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When Should ED Physicians Use an HIE? Predicting Presence of Patient Data in an HIE

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Abstract

Objectives—Health information exchanges (HIEs) make possible the construction of databases to characterize patients as multisystem users (MSUs), those visiting emergency departments (EDs) of more than one hospital system within a region during a 1-year period. HIE data can inform an algorithm highlighting patients for whom information is more likely to be present in the HIE, leading to a higher yield HIE experience for ED clinicians and incentivizing their adoption of HIE. Our objective was to describe patient characteristics that determine which ED patients are likely to be MSUs and therefore have information in an HIE, thereby improving the efficacy of HIE use and increasing ED clinician perception of HIE benefit.

Methods—Data were extracted from a regional HIE involving four hospital systems (11 EDs) in the Charleston, South Carolina area. We used univariate and multivariable regression analyses to develop a predictive model for MSU status.

Results—Factors associated with MSUs included younger age groups, dual-payer insurance status, living in counties that are more rural, and one of at least six specific diagnoses: mental disorders; symptoms, signs, and ill-defined conditions; complications of pregnancy, childbirth, and puerperium; diseases of musculoskeletal system; injury and poisoning; and diseases of the blood and blood-forming organs. For patients with multiple ED visits during 1 year, 43.8% of MSUs had ≥4 visits, compared with 18.0% of non-MSUs ($P < 0.0001$).

Conclusions—This predictive model accurately identified patients cared for at multiple hospital systems and can be used to increase the likelihood that time spent logging on to the HIE will be a value-added effort for emergency physicians.

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[A]Your other article says both March and April. Which is correct?

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Keywords

health information exchange; physician adoption; information sharing; electronic medical record; information technology

Health information exchange (HIE) was a highly anticipated technology, with the eHealth Initiative 2013 Survey identifying 315 HIE initiatives in the United States.[1–3] Some of these systems support regional "pull" operations using master patient index and record locator service technologies to find and retrieve relevant data from other healthcare systems. Others use an automated admit, discharge, transfer message. In either case the goal is the construction of a comprehensive electronic medical record (EMR) that is independent of the facility or practice in which the patient was seen.

The idea of transparent health information available from disparate regional systems is welcomed by most practicing emergency physicians.[4] Immediate access to health information at the point of care has been shown to reduce emergency department (ED) lengths of stay; avoid redundant imaging, prescriptions, and laboratory tests; decrease hospital admissions; and reduce costs.[5–9] ED clinician adoption of HIE remains low, with usage rates ranging from 2% to 26%, even when systems are available, however.[4,10] ED clinicians offer many reasons for not accessing an HIE, including workflow disruption, time constraints, the need to access multiple password-protected systems, and design flaws in the software.[1,2] One problematic issue is the logon for which the clinician does not find relevant data, a result that leads clinicians to avoid future use. We used data from our HIE to identify patients who visited multiple EDs within a region and created a predictive model based on their demographic and clinical characteristics. We believe this model can improve emergency physician adoption of HIE because it will alert them when patients are likely to have visited other hospitals. Such a predictive model could be incorporated into an EMR as an algorithm that would display a visual cue when patients are likely to have information in the HIE. This would indicate to a busy emergency physician that the time taken to log on to the HIE would be a value-added effort.

Methods

Using a regional HIE we constructed a data dictionary that included clinical and demographic characteristics of adult patients (18 years or older) who visited any of 11 EDs belonging to 4 hospital systems in our community during a 1-year period beginning in April 2012.[A] This data dictionary was a database constructed by our vendor, TELUS Health Solutions, to our specifications, after which the data were organized into individual ED visits that took place during the study period. Using the data, we identified patients who used EDs at different hospital systems. We defined the term *multisystem user* (MSU) to be any patient who visited two or more EDs belonging to different hospital systems during a 1-year period. Previous researchers have defined patients who visited or were hospitalized at two or more care sites during the study period as multisite users.[11] We believe this definition makes sense

[A]PIs provide street mailing address.

in that any patient who visited more than one site has by definition used multiple sites. We then performed a regression analysis to determine which characteristics could be used to identify MSUs and predict the availability of information in the HIE.

