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Research Article

Psychiatric co-morbidities and substance abuse are dominant factors in Predicting Emergency Department usage rates

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Abstract

Importance: 1% of the United States population accounts for 20% of healthcare costs. What characterizes heavy users of the Emergency Department (UED) both demographically and clinically is an area of active research.

Objective: Compare the proportion of nine common co-morbidities between heavy, moderate, and infrequent users then compare episodic and continuous heavy UED.

Setting: A large metropolitan healthcare system.

Participants: Heavy users were selected using a retrospective chart review of Barnes-Jewish Emergency Department records from 2010-2011. Emergency department usage for all unique patients seen in the time period specified was determined for two non-overlapping 365-day periods. Patients were stratified into 1 of 3 groups: Heavy users (> 10 visits for both periods), moderate users (5-9 visits for both periods), and infrequent users (1 visit in either the first or last period). There were 546 moderate users and 59,957 infrequent users matched 1:1 against 160 heavy users. These patients were matched for age, race, gender, and insurance. The 160 continuous heavy users were also compared to 388 patients who had > 10 visits in the first period, but not the second period, and 443 patients who had > 10 visits in the second period, but not the first. The proportion of subjects within each group was compared based on nine co-morbidities (substance abuse, mental illness, chronic pain, heart disease, lung disease, kidney disease, liver disease, cancer and stroke) using 95% confidence intervals.

Results: Infrequent users had lower rates of all co-morbidities. Moderate users had similar rates of all co-morbidities to heavy users, except slightly higher CVA rates (13.7% v 10.6%; $p = 0.49$), lower rates for mental illness (33.3% v 43.1%; $p = 0.08$) and significantly lower rates for substance abuse (17% v 35%; $p < 0.001$). Only substance abuse demonstrated a significant difference between episodic and continuous heavy UED (35% v 23.5%; $p = 0.002$).

Conclusion: Among nine common co-morbidities, only substance abuse rates were significantly higher among heavy users compared to matched moderate UED in our healthcare system. Infrequent users had lower rates of all co-morbidities. When comparing continuous and episodic heavy emergency department users, only substance abuse rates were significantly higher.

Introduction

Several studies, across a wide range of demographic groups, have shown that healthcare utilization rates are highly skewed, with the top 1% of healthcare users accounting for over 20% of all healthcare resource utilization, and the top 5% accounting for over 50% [1-3].

With the cost of healthcare rising at unsustainable rates, there is interest in examining this population as a potential way of decreasing overall healthcare costs. Identification of these users prospectively could assist healthcare providers in better managing their care and ultimately reduce healthcare costs, while maintaining or even improving health outcomes for the target population.

There have been a number of reports that attempt to identify those that are at increased risk for becoming a "super-user" or "high-cost user" by analyzing historical cost data, clinical and demographic data, or a combination of both [4-6]. As one might predict, those patients with numerous and more severe medical co-morbidities and higher prior healthcare expenditures were

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at increased risk to be "high-cost users" in subsequent years. These studies were instrumental in demonstrating that the risk of becoming a high-cost user of healthcare was predictable for large populations. However, it was apparent that significant variability exists at the individual patient level, making predictions at this level more problematic. In fact, two recent studies showed that fewer than half of frequent users in one year remain frequent users in the subsequent year [7,8].

The objective of this study was to compare the prevalence of nine "high cost" co-morbidities in a cohort of subjects who met our criterion definition for heavy users of the emergency department (UED) for each of two nearly contiguous 365-day periods with a cohort of moderate and infrequent users over the same study period, after matching for a number of demographic and social characteristics known to affect emergency department and overall healthcare usage. We also compared the prevalence of these same nine co-morbidities between continuous heavy users and subjects who met the definition of a heavy user for only a single year (episodic heavy user).

Methods

Study design

This was a retrospective longitudinal cohort study utilizing emergency department and hospital records across a large metropolitan healthcare system. All data were de-identified and patients were given a unique ID number prior to analysis. The study was given expedited approval by the Washington University in St. Louis Institutional Review Board.

