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Use of the point of origin code from a universal billing form, UB-04, to efficiently identify hospitalized patients admitted from other health care facilities

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Abstract

Background: Recent exposure to health care facilities is a risk factor for carriage of multidrug-resistant organisms, but identification of hospitalized patients admitted from other health care facilities is often inefficient.

Methods: At an acute care hospital, we utilized a standard point of origin code from a universal billing form (UB-04) to categorize hospitalized patients as admitted from any health care facility (long-term care facility vs acute care facility). In a prospective study, the point of origin code and information obtained from physician-documented history were validated against patient self-report.

Results: Admission source for 523 patients was assessed. For identifying admission from any health care facility, the point of origin code had 86% sensitivity (95% confidence interval [CI]: 77-92) and 98% specificity (95% CI: 97-99). Physician-documented history had 75% sensitivity (95% CI: 65-84) and 98% specificity (95% CI: 96-99). For identifying patients from long-term care facilities, the sensitivities of the point of origin code and physician history were 50% (95% CI: 23-77) and 71% (95% CI: 42-92), respectively. For identifying patients admitted from acute care facilities, the sensitivities of the point of origin code and physician history were 93% (95% CI: 84-98) and 76% (95% CI: 64-85), respectively.

Conclusion: The point of origin code is an accurate method of identifying patients admitted from another health care facility that is comparable with physician-documented history.

Keywords

Surveillance; Multidrug-resistant organisms; Long-term care facilities

Health care facilities, such as skilled nursing facilities, long-term acute care hospitals, and acute care hospitals, are considered potential reservoirs of multidrug-resistant organisms. Prior stay in a health care facility has been identified as an independent risk

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factor for colonization with multidrug-resistant organisms, including methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant *Enterococcus*, and carbapenem-resistant *Enterobacteriaciae*.[1-4]

The ability to quickly and efficiently identify patients who are admitted from other health care facilities is becoming an increasingly important component of hospital infection control. Such awareness could enable infection preventionists to apply control measures such as active surveillance and pre-emptive contact isolation at the time of hospital admission. At present, identification of patients admitted from other health care facilities is often accomplished by manual review of physician or nursing notes, which is labor intensive and often incomplete.

Since 2007, all health care institutions in the United States that receive reimbursement through the Centers for Medicare and Medicaid Services are required to assign each patient a point of origin code on the Universal Billing Form 04 (UB-04).[5] The point of origin code documents a patient's admission source (eg, physician's office, skilled nursing facility, home). At our institution, the point of origin code is obtained within 24 hours of admission by the hospital admissions or billing department and is accessible in the electronic medical record.

We assessed whether the point of origin code could accurately identify whether a hospitalized patient was admitted from another health care facility. If the point of origin code was sensitive for detecting such information, it could aid infection control efforts to screen for patients at risk for colonization of multidrug-resistant organisms. We assessed the accuracy of the point of origin code, as well as an alternate screening strategy of manually reviewing physician-documented history, using the gold standard of patient self-report.

METHODS

A prospective study was performed from July to August 2010 at Rush University Medical Center, a 676-bed urban academic medical center, as a part of a hospital quality improvement project to accurately identify patients admitted from other health care facilities for multidrug-resistant organism active surveillance. All adult (≥18 years old) inpatients, excluding pregnant and postpartum women, were eligible for inclusion in the study. Three to 4 wards were selected randomly each day, and all patients on the wards who were present in their room at the time of interview were invited to participate in the study. Each patient was included only once. Patients were excluded if they declined to participate or if they were incapable of participating in the interview and a family member was unable to be reached. This project was determined by the Institutional Review Board of Rush University Medical Center to be exempt from review.