The data for this study were extracted from the regional HIE known as the Carolina eHealth Alliance (CeHA) functioning at all of the four hospital systems (11 major EDs) in the greater Charleston, South Carolina metropolitan area. CeHA had the advantage of being designed as an "opt-out" HIE, a mechanism of enrollment that was recommended as the preferred form of HIE enrollment by Shapiro et al in a position paper developed in response to an American College of Emergency Physicians resolution.[12] During the study period no patients opted out of participating in our HIE, resulting in a comprehensive database that included all of the patients who visited any ED in our region. These data were made available to the researchers to examine the implementation, use, and effectiveness of the local eHealth exchange.

CeHA enabled clinicians at any of the 11 participating EDs to access a patient's EMR from any hospital system in the region. An electronic "window" was automatically provided to ED clinicians for 4 hours during the patient's visit that displayed clinical information from all four hospital systems. To view this information, ED clinicians were required to log in to the HIE.

Predictor variables for MSUs included age, race, sex, payer class, county of residence, and primary International Classification of Diseases, Ninth Revision (ICD-9) diagnostic categories. Payer class was categorized into uninsured, Medicaid, Medicare, dual payer (Medicaid and Medicare), and commercial insurance. Three primary counties in the greater Charleston metropolitan area were categorized based on the patient's ZIP code: Charleston (including downtown Charleston), Berkeley, and Dorchester. Patients from other counties were classified as "other."

Univariate (χ^2) and multivariable (logistic regression) analyses were performed. To determine significant predictors of MSUs versus non-MSUs, multiple regressions were used to calculate odds ratios (ORs) with 95% confidence intervals (CIs). Internal validation of each prediction model was assessed by creating a split sample using a random selection process; half of the sample (n = 63,836) was used as the initial cohort to develop the prediction model for estimates of all of the covariates, and the remaining half (n = 63,836) was used as the validation cohort to compare the true outcomes with the predicted outcomes. There are three popular approaches to prediction modeling and internal validation: split-sample, cross-validation, or bootstrap. We chose to conduct the study using a split-sample method (with random selection of patients for each sample) primarily because of our large cohort size. A concern with split-sample validation is when the development model is overly optimistic in its performance; however, this is a concern only with smaller cohort samples. Split-sample methodology using larger cohort samples (eg, the one under consideration) provides reliable results.[13,14] A receiver operating characteristic curve was created by plotting sensitivity against (1-specificity) for different cutoff points of the predicted outcome. A bootstrap study of 1000 replications was performed on the level of sensitivity,

specificity, and true-positive/false-positive/false-negative/true-negative validation. SAS version 9.3 (SAS Institute, Cary, NC) was used for the statistical analysis.

The study was conducted by the Sustaining Emergency Access to Information Systems Linking EDs (known as Sea Isles) writing group, an association of researchers and clinical scientists that includes an ED medical director, practicing emergency physicians, primary care specialists, biostatisticians, and a health economist. The expressed goal of the Sea Isles writing group was to investigate the impact of HIE on emergency care and determine whether this new resource would be sustainable. The study was approved by the Medical University of South Carolina's institutional review board and by the institutional review boards of all of the hospital systems participating in the HIE.

Results

The region captured by our HIE included three counties that make up the greater Charleston area (Charleston, Dorchester, and Berkeley), with a total population of 727,689 people. Of these, 51.1% are girls and women, 77.6% are older than 18 years, 13.3% are older than 65 years, 27.1% are African American, and 5.3% are Hispanic.[15]

The database contained 127,672 patients who had made ED visits during the 1-year period beginning April 2012[B] (Table 1). Twelve percent (15,277) of the total sample were classified as MSUs. The average age of the total sample was 45.5 ± 19.0 (standard deviation) years old, 58.2% of the sample were female patients, and 55.2% were white. Sixty-three percent of MSUs were female patients, and 48.2% of MSUs were white. The mean number of visits during the 1-year period was 1.9 ± 2.5 (standard deviation), with the 25th and 50th percentiles each being 1, the 75th being 2, and the 90th being 3. Thirty-four percent of the total population had primary commercial insurance and 25% were considered uninsured or status unknown. Usage patterns were significantly different between MSUs and non-MSUs; 43.8% of the patients who were considered to be MSUs made ≥4 visits, compared with 18.0% of the non-MSUs ($P < 0.0001$).

