the ED where clinicians must make rapid and consequential decisions, lack of knowledge regarding previous care may result in patients receiving sub-optimal, duplicative, or unnecessary care. In prior single state studies, patients who visited multiple different EDs were a significant minority of patients, but represented a disproportionate amount of all ED visits and costs.[12,21,22]

Nationally, little is known about the scale, costs and risk factors associated with patients seeking care at multiple EDs and therefore how to optimize policies and technologies to improve care for these patients. We sought to: 1) measure the number of patients who visit multiple EDs, 2) quantify the proportion of all ED visits and costs attributed to these individuals and 3) identify risk factors for visiting multiple EDs.

METHODS

Study Design and Setting

We performed a retrospective, cohort analysis of de-identified insurance claims for privately insured patients between January 2010 and February 2016. Beneficiaries were insured by a private, for-profit payer, providing health insurance for 23 million members annually. Its care network comprises 1.2 million health care professionals including over 695,971 physicians and 5,712 hospitals across all 50 states and territories in the United States.[23] This work was funded in part by Aetna Incorporated who had no role in the study design, data analysis, data interpretation, writing of the manuscript, or decision to submit the manuscript for publication. The study was approved by the Institutional Review Board at our institution with a waiver of informed consent.

Selection of Participants

We included patients of any age with at least one ED visit during the study period, defined as having a claim containing a current procedural terminology (CPT) code of 99281–99285. Critically ill patients (CPT codes 99291–99292) were not included as we could not accurately differentiate between critical care provided in the ED and critical care provided in other hospital settings using data available at the time of this study. Patients were excluded who only had ED-coded claims at locations of care that were unlikely to represent ED care such as audiology, home health care center, or outpatient laboratory without a concurrent hospital-based ED visit. We excluded patients who were not continuously enrolled with the payer for at least 30-days or who had missing or incomplete ED claims. Patients with interrupted enrollment were included for any time period ≥ 30 days in which they were enrolled.

We defined a unique ED visit as having occurred when an ED claim for a patient occurred on a unique date at a unique site of care (defined below). An index ED visit was defined as the first ED visit for that patient, and any subsequent ED visits for that patient were defined as return visits. Claims for ED visits frequently contain both facility/organization claims as well as provider claims. We analyzed the facility/organization claims because they more accurately identify the care location. Because claims are assigned only dates and not times, we could not determine if claims for ED visits occurring on the same or consecutive days represented revisits or transfers. For our primary analysis, we considered visits to unique EDs with claims on the same or following day to have been transfers, and not revisits. We also performed a sensitivity analysis treating these visits on the same or consecutive days as revisits.

Methods and Measurements

Patient demographics included age, gender, duration of enrollment in the health plan and region of residence from the available claims. Visit complexity for each ED was defined using CPT codes (99281–99285). For each visit, one of 25 Major Diagnostic Categories (MDCs) based upon diagnostic related groupings and International Classification of Disease Edition 9 or 10 (ICD-9 or ICD-10) coding was assigned for each diagnosis made during that visit.[24] All diagnoses were included for each visit to assess the impact of co-morbid conditions that might not be the primary indication for that ED visit.

The location of ED care was determined by matching the National Provider Identifier (NPI) number for each visit with the corresponding addressed within National Plan and Provider Enumeration System (NPPES). We used address correction software (ZP4, Semaphore Corp., Monterey, CA) to collapse sets of NPIs to single locations when appropriate, such as when they shared the same health-care system/hospital name at the same address with slight typographical variations. We limited the analyses to visits for which location of the ED care could accurately be determined.

Outcomes

The primary outcome for this study was the number of unique EDs visited. The secondary outcome was total allowable costs associated with ED care. Allowable costs include all reimbursements for medical services provided, including reimbursement paid by the patient (co-pays, co-insurance, deductibles and out of pocket expenses) as well as reimbursements paid by the insurance provider.

Analysis

Among patients with at least one ED visit during the study period, we tabulated the number of total ED visits per patient and the number of unique EDs each patient visited. Patients with at least one ED visit were included such that the proportion of all ED visits and all ED costs attributable to patients visiting multiple different EDs could be calculated. Because in bivariate analyses geographic region was a predictor of the number of EDs visited, and because the sample was disproportionately represented throughout geographic regions of the country, we performed an analysis of our primary outcome stratified by geographic region.

Subsequent analyses were limited to patients with two or more ED visits. To assess the impact of time on visiting multiple EDs, we first compared the duration between ED visits occurring at the same versus different EDs. Because 30-day revisits are a commonly used quality metric, we calculated the percent of all 30-day ED revisits occurring at the same versus different EDs.[25]

Potential risk factors associated with visiting multiple EDs among patients with at least two ED visits were assessed. Using bivariate analyses, patients with at least two ED visits to the same ED were compared to those with at least two ED visits to multiple EDs. We used Cohen's D statistics to describe the magnitude of difference between 2 continuous variables, and Cohen's H statistics to describe the magnitude of difference between 2 proportions. Cohen's D and H values > 0.1 would considered significant in bivariate analyses.[26] Multivariate analyses were performed using logistic regression. Type 3 Wald Chi-square tests were used to assess the independent effect of each variable. Point estimates and 95% confidence intervals (CI) for continuous variables and odds ratios and 95% CI for categorical variables were calculated. Given the large sample size, we anticipated that nearly all variables analyzed would be significant. We therefore included significant variables and variables we felt to be clinically important. All data were analyzed using SAS 9.4 (Cary, NC).

