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COST-EFFECTIVE: EMERGENCY DEPARTMENT CARE COORDINATION WITH A REGIONAL HOSPITAL INFORMATION SYSTEM

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Abstract—Background: Frequent and unnecessary utilization of the emergency department (ED) is often a sign of serious latent patient issues, and the associated costs are shared by many. Helping these patients get the care they need in the appropriate setting is difficult given their complexity, and their tendency to visit multiple EDs. **Study Objective:** We analyzed the cost-effectiveness of a multidisciplinary ED-care-coordination program with a regional hospital information system capable of sharing patients' individualized care plans with cooperating EDs. **Methods:** ED visits, treatment costs, cost per visit, and net income were assessed pre- and postenrollment in the program using nonparametric bootstrapping techniques. Individuals were categorized as *frequent* (3–11 ED visits in the 365 days preceding enrollment) or *extreme* (≥ 12 ED visits) users. Regression to the mean was tested using an adjusted measure of change. **Results:** Both *frequent* and *extreme* users experienced significant decreases in ED visits (5 and 15, respectively; 95% confidence intervals [CI] 2–5 and 13–17, respectively) and direct-treatment costs (\$1285; 95% CI \$492–\$2364 and \$6091; 95% CI \$4298–\$8998, respectively), leading to significant hospital cost savings and increased net income (\$431; 95% CI \$112–\$878 and \$1925; 95% CI \$1093–\$3159, respectively). The results further indicate that fewer resources were utilized per visit. **Conclusions:** When examined as a whole, research on the program suggests that expanding it would be an efficient allocation of hospital, and possibly societal, resources. © 2014 Elsevier Inc.

Keywords—emergency department; frequent users; care coordination; cost-effectiveness; information exchange

INTRODUCTION

Frequent improper use of the emergency department (ED) is a concern for hospitals and their patients, ED providers, third-party payers, and society. Studies have found that a small percentage of ED patients constitute a large proportion of total ED visits (1–4). It is not always clear what drives frequent ED use; however, it is likely a sign of serious latent issues (5). Some studies indicate that frequent use may be a function of patients lacking access to a primary care provider (PCP), whereas others have found evidence to the contrary (3,6–12). Frequent ED users tend to be a complex low-income population in poor physical health, with many suffering from mental illness or substance-use disorders (1,3,13–17). Resources consumed by this group are vast, and concomitant with an increased frequency of ED visits is ED crowding, wait times, strain on staff, and adverse outcomes (15,18–28). Therefore, helping these patients get the care they need in the appropriate setting is crucial.

A systematic review of the Emergency Medicine literature revealed substantial variability in the proportion of ED visits deemed to be nonemergent, with a median

finding of approximately 32% (29). Weinick et al. found that roughly 14–27% of all ED visits could be treated in clinics and urgent-care centers at a lower cost; a potential savings of \$4.4 billion per year (30). On a related note, a Washington State Hospital Association report found that half of all potentially avoidable ED visits were made by publicly insured individuals (31). Similarly, Zuckerman and Shen found that 18% of the patients in their sample with three or more ED visits in the prior year were uninsured and 29% were publicly insured, the latter group being over twice as likely to be frequent users as those who were either privately insured or uninsured (32).

Findings such as these have prompted policymakers to explore options for reducing expenditures on nonurgent visits to the ED. For example, the Washington State Health Care Authority (HCA) proposed a policy to deny reimbursement for ED visits made by Medicaid beneficiaries that are deemed to be “not medically necessary in the ED setting” (33). Several factors, including concern that this policy was not in the best interest of Medicaid recipients, resulted in its suspension by the Washington State legislature (34). Instead, the state implemented a policy allowing hospitals to apply seven *best practices* for reducing nonemergent ED visits; however, the HCA reserves the right to revert to the policy of denying payment if an adequate reduction in ED expenditures is not achieved.

Given the aforementioned complexity of frequent ED users, reducing inappropriate ED use and ensuring that needed care is received in the appropriate setting may be more difficult than simply triaging these patients and providing them with information on where such care can be received. Especially given that frequent users often visit multiple EDs (35–38). Therefore, multidisciplinary ED-care-coordination programs have received attention as a means to treat frequent users efficiently. The structure of such programs varies, but the majority involves a case manager who represents the care-coordination team and directs the patient through the care process; a format that has been effective at reducing ED visits (39). Programs that develop formal ED-care plans are less common, but also effective (40). Still, many studies assessing the effectiveness of such programs have failed to include a cost analysis. Cost-effectiveness is something that should be considered by health care facilities and policymakers interested in efficiently allocating scarce resources.