Multivariable logistic regression determining the predictors of MSU revealed that the odds of being dually insured (Medicare and Medicaid) and MSU were nearly 2.5 times those of commercially insured patients (OR 2.4, 95% CI 2.2–2.7 [reference group commercial]). We chose commercial insurance as the reference group for the payer classification variable because we believed it to be the most intuitive comparison standard for this category. In addition, the odds of patients in the younger age groups being MSUs were nearly twice those of older patients; 18 to 34 years: OR 1.7, 95% CI 1.6 to 1.9; and 35 to 44 years: OR 1.7, 95% CI 1.5 to 1.8 (reference group age 65 years and older). Patients living in Berkeley County were more likely to be MSUs than those living in Charleston County (OR 1.4, 95% CI 1.3–1.5). Patients with the following select diagnoses were found to have the highest ORs of being MSUs (diagnostic related group [DRG], number of MSUs in DRG [% of MSU/DRG], OR [95% CI]): mental disorders, n = 1462 (9.6%), OR 7.0 (95% CI 6.4–7.7); symptoms, signs, and ill-defined conditions, n = 9995 (65.4%), OR 6.2 (95% CI 6.0–6.5);

[B]March or April?

complications of pregnancy, childbirth, and puerperium, n = 1201 (7.9%), OR 5.3 (95% CI 4.8–5.8); diseases of musculoskeletal system, n = 4830 (31.6%), OR 4.8 (95% CI 4.5–5.0); injury and poisoning, n = 5201 (34.0%), OR 4.2 (95% CI 4.0–4.4); and diseases of the blood and blood-forming organs, n = 166 (1.1%), OR 3.9 (95% CI 3.0–5.0). The *ICD-9* categories with the 10 highest ORs are presented in Table 2.

The area under the curve (AUC) is a common measure for the performance of a binary classifier. The Figure shows the receiver operating characteristic curve of our predictive model for MSUs, with an AUC of 87%. In general, an AUC exceeding 0.9 is considered an excellent prediction. The validation analysis (split sample) of the MSU model produced a similarly strong predictive model, with an AUC of 87% as well.

Discussion

HIE represents a new resource for information sharing, and its ability to change our daily practice has yet to be fully understood. HIE allows ED clinicians to access health information from multiple disparate systems across the spectrum of care, providing a more complete summary of a patient's health information.

Health information technology and sharing have not kept up with the changes in the way patients seek health care. Patients often move among providers and hospitals, which results in significant fragmentation of care. Stiell et al[16] showed that 25% of patients used more than one ED and those visits were 19% of all ED visits. Campion and colleagues found that 41% of patients made visits at multiple facilities during a 23-month study period, accounting for 68% of total encounters.[17] Fertel et al reported that 14% of patients received care from more than one ED and these patients accounted for 25% of all ED encounters.[18]

Accurate prediction of patients who use multiple hospital systems has wide applicability in population health, targeted care coordination, and cost management. Use of an HIE can prevent duplicate testing, which consumes time and resources, is costly, and has a significant impact on patient well-being.[19–21] A survey of clinicians using an HIE in 11 EDs (4 disparate hospital systems) in a mid-sized southeastern US city demonstrated a potential reduction of Medicare-allowable reimbursements of more than $1 million ($2700 per patient who had information in the HIE).[19–22] Frisse et al calculated that an annual savings of $1.07 million would be realized if all regional hospitals in a single city participated in and used their HIE.[9] These authors also showed a significant reduction in number of admissions and computed tomographic scans across 12 EDs when an HIE was accessed.[9] Bailey and colleagues showed a decrease in neuroimaging for patients who made more than 1 ED visit for a headache when an HIE encompassing 15 hospitals and 2 major clinic systems was used.[7] An estimated annual savings of nearly $1 million was noted at an academic medical center (with a 40% reduction in the length of stay) when an HIE was used for 5.39% of its ED population.[20,21] Bailey et al also demonstrated reduced exposure to ionizing radiation from avoided diagnostic testing, resulting in a decreased lifetime incidence of cancer.[7]