RESULTS

Characteristics of Study Participants

A total of 53,015,427 patients had at least one month of enrollment over the 6.2-year study period, of whom 8,651,716 (16.3%) had at least one ED visit. Demographic and visit characteristics for included patients are summarized in Table 1. These patients accounted for a total of 16,390,676 ED visits with an associated cost of $26,102,831,740. Patients ranged in age from newborn to over 100 years old. The average enrollment length was 3.2 years (SD 1.9). The majority of visits were for moderate or high complexity conditions. The mean number of ED visits per patient was 1.9 (SD 2.3, range 1 to 578) and the median number of ED visits was 1.0 [Interquartile Range (IQR 1.0–2.0)].

Main Results

Patients visited a mean of 1.3 unique EDs (SD 0.6, range 1–81). The median number of unique EDs visited was 1.00 (IQR: 1.0–2.0). Among the study population, 6,876,220 (79.5%) of patients visited only one ED and accounted for 9,600,344 (58.6%) ED visits and $14,889,723,092 (60.8%) in ED costs. Patients visiting two EDs [N = 1,395,090 (16.1%)] accounted for 4,327,994 (26.4%) ED visits and $6,111,986,125 (25.0%) in ED costs. Patients visiting three EDs [N = 278,795 (3.2%)] accounted for 1,459,267 (8.9%) ED visits and $2,055,746,780 (8.4%) in ED costs. Patients visiting four EDs [N = 70,007 (0.8%)] accounted for 541,488 (3.3%) ED visits and $753,715,057 (3.1%) in ED costs. Finally, those patients who visited five or more EDs [N = 31,604 (0.4%)] accounted for 461,583 (2.8%) of ED visits and $687,461,100 (2.8%) in ED costs. Overall, patients visiting two or more EDs (N = 1,775,496, 20.5%), accounted for a disproportionate amount of all ED visits (6,790,333, 41.4%) and costs ($10,239,241,718.79, 39.2%).

Overall, 3,332,765 (39%) patients had at least two ED visits. Of these, 1,775,496 (53%) visited at least two unique ED. As the total number of ED visits increased, the likelihood of patients visiting multiple EDs increased (Table 2). For each additional ED visit, patients had 1.42 increased odds of having visited multiple unique EDs. However, even amongst patients with only 2 ED visits, 43.8% had been seen at two unique EDs. Among 1,602,127 return ED visits occurring within 30-days of an index ED visit, 505,603 (32%) were to a different ED from the index ED. In sensitivity analyses where same and next-day ED visits were treated as revisits and not transfers, among 30-day return ED visits (N=2,485,387), 592,459 (24)% were to a different ED from the index ED.

Among the cohort of patients with at least two ED visits, we compared those who visited multiple EDs with those who visited a single ED (Table 3). In bivariate analyses, many demographic and visit-level factors studied were statistically significantly associated with visiting multiple EDs. However, the factors most strongly associated with visiting multiple EDs included years of enrollment, living in the South, total number of ED visits, and higher visit complexity. In a stratified analysis by patient region, the proportion of patients with ≥ 2 ED visits who visited ≥ 2 different EDs varied by geographic region: Northeast (51.1%), West (51.0%), Midwest (51.0%) and South (56.3%, $p < 0.001$). Similarly, the proportion of all ED visits made by patients who had visited ≥ 2 different EDs varied by geographic region: Northeast (59.3%), West (58.5%), Midwest (59.3%) and South (64.1%, $p < 0.001$). Diagnoses most strongly associated with visiting multiple EDs included neurologic disorders, mental health disorders and disorders of alcohol and drug use. After adjusting for total number of ED visits in a multivariate model, age, geographic location, total years of enrollment and higher visit complexity were all associated with visiting multiple EDs (Table 4). In adjusted models, diagnostic categories most strongly associated with visiting multiple EDs were alcohol and drug diagnoses and mental health disorders.

DISCUSSION

Over a six-year period, 40% of all ED visits and ED costs were attributable to patients who had visited two or more different EDs. Among patients with two ED visits occurring within 30-days, when clinical information from the previous visit may be most critical to ED clinicians, nearly one-third occurred at a different ED from the index visit. Patients visiting multiple EDs often did so for higher complexity visits. Those patients with at least one visit for mental health conditions or alcohol/substance abuse conditions were more likely to have visited multiple EDs.