Study setting and population

A large metropolitan healthcare system (BJC Healthcare) with approximately 38% market share for healthcare services in the metropolitan St. Louis region, which consists of 15 counties and over 2.5 million people [9,10]. All unique patients seen in the Barnes-Jewish Hospital Emergency Department (ED) from 2010-2011 were identified and composed of the study population.

Study protocol

ED usage (total number of ED visits) for each unique patient seen in our ED during the calendar years 2010-2011 was determined for two non-overlapping 365-day periods using our emergency department patient tracking system (HMED, Allscripts). The first period was measured from the subject's last ED visit in 2010, going back 365 days; and the second was measured from their first ED visit in 2011, going forward 365 days. Patients were a priori stratified into 1 of 3 groups: heavy users (> 10 visits for both periods), moderate users (5-9 visits for both periods) and infrequent users (1 visit in either the first or last period, both measured as 365 days from the index visit). We matched subjects 1:1 in the moderate and infrequent user groups to those in the heavy-user group for age, race, gender and insurance status. The race was self-reported by the patient. Apart from meeting the numerical visit criteria, there was no other specific exclusion parameter for our study. If there were multiple matches for each heavy user among the matched moderate and infrequent users, a random number generator was used to select a patient match. All heavy users could be matched to infrequent users, but there were 7 heavy users that could not be matched to moderate users based on all four demographic variables, so the adjusted number for this group was 153 instead of 160.

After matching the patients, we reviewed ED records from the complete metropolitan BJC system, which includes 12 hospitals, to determine if any subjects in the moderate or infrequent groups dropped out by virtue of increased annual visits. The final categorization of usage (heavy vs. moderate vs. infrequent) was based on the total number of system-wide ED visits over the study periods defined above. For example, if a subject in the moderate group was found to have more than 9 visits in either of the 365-day periods as defined above, they were excluded and replaced by another subject from the moderate group that did not drop out. This same process was applied to the infrequent user group. We then performed a structured chart review on the 160 heavy users, 160 matched infrequent users and 153 matched moderate users, adhering to the strategies proposed by Gilbert, et al. [11] One abstractor (LL) performed all reviews of the medical records to determine the proportion of subjects in each user group identified as having any of the nine co-morbidities. Co-morbidities included substance abuse, mental illness, chronic pain, heart disease, lung disease, kidney disease, liver disease, cancer and stroke. The ICD-9 codes that were used to determine the presence of each of these medical conditions can be seen in the **Appendix**. Another of us (LML) verified information on 100 randomly selected charts (21.1%). All disagreements (n = 4) regarding the presence of a particular co-morbidity were resolved by reviewing the chart together. We compared the prevalence of each of the nine medical co-morbidities between the matched user cohorts as well as between episodic heavy users (> 10 visits in only one of the two periods) and continuous heavy users (> 10 visits in both periods).

Statistical analysis

The prevalence of each of the nine medical co-morbidities with 95% confidence intervals was calculated and compared for each of the three user groups in the first analysis and for the episodic vs. continuous heavy user groups in the second analysis. P-values were calculated using an unpaired t-test calculator.

Results

There were a total of 94,762 ED visits in 2010 and 96,484 ED visits in 2011 at the Barnes Jewish Hospital ED. Of these, there were 59,412 unique patients in 2010 and 59,535 unique patients in 2011. According to the St. Louis Regional Health Commission, the urban-based BJC System hospitals accounted for 38% of all ED visits within the region in 2012 [10].