The concept of the MSU is familiar to most practicing emergency physicians. Such patients are noted for receiving fragmented care and necessitating the investment of additional time

and effort to obtain records from outside hospitals.[23] Until the advent of HIE, there was little opportunity to document the characteristics of patients who visit multiple EDs and their pattern of ED visits or to more quickly obtain their records across healthcare systems. The availability of data from an HIE has made it possible to make these observations and to explore their utility in directing HIE use.[24]

HIE exists primarily in discrete geographic regions. These regional HIEs are the building blocks of the development of a nationwide health information network that allows patient health information to follow patients wherever they seek care.[25] Literature describing the potential for HIE to avoid duplication of diagnostic tests, avoid unneeded hospital admissions, reduce costs, and improve quality and efficiency is emerging quickly.[21,22,25] The power of HIE to assist with the coordination and delivery of acute and postacute care is being explored, along with approaches to efficiently expand HIE for other uses.

The financial support of HIE and its sustainability remain problematic. Our HIE was initiated with a grant from the Duke Endowment Foundation, a well-established benefactor of patient-directed initiatives in the Carolinas. Since the expiration of that grant (2-year limit), it has been funded by contributions of its major stakeholders: the participating hospital systems. The funding of HIE can be complex in part because of the financial ramifications of HIE use; theoretically it can both decrease and increase utilization of resources. Ultimately establishing a sustainable HIE will continue to require the support of data demonstrating its cost and health benefits as well as a commitment to improving patient care.[19]

We examined the population of patients who visited any ED in our region for a 1-year period and demonstrated that demographic and clinical data can be used to predict with high probability which patients will be MSUs and as such which patients will have information accessible in an HIE. This information can be used to construct a predictive rule to alert clinicians that health information is likely to be present in an HIE. The need for a predictive tool is based on literature reporting that ED clinicians perceive that HIE use is difficult and disrupts workflow.[4] Busy clinicians do not have the time to log on to an HIE only to find that no relevant information is available. They need some indication that useful information will be present in the HIE, making it worth their time to look. That is what we refer to as a “high-yield log-on,” which is consistent with the recommendations made in the HIE position paper by Shapiro and colleagues.[12] To address this need we have developed a predictive model that can accurately discern between MSUs and non-MSUs and thereby improve clinician efficiency.

In our analysis, characteristics having the greatest association with being an MSU were younger age groups; patients with dual-payer (Medicare and Medicaid) insurance status; patients living in counties that are more rural; patients with select diagnoses, including mental disorders; complications of pregnancy, childbirth, and puerperium; diseases of the blood and blood-forming organs; and diseases of the musculoskeletal system. The odds of being an MSU were in inverse proportion to the age of the patient: the younger the patient, the greater the odds relative to patients 65 years old and older, peaking with the 18- to 34-year-old age group, who were 1.7 times more likely to be MSUs than their older adult

counterparts. The reasons for this may be as simple as a convenience of care, lack of primary care, and an increased ability to travel through the region under study; however, further research is necessary. Patients in Berkeley County were more likely to be MSUs than those who lived in Charleston and Dorchester counties. We believe that was because Berkeley is a rural county and based on the geography of our area, patients who live there must travel greater distances to seek hospital care. The need for traveling greater distances broadened the catchment area for these patients, bringing many hospitals within equivalent distances. Furthermore, having made the decision to seek emergency care, patients from Berkeley County frequently placed their trust in the larger "downtown" hospitals.