This is the largest study to date evaluating patients seeking care at multiple EDs, following a broad national-scale sample tracked across health-care institutions and geographic regions, over more than 6 years. These results are consistent with previous regional studies about patients seeking care at multiple EDs.[22,27–29] A study set in Cincinnati demonstrated that 14% of patients sought care at multiple EDs.[22] In Utah, 6% of patients with at least four ED visits had visits at five or more different EDs.[30] Among Massachusetts patients, only 1% visited five or more acute care facilities. However, these patients accounted for nearly 10% of all acute care utilization.[28] We found that 20% of patients visited multiple EDs, and 1% visited four or more EDs. While our study is limited to privately insured patients, our results

are consistent with these prior studies which included both privately and publicly insured patients.[21,22]

Consistent with the prior literature on frequent ED utilizers we found substance use and mental health disorders were associated with visiting multiple EDs.[31–33] In addition, we found higher visit complexity was associated with patients visiting multiple different EDs. These findings are consistent with data on frequent ED utilizers who have been found to be more likely to be chronically ill and have higher utilization of other non-ED health-care resources.[11–13,34,35] Together, these findings underscore the challenges of caring for these patients who are complex, often have comorbid substance abuse and mental health conditions, have frequent ED utilization and have their ED care fragmented across multiple sites. Furthermore, while higher rates of ED utilization were associated with visiting multiple EDs, even among patients with only 2 ED visits, care was delivered at more than one ED 44% of the time.

In non-ED clinical settings, care fragmentation has been associated with higher resource utilization including increases in repeat testing, hospitalization rates, length of stay, and mortality in post-operative surgical patients.[28,36–41] ED clinicians manage acutely ill patients outside of the medical home, so the impact of ED care fragmentation may be even greater, as ED clinicians may not have the time or resources to have patient records faxed or transmitted on demand. Furthermore, nearly 80% of unplanned hospital admissions originate from the ED.[42] Therefore, a high degree of fragmented ED care may be a marker of a high-degree of fragmentation of acute, in-patient hospital care.

Patients seek care at multiple EDs for a host of reasons, including ambulance protocols, patient choice, referring clinician preferences, need for sub-specialty care, wait times, convenience, change in residence, travel, desire for second opinions, and drug seeking behaviors.[6] Regardless of the indication, ED clinicians must provide care to these patients but may be challenged to do so in the absence of critical information.[43] Future efforts should be made to evaluate the impact of visiting multiple EDs on care utilization and outcomes as well as the utility of approaches for improving access to important patient records across care settings and centers. Previous studies have demonstrated that having access to patients' health-care records across care settings reduces: costs, use of hospital resources, hospital admissions, hospital length of stay, redundant testing including expensive imaging studies and laboratory tests.[44–51] Current efforts have been endorsed by the American College of Emergency Physicians to improve access to patient records. Promising approaches include health information exchange systems or personally controlled health records.[46,52–54]

LIMITATIONS

The results of this study must be interpreted in the context of its limitations. These data were limited to members of a single, private health insurance payer and while we studied more than 16 million ED visits, these account for only 2% of all ED visits nationally over the study period.[14] However, the findings are consistent with other published studies including publicly insured patients.[28] Furthermore, patterns of enrollment in this insurance provider, including geographic variability, may impact the generalizability to other privately insured

patients in other parts of the country. However, even in stratified analyses the proportion of patients who had visited ≥ 2 different EDs and the proportion of visits made up by these patients remained significant. Second, we cannot account for all the reasons that patients visited multiple EDs. Patients may have been transferred, changed residences, or have been referred to a different ED, events not captured in claims data. Nonetheless, regardless of the reason, these patients pose the same challenges for the ED clinicians caring for them. Third, fine-grained clinical data are limited in our claims data and we therefore cannot measure some important clinical factors including those which may result in omitted variable bias in our model. However, our primary outcome – number of unique EDs visited – should be accurately captured in these claims. Finally, a limitation of claims data is that a small proportion of individuals may have more than one member identification number if they change plans or jobs or change in family/living situation. While this may result in an overestimation of the number of patients in the population, it can only result in an underestimation of number of different EDs visited per patient.

CONCLUSION

A substantial minority of patients who visit multiple EDs for their care represent a disproportionate amount of overall ED care and costs. These patients are often of high complexity and may have comorbid substance abuse and mental health conditions. Because clinical management of these patients can be challenging without access to complete medical records, facilitating exchange of health information across sites of care should be prioritized.

Acknowledgments

Funding Sources/Disclosures: Dr. Lyons was supported by a training grant from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (National Institutes of Health) Childhood (T32HD040128). Additional funding was provided by Aetna Incorporated who provided data and monetary support for this study. Aetna agreed to publish the results of this study irrespective of the findings.

Abbreviations

CPT	Current procedural terminology
ED	emergency department
HIE	health information exchange
ICD-9	International Classification of Disease Edition 9
MDCs	Major Diagnostic Categories
NPPES	National Plan and Provider Enumeration System
NPI	National Provider Identification

References

1. Lee MH, Schuur JD, Zink BJ. Owning the cost of emergency medicine: Beyond 2%. Ann Emerg Med. 2013; 62(5)

2. David G, Gunnarsson C, Saynisch Pa, Chawla R, Nigam S. Do patient-centered medical homes reduce emergency department visits? Health Serv Res. 2015; 50(2):418–39. [PubMed: 25112834]

3. Tang N, Stein J, Hsia RY, Maselli JH, Gonzales R. Trends and characteristics of US emergency department visits, 1997–2007. JAMA. 2010; 304(6):664–70. [PubMed: 20699458]

4. Skinner, HG., Blanchard, J., Elixhauser, A. Trends in Emergency Department Visits, 2006–2011: Statistical Brief #179 [Internet]. Healthcare Cost and Utilization Project (HCUP) Statistical Briefs. 2006. Available from: http://www.ncbi.nlm.nih.gov/pubmed/25473724

5. American College of Emergency Physicians. ER Visits Continue to Rise Since Implementation of Affordable Care Act. Irving, TX: 2015.