The demographic profile for heavy users (continuous and episodic), along with the unmatched demographic profile for moderate and infrequent users can be seen in Table 1. The 160

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heavy users were matched 1:1 for all four demographic variables against the 544 moderate users and 59,149 infrequent users, resulting in the matched demographic profile in Table 2. The proportion of subjects with each of the nine co-morbidities (with 95% CI) in the heavy, moderate and infrequent groups can be seen in Table 3. Infrequent users had lower rates of all co-morbidities when compared to both heavy and moderate users. Moderate users had similar rates of all co-morbidities to heavy users, except for nearly significantly lower rates of mental illness (33.3% v 43.1%; p = 0.08), and significantly lower rates of substance abuse (17% v 35%; p = 0.0003).

The same data set of 160 continuous heavy users were compared to 388 patients who had > 10 visits in the first period, but not the second period (dropouts) and 443 patients who had > 10 visits in the second period, but not the first (drop-ins). There were 19 patients who were excluded from the drop-out group because they died in 2011 and we also excluded 3 patients from the drop-in group due to death in 2011. In our population, 29% of the heavy user patients in 2010 continued to be heavy users in 2011. The proportion of subjects with each of the nine co-morbidities for both the continuous heavy user and the episodic heavy user groups (with 95% CI) can be seen in Table 4. Of the nine co-morbidities, only substance abuse demonstrated a significant difference between episodic and continuous heavy UED (35% v 23.5%; p = 0.002).

Discussion

It is becoming clear that heavy users of healthcare services, including emergency department services, are a heterogeneous group [7,12]. Thus, although we separated users into 3 groups (heavy users; those with > 10 visits in each 365-day period; moderate users; 5-9 visits in each period; and infrequent users, those with 1 visit in either of the two periods) it is likely that there are differences within each of these groups that are not reflected in this analysis. In fact, Ruger, et al. showed that there are significant differences in patient acuity among those using the ED over 20 times in a one-year period compared to those using it 10 or more times, but less than 20 [12]. It has been noted for at least a decade that many frequent emergency department users (defined somewhat differently across studies) are older and often sicker than their less frequent counterparts, based upon admission rate, DRG severity, and subsequent mortality [12-14]. Furthermore, the number of studies has shown increased rates of psychiatric morbidity, poor social support, and substance abuse among frequent ED users [7,15-18].

Table 1: Continuous and Episodic Heavy, Moderate, and Infrequent Users Unmatched Demographics.

User Category	Race		Sex	Age	Insurance			
	AA n (%)	White n (%)	Female n (%)	Mean ± SD	Medicare n (%)	Medicaid n (%)	Self-Pay n (%)	Private n (%)
Frequent n = 160	130 (81.3)	29 (18.1)	95 (59.4)	44 ± 16	63 (39.4)	65 (40.6)	26 (16.2)	6 (3.8)
Moderate n = 544	432 (79.4)	73 (13.4)	351 (64.5)	43 ± 17	198 (36.4)	202 (37.1)	117 (21.5)	27 (5)
Infrequent n = 59149	26587 (44.9)	28397 (48)	30780 (52)	44 ± 19	10089 (17.1)	6960 (11.8)	26329 (44.5)	15763 (26.6)
Drop-Outs n = 388	288 (74.2)	85 (21.9)	191 (49.2)	44 ± 16	139 (35.8)	151 (38.9)	82 (21.1)	16 (4.1)
Drop-Ins n = 443	313 (70.7)	102 (23)	228 (51.5)	42 ± 17	160 (36.1)	187 (42.2)	83 (18.7)	13 (2.9)

Table 2: Results of Matching Demographics Across All User Groups.

User Category	Race		Sex	Age ± SD	Insurance			
	AA n	White n	Female n	Mean	Medicare n	Medicaid n	Self-Pay n	Private n
Heavy n =160	130	29	95	44 ± 16	63	65	26	6
Moderate n =153	129	24	92	44 ± 16	60	61	24	8
Infrequent n =160	130	30	95	44 ± 16	63	62	26	9

Table 3: Prevalence of Co-Morbidities in Heavy, Moderate, and Infrequent Users.