Because our data dictionary provided one of the first opportunities to examine MSUs by DRG, we were unable to reference an explanation for why patients with certain DRGs were represented in the MSU population with high ORs. Literature describing MSUs from before the advent of HIE does not exist; a literature search using the key words emergency department, ED, multiple, disparate, frequent, visits, visitors, diagnosis, diagnostic code, and *DRG* revealed only three publications that evaluated frequent or multiple users and none that directly evaluated the reasons why patients visited multiple EDs.[11,26,27] Once MSUs have been identified using data such as ours,[C] future survey-based studies can be directed at the population of MSUs to address this important question. In the meantime, based on our experience as emergency physicians, we offer the following speculation as to why patients with certain DRGs were more likely to be MSUs in our data: Patients with "ill-defined conditions" (OR 10.9) encompassed those who did not carry diagnoses matching other *ICD-9* categories. To an ED clinician such patients rarely have life-threatening illness; rather, they seek help for nonspecific complaints such as pain, weakness, malaise, problems involving multiple body systems, want a professional assessment of their symptoms, or request a prescribed medication. Narcotics-seeking patients may be in this category. Patients with mental disorders (OR 9.1) frequently have no medical home, generally have poor coping skills, and are limited in their ability to comply with scheduled outpatient treatment. Many are homeless, have cognitive impairment, or lack the skills necessary for employment. Patients in these first two categories represent those for whom the ED provides a safety net and may be collectively referred to as "safety-net patients." The ED is a widely used portal for the diagnosis and treatment of pelvic pain in patients with disorders of pregnancy, childbirth, and puerperium (OR 8.4), and pregnancy is frequently diagnosed and evaluated there. Patients with hematologic disorders (OR 7.0) are largely represented in our community by those with sickle cell disease who seek pain management through the ED for outpatient treatment failures. In our data a small number of these patients account for an extraordinary number of ED visits. Patients with musculoskeletal complaints (OR 4.8) include those with chronic back and body pain whom most ED clinicians will readily report often are seen for pain that does not respond to typical therapies. Patients with abdominal pain (OR 4.9) often have symptoms that cause them significant distress despite negative workups. They seek symptom control and diagnosis through many avenues because of ongoing, unexplained gastrointestinal distress.

[C]As received the sentence beginning "Once identified using data" is a nonsequitur/dangling modifier because the survey studies are not what were identified. Is the copyeditor's change to "Once MSUs have been identified using data such as ours" correct? If not, what was identified?

Although our study did not evaluate factors that drive patients to become MSUs, once these patients have been identified, they can be approached and surveyed to investigate their reasons for seeking care at multiple EDs. Furthermore, identifying the determinants associated with multisystem hospital use can lead to improved coordination of postacute care, avoidance of redundancy, and decreased costs. Opportunity is available for the future study of subgroups of patients (eg, those with drug and/or alcohol addiction, those with chronic pain) within the major DRGs. We did not perform a subgroup analysis in our study; however, we can appreciate the potential benefit to be gained through doing so in future studies.

We believe that our development of a model to prospectively identify patients who are MSUs represents a promising start but one that will require further refinement before it becomes applicable clinically. We have indicated that recognizing the profile of an MSU can signal the need to query the HIE because of a high likelihood of finding relevant information. This new, data-driven approach can allay concerns among ED clinicians that the effort expended in looking for records in an HIE will be fruitless. An HIE user survey showed that a tool of this type, along with a means of embedding an HIE into an existing EMR, is needed if HIE adoption by ED clinicians is to improve.[28]

HIE use for population health improvement is only now being explored. We envision the use of HIE to identify MSUs and assign them to community-based case managers who will intervene by visiting these patients and repairing failures in their access to care.[1]

Understanding the profile of an MSU can provide insight into commonly held beliefs about these patients. The stereotype of MSUs as predominantly uninsured was not supported by our data; in our analysis commercially insured patients had a 25% incidence of being MSUs, the same proportion as those without insurance. Dual payers were nearly 2.5 times more likely to be MSUs than those with commercial insurance; this is surprising given that these patients often are older, have less mobility, and usually have a medical home. Patients without insurance were only 19% more likely than those with commercial insurance to be MSUs. This is consistent with reports of previous authors who reported that many patients previously believed to overuse the ED for socioeconomic or insignificant medical problems were as sick as less-frequent ED users.[26] Bourgeois et al made the observation that the smallest group of patients making five or more annual visits to multiple institutions comprised self-pay patients and those who received free care.[11] Further research regarding patient motivations and preferences for seeking ED care is needed to understand the trends noted in our data.