6. Guly HR, Grant IC. Patients who attend two accident and emergency departments. J Accid Emerg Med. 1994; 11(4):231–3. [PubMed: 7894808]

7. Wolinsky FD, Liu L, Miller TR, et al. Emergency department utilization patterns among older adults. Journals Gerontol Ser A-Biological Sci Med Sci. 2008; 63(2):204–9.

8. Hunt, Ka, Weber, EJ., Showstack, Ja, Colby, DC., Callaham, ML. Characteristics of Frequent Users of Emergency Departments. Ann Emerg Med. 2006; 48(1):1–8. [PubMed: 16781914]

9. Woo JH, Grinspan Z, Shapiro J, Rhee SY. Frequent Users of Hospital Emergency Departments in Korea Characterized by Claims Data from the National Health Insurance: A Cross Sectional Study. PLoS One [Internet]. 2016; 11(1):e0147450. Available from: http://dx.plos.org/10.1371/journal.pone.0147450.

10. Byrne M, Murphy AW, Plunkett PK, McGee HM, Murray A, Bury G. Frequent attenders to an emergency department: A study of primary health care use, medical profile, and psychosocial characteristics. Ann Emerg Med. 2003; 41(3):309–18. [PubMed: 12605196]

11. Hansagi H, Olsson M, Sjöberg S, Tomson Y, Göransson S. Frequent use of the hospital emergency department is indicative of high use of other health care services. Ann Emerg Med. 2001; 37(6): 561–7. [PubMed: 11385324]

12. Fuda KK, Immekus R. Frequent Users of Massachusetts Emergency Departments: A Statewide Analysis. Ann Emerg Med. 2006; 48(1)

13. Sun BC, Burstin HR, Brennan Ta. Predictors and Outcomes of Frequent Emergency Department Users. Acad Emerg Med. 2003; 10(4):320–8. [PubMed: 12670845]

14. Niska R, Bhuiya F, Xu J. National Hospital Ambulatory Medical Care Survey: 2007 emergency department summary. Natl Health Stat Report [Internet]. 2010; 26:1–31. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20726217.

15. Colligan, EM., Pines, JM., Colantuoni, E., Howell, B., Wolff, JL. Risk Factors for Persistent Frequent Emergency Department Use in Medicare Beneficiaries. Ann Emerg Med [Internet]. 2016. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0196064416000846

16. Soril, LJJ., Leggett, LE., Lorenzetti, DL., Noseworthy, TW., Clement, FM. Characteristics of Frequent Users of the Emergency Department in the General Adult Population: A Systematic Review of International Healthcare Systems. Health Policy (New York) [Internet]. 2016. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0168851016300240

17. Ruger JP, Richter CJ, Spitznagel EL, Lewis LM. Analysis of costs, length of stay, and utilization of emergency department services by frequent users: Implications for health policy. Acad Emerg Med. 2004; 11(12):1311–7. [PubMed: 15576522]

18. Andren KG, Rosenqvist U. Heavy Users of an Emergency Department-A Two Year Follow-Up Study. Soc Sci Med [Internet]. 1987; 25(7):825–31. Available from: http://ac.els-cdn.com/0277953687900402/1-s2.0-0277953687900402-main.pdf?_tid=679d0408-03b4-11e5-9127-00000aab0f26&acdnat=1432651087_0170025632a5b650db14663dc70e5e78.

19. Hansagi H, Allebeck P, Edhag O, Magnusson G. Frequency of emergency department attendances as a predictor of mortality: nine-year follow-up of a population-based cohort. J Public Health Med. 1990; 12(1):39–44. [PubMed: 2390308]

20. Lucas RH, Sanford SM. An analysis of frequent users of emergency care at an urban university hospital. Ann Emerg Med. 1998; 32(5):563–8. [PubMed: 9795318]