The objective of this article was to preliminarily assess the cost-effectiveness of a relatively unique multidisciplinary ED-care-coordination program. This program is unique in that not only are individualized ED-care guidelines created for each patient, but also at its core is a regional hospital information system that allows participating EDs to view the guidelines. This is important, as

the guidelines inform the emergency physician on proper care in the ED while directing the patient to further care in the appropriate setting. Such a program has the potential to benefit patients, all EDs in a given area, and in turn, society as a whole. As a result, this type of electronic patient-information-exchange system is receiving considerable attention in Washington State. In fact, the first *best practice* requires EDs to exchange patient information in real time using a similar system (41).

Additional contributions to the literature include subgroup analyses according to the frequency of ED visits made over the year prior to initiation into the ED-care-coordination program, and focusing not only on changes in visits and direct-treatment costs as others have done, but also on changes in the hospital’s net income and the direct cost of treatment per ED visit. Analyzing cost per visit allowed us to determine whether changes in cost were concomitant with changes in trips to the ED, or if the program also affected the resources used during a given ED visit. Separate analyses of relatively low and high frequent users gives stakeholders a sense of whether the program is cost-effective for all patients fitting the description of an over-user, or if resources should be focused on a subset of this population.

METHODS

Study Design

This was a 2-year retrospective pre-post analysis on a convenience sample of patients enrolled in a multidisciplinary ED-care-coordination program. Enrollment was based on referrals from ED physicians and Medicaid managed care plans. Prior to enrollment, patients’ ED visits were retrospectively reviewed by a nurse case manager and a multi-disciplinary committee who determined that the patient demonstrated a pattern of inappropriate ED visits that could benefit from ED care coordination. Preference was given to managed-care Medicaid patients whose health plan provided reimbursement to the program. Data were collected on each subject for the 365 days prior to their initiation date for the program, and the 365 days after. The study was reviewed and approved by the Institutional Review Board (IRB) Spokane in Spokane, Washington (an IRB overseeing research done at the major Spokane-area medical facilities), and the Washington State University IRB.

Study Setting

The setting for this study was the Consistent Care (CC) program based at Providence Sacred Heart Medical Center & Children’s Hospital (SHMC) in Spokane. SHMC is a regional medical and trauma center for the

Pacific Northwest, with 644 beds and approximately 80,000 yearly ED visits. The CC program is a multidisciplinary ED-care-coordination program designed to reduce unnecessary utilization of the ED. At the time of the study, the program's core staff was comprised of a 0.25 full-time equivalent (FTE) medical director, a 1.0 FTE case coordinator, and a 1.0 FTE administrative assistant.

Once enrolled in CC, staff members review electronic hospital records to determine the patient's PCP, at which point the provider is contacted to confirm their relationship with the patient and inform them of the patient's frequent ED use. If it is discovered that care is being obtained from multiple providers unbeknownst to each other, each is contacted, and a single provider is determined and recorded in the ED-care guidelines. The PCP provides information on the existence of a pain-management agreement, recurring opioid prescriptions, medical conditions, and ED treatment suggestions, all of which are placed in the ED-care guidelines, along with information on frequent computed tomography scans, overdoses, chemical dependency, and mental-health diagnoses. Every guideline contains a recommendation that controlled substances be prescribed or administered only in the ED for acute conditions with objective findings. Additional recommendations for ED-care coordination and ED treatment are obtained in consultation with a multidisciplinary committee consisting of physicians, nurses, mental-health and substance-abuse professionals, ED nurse managers, a pharmacist, a social worker, a chaplain, and others. Patient input is considered, but included in the guidelines only when deemed constructive. Furthermore, the CC program frequently arranges referrals to substance-abuse and mental-health services, issues that are prevalent in this population.

Attempts to contact each patient are made via telephone and letter to inform them of their enrollment in the program, and the assistance that is now available for obtaining appropriate medical care in appropriate settings. Care-coordination services are provided for as long as the patient is willing to engage.