Assessment of patient self-reported admission source, the gold standard

One member of the research team (K.K.P.) approached each selected patient and assessed for orientation to person, place, and time. Fully oriented patients were then asked the following questions: "1. Where were you staying immediately before being admitted to Rush University Medical Center? For example, were you in a nursing home, rehabilitation

center, or your own home? 2. Did you initially present to another hospital or emergency room before being transferred to Rush University Medical Center?" If the patient was not fully oriented at the time of interview, a family member was contacted, either in person or by telephone, and asked the same questions regarding the patient. The following information was additionally obtained by chart review: age, gender, admitting service, contact isolation status, and primary insurer.

Assessment of physician-documented history

Physician-documented history, obtained by chart review, was defined as prior patient location as documented anywhere within the admission History and Physical physician note. Specifically, the History of Present Illness and Social History sections of the note were reviewed for each patient.

Generation of the point of origin code

On the UB-04 billing form, "point of origin" numerical codes refer to a patient's immediate location prior to presenting to the hospital. We categorized each code as "health care facility," "non-health care facility," or "not applicable" (Table 1). The following institutions were considered to be a "health care facility": acute care hospitals, emergency departments, long-term acute care hospitals, skilled nursing facilities, and intermediate care facilities, as defined by the Centers for Medicare and Medicaid Services. We further divided health care facilities into 2 subsets: "long-term care facilities" was defined as skilled nursing facilities and intermediate care facilities, and "acute care facilities" was defined as acute care hospitals, emergency departments, and long-term acute care hospitals. Assisted living facilities were considered non-health care facilities because residents live in semi-independent units and do not require skilled nursing care. At our institution, point of origin information is collected upon presentation to the hospital and entered into the electronic medical record system, Epic (Epic Systems Corporation, Madison, WI). Patients (who are not pregnant) at our institution are admitted in 1 of 3 ways: through the emergency department, as a direct admission to the ward, or as an interfacility transfer. In the emergency department, registration personnel scan all ambulance report forms and face sheets that accompany each patient brought in by transport vehicles. From location information contained in the scanned forms, registration personnel then record a point of origin (eg, skilled nursing facility) by referencing a master list of all institutions within the state. The default point of origin for patients who do not present with any paperwork is "non-health care facility source." For directly admitted patients, the admitting physician indicates the admission source on a reservation sheet that is entered as a point of origin by the Patient Access Department. For interfacility transfer patients, the Patient Access Department identifies the transferring facility as the point of origin. Once point of origin is documented within the electronic medical record, it becomes immediately visible to all users, including the billing department, which automatically converts it into the point of origin code used on UB-04 forms.

Statistical analysis

The primary outcomes were the performance characteristics (sensitivity, specificity, positive predictive value, and negative predictive value) of the point of origin code in identifying

patients admitted from health care facilities compared with the gold standard of patient self-report. As secondary outcomes, we also assessed the performance characteristics of the physician-documented history and calculated the κ agreement of both methods. We also compared health care facility and non-health care facility patients for significant differences in age, gender, admitting service, contact isolation status, or primary insurer to determine whether the health care facility patients represented an epidemiologically distinct group of patients compared with non-health care facility patients; we used χ^2 and Student *t* test where appropriate. We considered *P* value < .05 to be significant. A κ statistic from 0.6 to 0.79 was considered to be a "substantial" level of agreement and > 0.8 was considered "outstanding" agreement.[6] All analyses were performed using SAS 9.1.3 (SAS Institute, Cary, NC).

RESULTS

Of 599 eligible patients, 523 (87.3%) were included in the study. Of the 76 excluded patients, 61 were away from their room at the time of interview; the remainder was excluded because of patient declination to participate (n = 6) inability to reach a family member (n = 8) or family member unawareness regarding patient's residence (n = 1). Overall, 85 (16.3%) of 523 patients were admitted from another health care facility, with 13 patients admitted from a long-term care facility and 72 patients admitted from other acute care facilities. In detecting patients admitted from another health care facility, the point of origin code had a sensitivity of 86% (95% confidence interval [CI]: 77-92) and a specificity of 98% (95% CI: 97-99); the κ value was 0.86 (95% CI: 0.80-0.92). The physician-documented history had a sensitivity of 75% (95% CI: 65-84), a specificity of 98% (95% CI: 96-99), and a κ value of 0.77 (95% CI: 0.70-0.85). Positive predictive value and negative predictive value were similar between the point of origin code and physician-documented history (Table 2).