21. Bourgeois FC, Olson KL, Mandl KD. Patients treated at multiple acute health care facilities: Quantifying information fragmentation. Arch Intern Med [Internet]. 2010; 170(22):1989–95. Available from: http://archinte.ama-assn.org/cgi/content/abstract/170/22/1989.
22. Fertel, Baruch S., Hart, Kimberly W., Lindsell, Christopher J., Ryan, Richard J., Lyons, MS. Patients Who Use Multiple EDs: Quantifying the Degree of Overlap Between ED Populations. West J Emerg Med. 2015; 49(2):229.
23. Aetna Incorporated. Aetna: Aetna Facts [Internet]. 2016. [cited 2016 Nov 14];Available from: https://www.aetna.com/about-us/aetna-facts-and-subsidiaries/aetna-facts.html
24. Utah Department of Health. Major Diagnostic Categories (MDC) [Internet]. 2016. [cited 2016 Jun 28]; Available from: http://health.utah.gov/opha/IBIShelp/codes/MDC.htm
25. Medicare.gov. Hospital Readmissions Reduction Program: 2013 [Internet]. 2013. [cited 2016 Sep 9]; Available from: https://www.medicare.gov/hospitalcompare/readmission-reduction-program.html?AspxAutoDetectCookieSupport=1
26. Sandhu AT, Heidenreich PA, Bhattacharya J, Bundorf MK. Cardiovascular Testing and Clinical Outcomes in Emergency Department Patients With Chest Pain. JAMA Intern Med [Internet]. 2017; 177(8):1175–82. Available from: http://www.ncbi.nlm.nih.gov/pubmed/28654959.
27. Johnson KB, Unertl KM, Chen Q, et al. Health information exchange usage in emergency departments and clinics: the who, what, and why. J Am Med Inform Assoc [Internet]. 18(5):690–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21846788.
28. Bourgeois FC, Olson KL, Mandl KD. Patients treated at multiple acute health care facilities: Quantifying information fragmentation. Arch Intern Med [Internet]. 2010; 170(22):1989–95. Available from: http://archinte.ama-assn.org/cgi/content/abstract/170/22/1989.
29. Lammers EJ, Adler-Milstein J, Kocher KE. Does health information exchange reduce redundant imaging? Evidence from emergency departments. Med Care [Internet]. 2014; 52(3):227–34. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24374414.
30. Cook LJ, Knight S, Junkins EP, Mann NC, Dean JM, Olson LM. Repeat Patients to the Emergency Department in a Statewide Database. Acad Emerg Med. 2004; 11(3):256–63. [PubMed: 15001405]
31. O'Mahony L, O'Mahony DS, Simon TD, Neff J, Klein EJ, Quan L. Medical complexity and pediatric emergency department and inpatient utilization. Pediatrics [Internet]. 2013; 131(2):e559–65. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23319525.
32. LaCalle E, Rabin E. Frequent users of emergency departments: the myths, the data, and the policy implications. Ann Emerg Med [Internet]. 2010; 56(1):42–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20346540.
33. Doupe MB, Palatnick W, Day S, et al. Frequent users of emergency departments: developing standard definitions and defining prominent risk factors. Ann Emerg Med [Internet]. 2012; 60(1): 24–32. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22305330.
34. Johnson TL, Rinehart DJ, Durfee J, et al. For many patients who use large amounts of health care services, the need is intense yet temporary. Health Aff (Millwood) [Internet]. 2015; 34(8):1312–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/26240244.
35. Billings J, Raven MC. Dispelling an urban legend: frequent emergency department users have substantial burden of disease. Health Aff (Millwood) [Internet]. 2013; 32(12):2099–108. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24301392.
36. Tsai TC, Orav EJ, Jha AK. Care Fragmentation in the Postdischarge Period. JAMA Surg [Internet]. 2015; 150(1):59. Available from: http://archsurg.jamanetwork.com/article.aspx?doi=10.1001/jamasurg.2014.2071.
37. Grinspan ZM, Abramson EL, Banerjee S, Kern LM, Kaushal R, Shapiro JS. People with epilepsy who use multiple hospitals; prevalence and associated factors assessed via a health information exchange. Epilepsia [Internet]. 2014; 55(5):734–45. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24598038.
38. Liu CW, Einstadter D, Cebul RD. Care fragmentation and emergency department use among complex patients with diabetes. Am J Manag Care [Internet]. 2010; 16(6):413–20. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20560685.