The regional hospital information system in place during the study period consisted of all Spokane-area hospitals and several surrounding rural hospitals. The individualized ED-care guidelines were stored in the system, and the patient's record was flagged. ED providers who accessed a patient's record saw a notification screen indicating that an ED-care plan existed within the system. Information sharing between EDs subsequent to this study has been improved by implementing an additional system that automatically faxes the ED-care guideline and ED-visit history to the ED-treatment area upon patient registration. This reduces the chance that busy ED physicians will overlook the information.

Participants

Patients whose CC enrollment date was between January 1, 2008 and December 31, 2010, and who had complete data for the year prior to their induction into the program were included in the study. Individuals eligible for the study were at least 18 years of age at the time of program entry and had at least three visits to the ED in the 365 days prior to this index date. The end date for enrollment of December 31, 2010 was chosen to ensure that 365 days of data after enrollment were available. After eliminating 154 observations from 17 individuals for which cost data were not available, 2659 observations from 141 individuals remained.

Data Collection and Measurements

Our analysis was conducted from the hospital's perspective; therefore, costs reflect those incurred by the hospital in the treatment of these patients. Information on the number of ED visits made during the study period, the associated direct-treatment costs, and net income, calculated as reimbursement minus total costs (direct plus indirect), were obtained from Providence Health Care's financial databases. Direct treatment costs were defined as those that were directly associated with the care received during a particular visit (e.g., wages and salaries, materials), whereas indirect costs were defined as those incurred as part of the production process, but could not be directly attributed to a specific visit (e.g., administrative costs, maintenance costs, insurance). Cost of treatment per visit was defined as total direct-treatment costs incurred during a given time frame divided by the number of ED visits for that period. A separate cost analysis of the CC program was previously performed to estimate the direct monthly cost of running the program, and the direct per-client cost of enrollment (42). All nominal figures were adjusted to 2011 values using the Medical Care Price Index for cities in the western United States with populations between 50,000 and 1,500,000 (43). As of 2010, the Spokane metropolitan statistical area had a population of approximately 470,000. All figures were calculated on an annual basis for the 365 days pre- and postenrollment.

A standard *frequent ED user* definition has not been established in the literature; definitions range from greater than three ED visits in a 12-month period, to 18 or more (1,39). To determine whether the program was cost-effective for both relatively low and high frequent users, the sample was split into two groups, those with 3–11 ED visits in the 365 days preceding their CC-enrollment date, and those with > 11 visits, approximately dividing the sample in half and allowing for sufficient statistical power in each group. These groups will hereafter be referred to as *frequent* and *extreme* users, respectively.

Analysis

The effect of the CC program on ED visits, treatment costs, cost per visit, and net income were assessed for *frequent* and *extreme* users using nonparametric bootstrapping. This type of procedure estimates the empirical distribution of the variable of interest by drawing random samples with replacement from the existing dataset, equal to the number of observations in the dataset. This process is repeated a set number of times, and has been shown to provide robust test results in situations where the data are nonnormal and asymmetrical, as was the case here (44). We applied the bootstrapping to median values, resampling 1000 times, to estimate bias-corrected 95% confidence intervals (CIs). These CIs were then used to test the null hypothesis that a significant change in each measure did not occur after enrollment in the CC program. The cost of the program was then varied to generate a rough estimate of the hospital’s break-even point from a cost-saving perspective, for each group.

One of the primary concerns associated with a pre-post study design is regression toward the mean (RTM); that is, that subjects selected as a result of having extreme values for a given measure would eventually experience a decline without intervention (14,45,46). The best method for controlling for RTM is to conduct a well-designed, randomized controlled trial (RCT). Though we are in the process of conducting such a trial on a similar program, it was not an option here; therefore, the following adjusted measure of change was used to account for RTM:

$$Y_{i2} - \hat{Y}_{i2} \equiv E(Y_{i2}|Y_{i1}) = Y_{i2} - (\rho Y_{i1} + (1 - \rho)\mu),$$

where Y_{it} is a performance measure for provider i evaluated at time 1 and 2, ρ represents the degree of correlation between Y_{i1} and Y_{i2} , and μ symbolizes the population mean, which was estimated for each measure via bootstrapping on the entire sample (45). The performance measures do not have a specified distribution, but are assumed to have the same mean under the null hypothesis of *no change*. If $\rho = 1$, the observed change between Y_{i1} and Y_{i2} is not correlated with the initial measure of Y_{i1} , and RTM is not an issue. Equation (1) was estimated via bootstrapping, resampling 1000 times. As above, bias-corrected 95% CIs were estimated, and used to retest the null hypotheses of *no change* in the outcome measures pre- and postenrollment.