User Category	Substance Abuse n, %, (95% CI)	Chronic Pain n, %, (95% CI)	Mental Disorder n, %, (95% CI)	Heart Disease n, %, (95% CI)	Lung Disease n, %, (95% CI)	Kidney Disease n, %, (95% CI)	Liver Disease n, %, (95% CI)	Cancer n, %, (95% CI)	Stroke n, %, (95% CI)
Heavy n = 160	**56 35 (28-43)**	45 28.1 (22-36)	69 43.1 (36-51)	45 28.1 (22-36)	54 33.8 (27-41)	32 20 (15-27)	19 11.9 (08-18)	13 8.1 (05-13)	17 10.6 (07-16)
Moderate n = 153	26 17 (12-24)	33 21.6 (16-29)	51 33.3 (26-41)	47 30.7 (24-38)	54 35.3 (28-43)	27 17.6 (12-24)	21 13.7 (9-20)	15 9.8 (6-16)	21 13.7 (9-20)
Infrequent n = 60	13 8.1 (5-13)	11 6.9 (4-12)	26 16.3 (11-23)	12 7.5 (4-13)	16 10 (6-16)	7 4.4 (2-9)	6 3.8 (2-8)	10 6.3 (3-11)	5 3.1 (1-7)
p - values Heavy vs. Moderate	0.0003	0.18	0.075	0.6159	0.7748	0.5961	0.6253	0.6043	0.491

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Table 4: Prevalence of Co-Morbidities in Continuous and Episodic Heavy Users.

User Category	Substance Abuse n, %, (95% CI)	Chronic Pain n, %, (95% CI)	Mental Health n, %, (95% CI)	Heart Disease n, %, (95% CI)	Lung Disease n, %, (95% CI)	Kidney Disease n, %, (95% CI)	Liver Disease n, %, (95% CI)	Cancer n, %, (95% CI)	CVA n, %, (95% CI)
Continuous Heavy Users *n* = 160	56 35 (28-43)	45 28.1 (22-36)	69 43.1 (36-51)	45 28.1 (22-36)	54 33.8 (27-41)	32 20 (15-27)	19 11.9 (8-18)	13 8.1 (5-13)	17 10.6 (7-16)
Drop-outs *n* = 388	101 26 (22-31)	105 27.1 (23-32)	179 46 (41-51)	112 28.9 (25-34)	118 30.4 (26-35)	66 17 (14-21)	48 12.4 (9-16)	30 7.7 (5-11)	46 11.9 (9-15)
Drop-ins *n* = 443	94 21.2 (18-25)	144 32.5 (28-37)	171 38.6 (34-43)	110 24.8 (21-29)	124 28 (24-32)	60 13.5 (11-17)	58 13.1 (10-17)	38 8.6 (6-12)	46 10.4 (8-14)
Combined Drop-outs & Drop-ins *n* = 831	195 23.5 (21-26)	249 30 (27-33)	350 42.1 (39-46)	222 26.7 (24-30)	242 29.1 (26-32)	126 15.2 (13-18)	106 12.8 (11-15)	68 8.2 (7-10)	92 11.1 (9-13)
p -value Episodic vs. Continuous	0.002	0.64	0.81	0.71	0.24	0.13	0.76	0.98	0.87

The demographics of our heavy user group are similar to those found in other studies. The patient group is largely insured with either Medicaid, Medicare, or private insurance, which continues to dispel the stereotype that those who frequently present to the ED are uninsured [19]. In fact, this is also consistent with National Health Interview Survey data, which demonstrated that a larger percentage of patients with one or more ED visits in the preceding 12 months had Medicaid rather than no insurance at all [20]. Similar to data from the 2009 systematic review of frequent user studies, our patient population fit the expected age range and female predominance, however, our heavy users were more likely to be African American than Caucasian as the national data demonstrate [15]. These results could not be completely explained by the demographics of the surrounding area.