39. Epstein K, Juarez E, Epstein A, Loya K, Singer A. The impact of fragmentation of hospitalist care on length of stay. J Hosp Med [Internet]. 2010; 5(6):335–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20803671.
40. Frandsen BR, Joynt KE, Rebitzer JB, Jha AK. Care Fragmentation, Quality, and Costs Among Chronically Ill Patients. Am J Manag Care. 2015; 21(5):355–62. [PubMed: 26167702]
41. Thorpe, JM., Thorpe, CT., Gellad, WF., et al. Dual Health Care System Use and High-Risk Prescribing in Patients With Dementia: A National Cohort Study. Ann Intern Med [Internet]. 2016. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27919104
42. Kocher KE, Dimick JB, Nallamothu BK. Changes in the source of unscheduled hospitalizations in the United States. Med Care [Internet]. 2013; 51(8):689–98. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23752257.
43. Terp, S., Seabury, SA., Arora, S., Eads, A., Lam, CN., Menchine, M. Enforcement of the Emergency Medical Treatment and Labor Act, 2005 to 2014. Ann Emerg Med [Internet]. 2016. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27496388
44. Bailey JE, Pope Ra, Elliott EC, Wan JY, Waters TM, Frisse ME. Health information exchange reduces repeated diagnostic imaging for back pain. Ann Emerg Med [Internet]. 2013; 62(1):16–24. Available from: http://dx.doi.org/10.1016/j.annemergmed.2013.01.006.
45. Carr CM, Gilman CS, Krywko DM, Moore HE, Walker BJ, Saef SH. Observational study and estimate of cost savings from use of a health information exchange in an academic emergency department. J Emerg Med [Internet]. 2014; 46(2):250–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24071033.
46. Rudin RS, Motala A, Goldzweig CL, Shekelle PG. Usage and Effect of Health Information Exchange: A Systematic Review. Ann Intern Med [Internet]. 2014; 161(11):803–11. Available from: http://www.ncbi.nlm.nih.gov/pubmed/25437408.
47. Vest JR, Kern LM, Campion TR, Silver MD, Kaushal R. Association between use of a health information exchange system and hospital admissions. Appl Clin Inform [Internet]. 2014; 5(1): 219–31. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24734135.
48. Saef SH, Melvin CL, Carr CM. Impact of Health INformation Exchange on Resource Use and Medicare-Allowable Reimbursement at 11 Emergency Departments in a Midsized city. West J Emerg Med. 2014; 26(1):217–20.
49. Bailey JE, Wan JY, Mabry LM, et al. Does health information exchange reduce unnecessary neuroimaging and improve quality of headache care in the emergency department? J Gen Intern Med. 2013; 28(2):176–83. [PubMed: 22648609]
50. Yaraghi N. An empirical analysis of the financial benefits of health information exchange in emergency departments. J Am Med Inform Assoc [Internet]. 2015; 22(6):1169–72. Available from: http://www.ncbi.nlm.nih.gov/pubmed/26117143.
51. Everson J, Kocher KE, Adler-Milstein J. Health information exchange associated with improved emergency department care through faster accessing of patient information from outside organizations. J Am Med Inform Assoc [Internet]. 2017; 24(e1):e103–10. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27521368.
52. Mandl KD, Kohane IS. Time for a Patient-Driven Health Information Economy? N Engl J Med [Internet]. 2016; 374(3):205–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/26789868.
53. American College of Emergency Physicians. The American College of Emergency Physicians (ACEP) Exclusively Endorses Edie (TM). In: Premanage, AKA., editor. Solution for Collective Medical Tehcnologies [Internet]. Salt Lake City, UT: 2017. Available from: http://newsroom.acep.org/news_releases?item=122817
54. Shapiro JS, Crowley D, Hoxhaj S, Ii JL, Panik B. Health Information Exchange in Emergency Medicine. Ann Emerg Med [Internet]. 2016; 67(2):216–26. Available from: http://dx.doi.org/10.1016/j.annemergmed.2015.06.018.

Table 1

Patient and visit characteristics for patients with at least 1 Emergency Department Visit

Characteristic	Value
Demographics	**N = 8,651,016**[a]
Age in years, mean (SD)	37.5 (22.7)
Age Category, N (%)	
Birth-14 years	1,566,526 (18.1)
15– 24 years	1,297,733 (15.0)
25–44 years	2,459,990 (28.4)
45–64 years	2,216,398 (25.6)
≥ 65 years	1,110,369 (12.8)
Male, N (%)	3,992,574 (46.2)
U.S. Census regions,[b] **N (%)**	
Northeast	2,292,502 (26.5)
Midwest	1,335,105 (15.4)
South	3,637,343 (42.1)
West	1,375,900 (15.9)
U.S. territories	1,066 (0.0)
Enrollment Duration Categories, N (%)	
< 1 year	907,942 (10.5)
1–2.9 years	3,256,103 (37.6)
3–4.9 years	2,184,596 (25.3)
≥ 5 years	2,303,075 (26.6)
Major diagnostic group,[c] **N (%)**	
Musculoskeletal system and connective tissue	2,026,778 (23.4)
Injuries, poison, and toxic effects of drugs	1,781,890 (20.6)
Digestive system	1,614,518 (18.7)
Circulatory system	1,352,981 (15.6)
Respiratory system	923,866 (10.7)
Ear, nose, mouth, throat	896,208 (10.4)
Nervous system	890,649 (10.3)
Skin, subcutaneous tissue, and breast	884,401 (10.2)
Kidney and urinary tract	607,186 (7.0)
Factors influencing health status	379,468 (4.4)
Infectious and parasitic disease and disorders	362,596 (4.2)
Pregnancy and childbirth	247,989 (2.9)
Mental diseases and disorders	244,717 (2.8)
Female reproductive system	200,107 (2.3)
Endocrine, nutritional, and metabolic system	189,198 (2.2)

Characteristic	Value
Eye	155,994 (1.8)
Hepatobiliary system and pancreas	92,817 (1.1)
Alcohol/drug use or induced mental disorders	84,050 (1.0)
Blood, blood-forming organs	57,435 (0.7)
Burns	43,275 (0.5)
Male reproductive system	19,105 (0.2)
Myeloproliferative diseases and disorders	11,778 (0.1)
Newborns and neonates (perinatal period)	9,770 (0.1)
Multiple significant trauma	8,109 (0.1)
Human Immunodeficiency virus infections	719 (0.0)
Visit Severity,[d] N (%). (15,773,085 visit dates)	
99281 (Straight Forward)	161,266 (1.0)
99282 (Low Complexity)	619,948 (3.9)
99283 (Moderately Low Complexity)	4,845,879 (30.7)
99284 (Moderately High Complexity)	5,473,772 (34.7)
99285 (High Complexity)	4,672,220 (29.6)

Abbreviations: N= number of patients, SD= standard deviation, %= percent of observations with non-missing values, ED= emergency department.