RESULTS

Descriptive Statistics

Of the 144 patients in our sample, 67% were female, and at the time of initiation into the program, enrollees’ ages

ranged from 19 to 68 years, with an average of 35 years (SD 10.48). During the year prior to (after) enrollment, approximately 68% (63%) of the total visits by the *extreme* user group were covered by Medicaid, 14% (14%) by Medicare, 9% (8%) by commercial insurers, 3% (0%) by other government programs, and 6% (15%) were considered to be charity care or self-pay. For the *frequent* user group in the year prior to (after) enrollment, 70% (75%) of the visits were covered by Medicaid, 16% (10%) by Medicare, 6% (0%) by commercial insurers, 4% (1%) by other government programs, and 5% (13%) were considered to be charity care or self-pay. Figure 1 displays the change in total ED visits on a quarterly basis for the *frequent* and *extreme* users.

Although we were unable to determine the primary diagnoses of the individuals in our sample, a prior analysis of 275 CC patients revealed that pain accounted for 75% of all chief complaints within the 6 months prior to enrollment (47). The top 6 pain complaints were abdominal, back/neck, extremity, dental, body-part, and headache. Roughly 56% of patients reported a history of substance abuse, 63% of which reported a history of polysubstance abuse. Opioids were the most commonly used individual substance (13%), followed by THC (tetrahydrocannabinol; 12%), alcohol (7%), and stimulants (6%). Thirty percent of patients had a documented psychiatric diagnosis, the most prevalent being personality disorders, followed by depression, anxiety, and mood disorders. Furthermore, 24% of patients had a history of co-occurring substance abuse and psychiatric diagnoses, and 38% had neither.

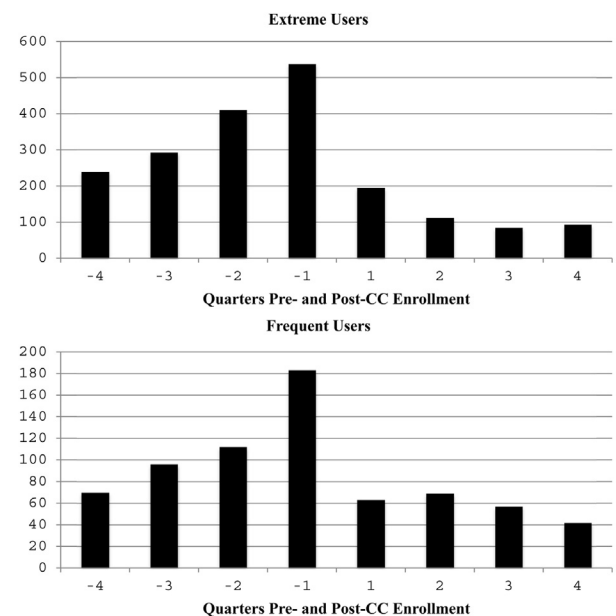


Figure 1. Total number of emergency department visits. CC = Consistent Care.

Main Results

Table 1 contains the pre and post cost and utilization figures for *extreme* and *frequent* users, as well as the bootstrapped bias-corrected 95% CIs. The *extreme* group had a median of 19 total visits to the ED during the year prior to CC enrollment. The *frequent* user group had a median of seven total ED visits during the same time period. The program was successful at significantly reducing ED visits for both groups. The median number of total visits decreased by 15 for the group of *extreme* users and five for the *frequent* users, a 79% and 71% decrease, respectively.