Most of the patients who visit the BJH ED are from St. Louis City. This specific area has a population, based on 2010 US Census Data, of 319, 294 people [9]. The racial demographics are 43.9% White, 49.2% African American, 3.2% Hispanic and 2.9% Asian. This racial distribution is consistent with the racial distribution among infrequent users of the ED, but it seems to be largely weighted toward African American patients in the moderate and heavy user groups. The median age in St. Louis city is approximately 34 years, almost a decade younger than the median age we found among all 3 of our user groups. The gender mix of St. Louis City is 48.3% male and 51.7% female. This is similar to the gender mix among our infrequent users, but there is an increase in females among the moderate and heavy users.

Since there have been a number of reports demonstrating that healthcare utilization is affected by age, race, gender and insurance status [7], we thought it was important to adjust for these variables when evaluating the effect of co-morbidities on healthcare utilization. This study has two unique features. First, it takes into account certain social and demographic variables known to affect ED usage rates, and second, it evaluates usage over more than a single year period, allowing a comparison between episodic heavy users and more continuous heavy users to determine if certain features may be more predictive of heavy usage over time. In our first analysis, we characterized both heavy and moderate users as those who had two consecutive years of their designated number of visits as opposed to a single year. The cut-off values for defining our 3 sub-groups were based on previous work and the literature, but these values remain somewhat arbitrary, particularly for a study looking at greater than a 1-year period [7].

Our results show that the subjects we categorized as having moderate usage (5-9 visits annually) have significantly higher rates of medical co-morbidities such as heart, lung, renal and liver disease than those seen among the infrequent ED usage group, but with rates that are comparable to the heavy user group. Poorly controlled chronic medical diseases have previously been reported as a cause of increased healthcare resource utilization [1,2,4,5,19]. This was also demonstrated in our study, where every one of the nine medical co-morbidities was significantly more prevalent in the moderate and heavy user group than in the infrequent user group. But this study also suggests that two of the co-morbidities we evaluated, substance abuse and mental illness, may identify a sub-group of the heaviest UED that would benefit from specific programs geared toward the treatment of these conditions.

The finding of substance abuse as a prominent co-morbidity among heavy users has been cited previously [14,18,21], but this study supports the dominant effect this co-morbidity has on differentiating heavy users from infrequent or moderate users. Additionally, substance abuse was the only statistically significant co-morbidity distinguishing continuous from episodic heavy users of the ED. Based on national data, substance abuse is a problem that plagues 9.2% of persons 12 years of age and over [20]. Thus it may not be surprising that this co-morbidity emerged as the most defining characteristic of heavy UED among the nine high-cost co-morbidities that we evaluated. This finding further supports the results of a recent regional study that highlights the need for more resources to be given to programs and facilities that treat not just mental health disorders but also focus on substance abuse rehabilitation [18].

Limitations

One of the primary limitations of this study is that it only involved a single hospital system. Although we have a large catchment area and high numbers of ED visits, it may not

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be representative of the country as a whole, but it is likely representative of many urban areas.

The chart review of patients was limited by the amount of data provided either in ED history and physicals, admission history and physicals, and discharge summaries.

As this was a retrospective study, there were no patient anecdotes detailing the reasons they felt they needed to go to the ED as opposed to their primary medical doctor or other outlets for healthcare.

We followed the methodologic standards for retrospective chart review, with the exception that there was no blinding of the chart reviewer to the etiologic relation being studied and the patients' group assignments [11]. Otherwise, there was a standardized form for data abstraction and entry which the abstractor was trained to use, there were periodic meetings to review progress, and there was a review of abstractor accuracy on about 20% of randomly selected charts.

We were also unable to perform a calculation of the odds of heavy usage with the presence or absence of the various co-morbidities due to our inability to manually review the nearly 60,000 infrequent user records in our data set.

Conclusion

Substance abuse and mental illness are strongly associated with heavy ED usage rates and may play a dominant role in excessive ED utilization. There is a need for hospital administrators and health policymakers to focus on ways to better treat these disorders if we want to address the most likely causes of persistent heavy ED utilization.

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(Supplementary file)

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