[a] Demographics missing for 700 (0.008%) patients

[b] Region is based on member zip code at first enrollment date.

[c] Reported as number with at least 1 visit for each category. Total percent is > 100 if patients have >1 diagnosis.

[d] If a patient visited >1 emergency department on the same day, the value reported is most severe for that day.

Table 2

Number of unique Emergency Departments visited by number of total Emergency Department visits per patient

	Number of Unique Emergency Departments Visited, N (%)				
Number of ED Visits	**1**	**2**	**3**	**4**	**5+**
1	5,318,951 (100%)				
2	999,610 (56.2%)	780,000 (43.8%)			
3	305,751 (44.6%)	279,839 (40.9%)	99,424 (14.5%)		
4	121,520 (35.1%)	148,757 (42.9%)	60,249 (17.4)	16,130 (4.7%)	
5+	130,388 (25.0%)	186,494 (35.8%)	119,122 (22.8%)	53,877 (10.3%)	31,604 (6.1%)

Table 3

Bivariate analyses of individual predictors for utilization of multiple EDs for patients with two or more ED visits.

	Patient with ≥ 2 Visits to the Same ED	Patients with ≥ 2 Visits to ≥ 2 Unique EDs	Difference (95% CI)
Demographics			
Age, Mean (SD)	39.6 (24.6)	38.6 (23.4)	−1.1 (−1.1, −1.0)
Years of Enrollment, Mean (SD)	3.6 (1.9)	3.7 (1.9)	0.1 (0.1, 0.1)
Male Gender, N/Total (%)	695,999/1,557,183 (44.7)	772,849/1,775,439 (43.5)	−1.2 (−1.1, −1.3)
Number of ED Visits, Mean (SD)	2.7 (1.6)	3.8 (4.0)	1.1 (1.1, 1.1)[d]
US Census Region	N = 1,555,434	N=1,774,011	
Northeast, N (%)	438,591 (28.2)	459,088 (25.9)	−2.3 (−2.4, −2.2)
Midwest, N (%)	264,523 (17.0)	275,651 (15.5)	−1.5 (−1.6, −1.4)
South, N (%)	623,533 (40.1)	801,632 (45.2)	5.1 (5.0, 5.2) [d]
West, N (%)	228,787 (14.7)	237,640 (13.4)	−1.3 (−1.2, −1.4)
Major diagnostic Categories	N=1,557,260	N=1,775,496	
Nervous system, N (%)	229,039 (14.7)	333,280 (18.8)	4.1 (4.0, 4.1)[d]
Eye, N (%)	38,109 (2.5)	54,351 (3.1)	0.6 (0.6, 0.6)
Ear, nose, mouth, throat, N (%)	248,675 (16.0)	196,605 (16.7)	0.7 (0.7, 0.8)
Respiratory system, N (%)	264,411 (17.0)	331,557 (18.7)	1.7 (1.6, 1.8)
Circulatory system, N (%)	336,360 (21.6)	451,804 (25.5)	3.8 (3.8, 3.9)
Digestive system, N (%)	413,419 (26.6)	537,369 (30.3)	3.7 (3.6, 3.8)
Liver, GB, and pancreas, N (%)	24,954 (1.6)	33,459 (1.9)	0.3 (0.3, 0.3)
Musculoskeletal, N (%)	484,064 (31.1)	626,674 (35.3)	4.2 (4.2, 4.3)
Skin and soft tissue, N (%)	255,682 (16.4)	302,636 (17.1)	0.6 (0.5, 0.7)
Endocrine and metabolic, N (%)	53,770 (3.5)	75,833 (4.3)	0.8 (0.8, 0.9)
Kidney and urinary tract, N (%)	164,748 (10.6)	206,989 (11.7)	1.1 (1.0, 1.1)
Male reproductive system, N (%)	5,203 (0.3)	6,998 (0.4)	0.1 (0.0–0.1)
Female reproductive system, N (%)	48,176 (3.1)	82,275 (4.6)	1.5 (1.5, 1.6)
Pregnancy and childbirth, N (%)	60,716 (3.9)	82,764 (4.7)	0.8 (0.7, 0.8)
Newborn and neonatal,[c] N (%)	2,015 (0.1)	2,435 (0.1)	0.0 (0.0, 0.0)
Blood and immunological, N (%)	16,898 (1.1)	23,480 (1.3)	0.2 (0.2, 0.3)
Myeloproliferative, N (%)	3,686 (0.2)	5,138 (0.3)	0.1 (0.0, 0.1)
Infectious and parasitic, N (%)	103,802 (6.7)	122,558 (6.9)	0.2 (0.2, 0.3)
Mental disorders, N (%)	55,472 (3.6)	109,342 (6.2)	2.6 (2.6, 2.6)[d]
Alcohol and drugs, N (%)	13,671 (0.9)	38,293 (2.2)	1.3 (1.3, 1.3)[d]
Injuries/poisoning/Toxic Effects Drugs, N (%)	408,287 (26.2)	518,291 (29.2)	3.0 (2.9, 3.0)
Burns, N (%)	9,89 2(0.6)	14,362 (0.8)	0.2 (0.2, 0.2)