Figure 2 displays the change in total direct-treatment costs on a quarterly basis for both *extreme* and *frequent* users. The post-CC enrollment figures were adjusted for the per-client cost of CC enrollment (\$554) (42). The CC program significantly reduced the hospital treatment costs for the *extreme* users, by \$6091, a 76% decline; and \$1285 for the *frequent* users, a 55% decline. Further analysis indicates that the cost of enrolling an *extreme* user in the program could increase approximately eight-fold before the direct-treatment costs would no longer be significantly lower than prior to enrollment, whereas the enrollment cost for *frequent* users would have to double for this to be the case. The aggregate results further support this assertion. The total direct cost for the year after enrollment was \$710,474 lower than the year prior for all clients in the sample, \$567,665 of which could be attributed to *extreme* users. The estimated cost of running the CC program for 1 year was \$265,680 (42).

There were also significant changes associated with the hospital’s net income and direct-treatment cost per

visit among both pre- and postenrollment groups. The median net income increased \$1925 for *extreme* users, and \$431 for *frequent* users, a 78% and 71% increase, respectively. The hospital’s net income for the year after CC enrollment was \$122,495 higher than the year prior for the entire sample, \$83,988 of which could be attributed to *extreme* users. The median cost per visit (excluding the costs of CC) dropped by \$133 for the *extreme* group, and \$88 for the *frequent* group, a 33% and 27% reduction, respectively.

Overall, the results from the RTM-adjusted tests of *no change* in each measure pre- and post-CC enrollment were consistent with those from the non-RTM-adjusted tests. The one exception was the *failure-to-reject* result associated with the hospital’s net income among the group of *extreme* users.

DISCUSSION

The CC program seems to be cost saving from the hospital’s perspective for both *frequent* and *extreme* users of the ED, but especially for the latter group. Both groups experienced significant decreases in ED visits and direct-treatment costs, even after accounting for the costs of the program. In fact, the aggregate figures indicate that after just 1 year in the CC program, the cost savings were enough to pay for the entire program for over 2.5 years. The savings of the *extreme* user group alone could cover program costs for over 2 years. Savings associated with CC will likely become even more pronounced as the program expands, given the findings of a prior cost analysis that economies of scale opportunities exist (42).

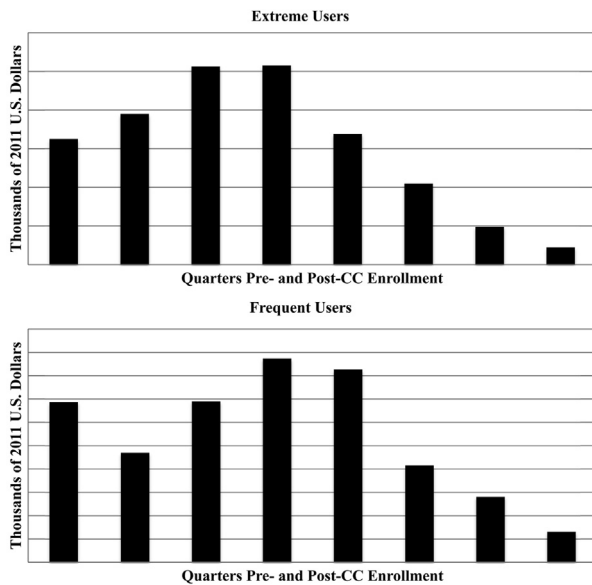
Table 1. Cost and Utilization Figures (Median Values)

Variable	Pre	Post	Difference (Post – Pre)	95% Bias-corrected CI	
Extreme users (12 or more visits in the 365 days preenrollment) n = 76					
Visits	19	4	–15*	–17	–13
Direct treatment costs	\$8058	\$1967†	–\$6091*	–\$8998	–\$4298
Net income	–\$2481	–\$556	\$1925*	\$1093	\$3159
Direct treatment cost per visit	\$407	\$274	–\$133*	–\$211	–\$50
Inpatient visits	1	0	–1*	–1	0
Outpatient visits	17	4	–13*	–14	10
Frequent users (3–11 visits in the 365 days preenrollment) n = 65					
Visits	7	2	–5*	–5	–2
Direct treatment costs	\$2328	\$1043†	–\$1285*	–\$2364	–\$492
Net income	–\$608	–\$177	\$431*	\$112	\$878
Direct treatment cost per visit	\$323	\$235	–\$88*	–\$150	–\$33
Inpatient visits	0	0	0	NA	NA
Outpatient visits	7	2	–5*	–5	–2

CI = confidence interval.