For the purposes of analysis, we coined the term MSU to describe patients who seek care at more than one ED. This concept is important because these are the patients for whom the time spent consulting an HIE will be the most helpful.[25] Before the development of HIE, there was no means of easily identifying and studying all of the patients who visited multiple disparate EDs.[27,29–31] In general, these patients receive episodic and fragmented care, lack the benefits of primary care, and may require expensive and intensive resuscitation when crises arise.[32] Future uses of HIE should include postacute community-based care coordination of MSUs and ultimate placement of these MSUs in a medical home. We

believe that such a project may reduce ED and hospital readmissions as well as improve overall health.

Conclusions

Although HIE is a likely beneficial health-improvement tool and cost-savings device, it is a relatively new and underused technology. Because of delays in physician adoption, concerns about its economic impact, and lack of stable funding, HIE sustainability is in question. To address these concerns we used descriptive data from an HIE to construct an algorithm that identified all of the patients who visited 11 EDs belonging to 4 disparate hospital systems within a region during a 1-year period. We believe our database to be of particular value in that it contains every patient who presented to any ED in our region during the study period. Our algorithm has the potential to cue busy ED clinicians that if they query an HIE they will likely find information. This is consistent with the recommendations in a position paper promoted by the American College of Emergency Physicians.[26] Of greater value may be the ability to identify MSUs, allowing them to be sought out for special interventions such as enrollment in patient-centered medical homes and social programs. Our model supports the belief that the focused use of an HIE offers a promising approach to defragmenting the US healthcare system.

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[B]Pls check COI statement for accuracy.

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Key Points

- Delays in physician adoption, concerns about its economic impact, and lack of stable funding are threatening the sustainability of the health information exchange (HIE).
- Using our HIE we created a data dictionary that included important characteristics of all of the patients who visited emergency departments belonging to multiple disparate hospital systems within a region during a 1-year period.
- We constructed an algorithm that identified the patients most likely to have information present in the HIE.

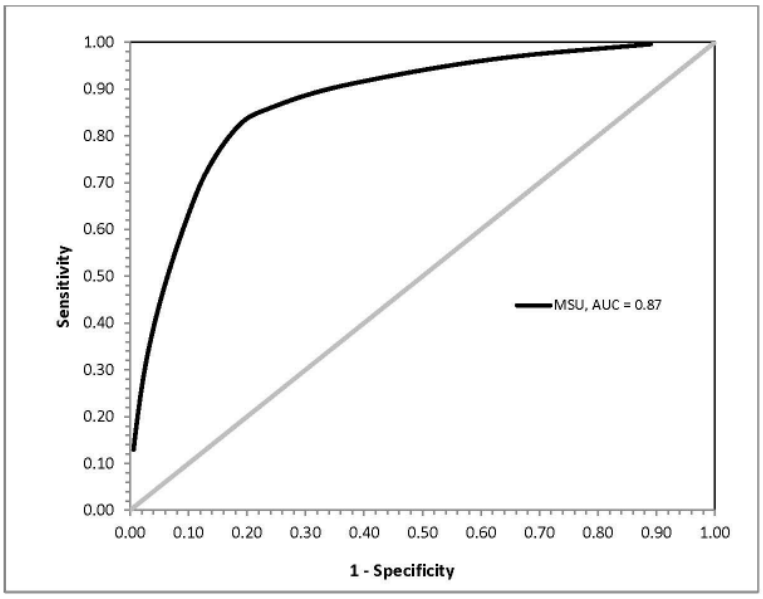

Fig.

ROC curve for our predictive model for MSUs. AUC 0.87. AUC, area under the curve; MSU, multisystem users (patients making visits to EDs belonging to >1 hospital system); ROC, receiver operating characteristic.