	Patient with ≥ 2 Visits to the Same ED	Patients with ≥ 2 Visits to ≥ 2 Unique EDs	Difference (95% CI)
Factors influencing health, N (%)	108,970 (7.0)	154,512 (8.7)	1.7 (1.6, 1.8)
Multiple trauma, N (%)	1,911 (0.1)	3,183 (0.2)	0.1 (0.0, 0.1)
Human Immunodeficiency Virus, N (%)	186 (0.01)	349 (0.02)	0.01 (0.1, 0.0)
Highest Visit Complexity	N = 1,557,269	N=1,775,496	
99281 (Straight Forward)	1,554(0.1)	196 (0.01)	−0.1 (−0.1, −0.1)
92282 (Low Complexity)	12,495 (0.8)	5,705 (0.3)	−0.5 (−0.5, −0.5)
99283 (Moderately Low Complexity)	253,492 (16.3)	204,984 (11.5)	−4.7 (−4.8, −4.7)[d]
99284 (Moderately High Complexity)	547,954 (35.2)	553,633 (31.2)	−4.0 (−4.1, −3.9)
99285 (High Complexity)	741,774 (47.6)	1,010,978 (56.9)	9.3 (9.2, 9.4)[d]

Abbreviations: ED= emergency department, N= number of patients, SD= standard deviation, %= percent, Dx= diagnosis.

[a] T-tests were used to compare use of single vs multiple EDs for continuous variables

[b] Values for categorical variables are for the number and percent of patients who visited multiple EDs. Chi-square tests or logistic regression was used to evaluate proportions who visited multiple EDs. P-values are from Chi-square tests for two-category variables (gender, diagnoses) and for Type 3 tests for variable with five categories (region, maximum 9928- CPT code). All p-values are <.001 unless otherwise indicated.

[c] p=0.053.

[d] Cohen's statistic > 0.1

Table 4

Multivariate associations between demographic and visit-level factors and visiting multiple EDs by patients with two or more ED visits

Variable	Odds of Visiting Multiple Unique EDs (95% CI)
Demographics	
Age, years	.099 (0.99, 0.99)
Years of Enrollment	1.03 (1.03, 1.03)
Total Number of ED Visits	1.42 (1.42, 1.42)
Gender	
Male	1.00 (ref)
Female	1.00 (0.99, 1.00)
US Census Region	
Northeast	1.00 (ref)
West	0.99 (0.99, 1.00)
Midwest	0.96 (0.96, 0.97)
South	1.22 (1.21, 1.22)
Major Diagnostic Category	
Nervous system	0.83 (0.82, 0.83)
Eye	0.94 (0.92, 0.95)
Ear, nose, mouth, throat	0.72 (0.72, 0.73)
Respiratory system	0.70 (0.70, 0.71)
Circulatory system	0.80 (0.79, 0.80)
Digestive system	0.75 (0.75, 0.76)
Liver, GB, and pancreas	0.76 (0.75, 0.78)
Musculoskeletal	0.85 (0.84, 0.85)
Skin and soft tissue	0.72 (0.72, 0.73)
Endocrine and metabolic	0.76 (0.75, 0.77)
Kidney and urinary tract	0.73 (0.73, 0.74)
Male reproductive system	0.84 (0.81, 0.87)
Female reproductive system	0.93 (0.92, 0.94)
Pregnancy and childbirth	0.76 (0.75, 0.77)
Newborn and neonatal	0.81 (0.77, 0.87)
Blood and immunological	0.76 (0.74, 0.77)
Myeloproliferative	0.85 (0.81, 0.89)
Infectious and parasitic	0.71 (0.70, 0.72)
Mental disorders	1.05 (1.04, 1.07)
Alcohol and drugs	1.56 (1.53, 1.60)
Injuries/poisoning/Toxic Effects Drugs	0.86 (0.86, 0.87)
Burns	0.95 (0.92, 0.98)

Variable	Odds of Visiting Multiple Unique EDs (95% CI)
Factors influencing health	0.79 (0.79, 0.80)
Multiple trauma	1.02 (0.96, 1.08)
Human Immunodeficiency Virus	0.97 (0.81, 1.18)
Highest Visit Complexity	
99285 (High Complexity)	1.00 (ref)
99281 (Straight Forward)	0.10 (0.09, 0.12)
92282 (Low Complexity)	0.40 (0.39, 0.41)
99283 (Moderately Low Complexity)	0.68 (0.67, 0.68)
99284 (Moderately High Complexity)	0.82 (0.81, 0.82)

Abbreviations: ED= emergency department, N= number of patients, SD= standard deviation, %= percent, Dx= diagnosis.

Logistic regression models controlled for all other variables. Odds ratios compare patients with each diagnosis to patients without each diagnosis.