* $p < 0.0$.

† Cost of Consistent Care enrollment is included.



NOTE: Costs of Consistent Care program enrollment included in 1st quarter post-enrollment.

Figure 2. Total direct treatment costs. CC = Consistent Care.

It seems that the CC program may also result in more efficient care for its clients. The direct-treatment cost (excluding program cost) per visit decreased after enrollment, indicating that falling costs were not due solely to decreased visits, but that the resources utilized per visit were also diminishing.

Our findings further revealed significant increases in the hospital's net income, with the possible exception of *extreme* users after controlling for RTM. These amounts will certainly differ according to payer-mix. Our sample contained a large proportion of publicly insured patients; however, previous studies indicate that a large share of frequent users is publicly insured (31,32).

A prior analysis of 71 Medicaid beneficiaries enrolled in the CC program revealed a cumulative 44% reduction in ED visits over a 4-month period across all EDs in Washington State (48). This finding is indicative of the potential associated with combining an ED care-coordination program with a patient-information-exchange system. Also reported was a reduction in all paid Medicaid claims (48). Despite our inability to track patients' utilization patterns after enrollment in the CC program, the fact that staff members ensure that each patient has a PCP, who helps develop the individualized ED-care guidelines, indicates that care for nonemergent conditions should be accessible. These findings, in conjunction with those that economies of scale opportunities exist, suggest that stakeholders' most efficient option would be to link all EDs in a region to an information-exchange system and create one large multidisciplinary ED-care-coordination program for that area (42).

Limitations

There are a number of limitations to consider. First, our sample may not be representative of all frequent ED users. That is, patients were enrolled in the CC program according to referrals made by ED physicians and Medicaid managed care plans. Preference was given to managed care Medicaid patients whose health plan provided reimbursement to the program. This reimbursement was not considered in the analysis, but provides further motivation to implement ED care-coordination programs. Regardless, this sample's health-care utilization patterns and their associated costs indicate that they are a group worthy of attention. Second, there is concern that frequent users would experience RTM (14,46). Though we retested the null hypotheses of *no change* in the outcome measures pre- and postenrollment using an RTM-adjusted measure of change, and the findings suggest it is not a concern, we cannot rule it out without a well-designed RCT (45). Third, we were unable to determine the chief complaints of patients in our sample; however, we did have access to a previous study analyzing this information for a sample of patients in the program. Finally, we were not able to measure and assess changes in patients' health-related quality of life, nor were we able to track their use of health care resources across all facilities. An analysis in which these measures are included and a societal-cost perspective is adopted would be ideal. An RCT in which many of these factors are addressed is underway.

CONCLUSION

Frequent ED users are typically a complex low-income population suffering from multiple comorbidities. Many lack access to a PCP and have a tendency to visit multiple EDs (6–8,35–38). Moreover, the costs associated with frequent and improper use of the ED are incurred not only by the patients themselves, but also by other patients, hospitals, ED providers, third-party payers, and society in general. The CC program, along with its regional health information system, assists these patients with getting the care they need in the appropriate setting. When examined as a whole, research on the program suggests that expanding it would be an efficient allocation of hospital, and possibly societal, resources.

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ARTICLE SUMMARY

1. Why is this topic important?

Frequent improper use of the emergency department (ED) is generally a sign of serious latent patient issues; however, the costs associated with it are incurred not only by the patients themselves, but also by other patients, hospitals, ED providers, third-party payers, and society in general.

2. What does this study attempt to show?

A multidisciplinary ED-care-coordination program with a regional hospital information system capable of sharing patients' individualized care plans with cooperating EDs can be cost-effective from the hospital's perspective.

3. What are the key findings?

Relatively high and low frequent ED users experienced significant decreases in ED visits and direct-treatment costs, which led to significant hospital cost savings and increased net income. Moreover, it seems that fewer resources were utilized per visit.

4. How is patient care impacted?

Frequent ED users are typically a complex low-income population suffering from multiple comorbidities. Many lack access to a primary care provider and have a tendency to visit multiple EDs. The Consistent Care program, along with its regional health information system, assists these patients with getting the care they need in the appropriate setting. When examined as a whole, research on the program suggests that expanding it would be an efficient allocation of hospital, and possibly societal, resources.