Table 1

Patients' characteristics

	MSU	Non-MSU
No. patients (%)	15,277 (12.0)	112,395 (88.0)
Age, y (mean, SD)	40.6 ± 17.0	46.2 ± 19.2
Age group, y, n (%)		
18–34	7075 (46.3)	39,694 (35.3)
35–44	2748 (18.0)	16,977 (15.1)
45–54	2329 (15.3)	17,791 (15.8)
55–64	1468 (9.6)	15,484 (13.8)
≥65	1657 (10.9)	22,449 (20.1)
Sex, n (%)		
Male	5603 (36.7)	47,703 (42.4)
Female	9674 (63.3)	64,692 (57.6)
Race, n (%)		
African American	7534 (49.3)	44,079 (39.2)
White	7362 (48.2)	63,085 (56.1)
Other	381 (2.5)	5231 (4.7)
Payer, n (%)		
Dual (Medicaid and Medicare)	1107 (7.3)	3049 (2.7)
Medicaid	4028 (26.4)	13,838 (12.3)
Medicare	1891 (12.4)	21,823 (19.4)
Military	511 (3.3)	6281 (5.6)
Commercial	3823 (25.0)	39,215 (34.9)
Uninsured/status unknown	3917 (25.6)	28,189 (25.1)
Resident county, n (%)		
Charleston	7321 (47.9)	51,090 (45.5)
Berkeley	4448 (29.1)	25,020 (22.3)
Dorchester	2934 (19.2)	22,929 (20.4)
Other	574 (3.8)	13,356 (11.9)
Present year *ICD-9* category[a]		
Nonspecific signs/symptoms	9995 (65.4)	38,928 (34.6)
Injury/poisoning	5201 (34.0)	21,102 (18.8)
Musculoskeletal	4830 (31.6)	14,245 (12.7)
Neurologic	2394 (15.7)	6946 (6.2)
Genitourinary	2262 (14.8)	7303 (6.5)
Digestive	2173 (14.2)	7085 (6.3)
Injury history	1619 (10.6)	5898 (5.3)
Mental illness	1462 (9.6)	2820 (2.5)

ICD-9, International Classification of Diseases, Ninth Edition; MSU, multisystem user; SD, standard deviation.

[a] In descending order of frequency. Table includes only those *ICD-9* categories making up ≥10% of sample.

Table 2

Multivariable logistic regression analyses

	Dependent variable: MSU by OR (95% CI)
Age group, y	
18–34	1.7 (1.6–1.9)
35–44	1.7 (1.5–1.8)
45–54	1.4 (1.2–1.5)
55–64	1.1 (1.0–1.2)
≥65 (reference)	
Sex	
Male (reference)	
Female	1.0 (0.9–1.0)
Race	
White (reference)	
African American	1.1 (1.0–1.1)
Other	0.7 (0.6–0.8)
Payer	
Commercial (reference)	
Dual (Medicaid and Medicare)	2.4 (2.2–2.7)
Medicaid	1.4 (1.3–1.5)
Medicare	1.2 (1.1–1.3)
Military	0.8 (0.7–0.8)
Uninsured/status unknown	1.2 (1.1–1.3)
Resident county	
Charleston (reference)	
Berkeley	1.4 (1.3–1.5)
Dorchester	1.0 (1.0–1.1)
Other	0.5 (0.5–0.6)
ICD-9 category[a]	
Mental illness	7.0 (6.4–7.7)
Nonspecific signs/symptoms	6.2 (6.0–6.5)
Pregnancy/childbirth	5.3 (4.8–5.8)
Musculoskeletal	4.8 (4.5–5.0)
Injury/poisoning	4.2 (4.0–4.4)
Hematologic	3.9 (3.0–5.0)
Digestive	3.6 (3.4–3.9)
Injury history	3.6 (3.3–3.9)
Neurologic	3.5 (3.3–3.7)
Cardiovascular	3.4 (3.1–3.7)

	Dependent variable: MSU by OR (95% CI)
Genitourinary	3.2 (3.0–3.5)

CI, confidence interval; *ICD-9, International Classification of Diseases, Ninth Edition*; MSU, multisystem user; OR, odds ratio.

[a] In order of descending OR. Includes only *ICD-9* categories with ORs >3.0.