In detecting patients admitted from long-term care facilities, the point of origin code had a sensitivity of 50% (95% CI: 23-77), compared with a sensitivity of 71% (95% CI: 42-92) for the physician-documented history. Specificity was similar between the 2 groups. In detecting patients admitted from acute care facilities, the point of origin code had a sensitivity of 93% (95% CI: 84-98), and the physician-documented history had a sensitivity of 76% (95% CI: 64-85), with similar specificity between the 2 groups.

Of the 14 patients admitted from long-term care facilities, 7 were not detected by the point of origin code in our study. Further investigation of their medical records revealed the reasons for the 7 failed identifications: 3 patients were scheduled admissions for surgery and were transported to the hospital by family members. Three additional patients were directly admitted from physicians' offices and also transported to the hospital by family members. None of these 6 patients had a face sheet from their long-term care facility in their charts. One remaining patient was misclassified because of error by admitting personnel.

The age, gender, and proportion with Medicare or Medicaid insurance were similar for health care facility patients and non-health care facility patients (all *P* > .05, data not shown). Over twice as many health care facility patients were in contact isolation for any reason compared with non-health care facility patients (15.3% vs 7.1%, respectively, *P* = .01). A 3-fold greater proportion of health care facility patients were nonverbal or had

an altered mental status compared with non-health care facility patients (32.9% vs 9.1%, respectively, $P < .001$). Health care facility patients were also twice as likely to be admitted to an intensive care unit compared with non-health care facility patients (31.8% vs 16.4%, respectively, $P = .001$).

DISCUSSION

We developed a strategy of using a point of origin code from a widely utilized billing form (UB-04) to efficiently identify patients admitted to our hospital with an immediate prior stay in another health care facility. Using a gold standard of patient self-report, the point of origin code had excellent sensitivity and specificity in identifying patients admitted from other health care facilities and performed comparably with manual review of physician-documented history. The point of origin code performed well for identifying patients admitted from acute care facilities but had poorer sensitivity in identifying patients admitted from long-term care facilities.

Our findings suggest that determination of prior health care facility exposure can be potentially automated using existing administrative data. Automated tools for infection control activities have become increasingly widespread in recent years. For example, they have been used to alert physicians when a patient with a multidrug-resistant organism is readmitted to the hospital, calculate device-days for reporting of health care-associated infections, and detect potential outbreaks.[7-10] Automated methods have been shown to be as accurate as manual methods, with increased efficiency and timeliness.[9] Staff time saved by using automation may be used by infection preventionists to focus on prevention rather than perform surveillance.[11]

The point of origin code is typically obtained within 24 hours of a patient's admission and can be used to generate an electronic flag available to hospital personnel. The flag would be useful to infection preventionists interested in rapid identification of patients admitted from other health care facilities, especially in regions where long-term care facilities and long-term acute care hospitals are significant reservoirs for highly resistant organisms such as carbapenem-resistant *Enterobacteriaceae*.[12,13] Such a flag could also trigger automated orders such as targeted active surveillance cultures or isolation precautions. Because all US hospitals that receive reimbursement from the Centers for Medicare and Medicaid Services are already required to collect point of origin code information at the time of admission for billing purposes, the point of origin code can be readily utilized, with or without an existing electronic medical record. The point of origin code has the distinct advantage of being standardized; it does not require manual chart review of physician documentation, which can be labor intensive for infection preventionists. Furthermore, health care facilities have a strong incentive to correctly document administrative data because it has a direct impact on their financial reimbursement. Nurses and physicians, on the other hand, may not complete these sections of the note or include updated information because they may not be required to do so.

Both the point of origin code and the physician-documented history were not sensitive in identifying long-term care facility patients compared with patients from other health

care facilities. This likely reflects the more diverse points of entry of long-term care facility patients who present to our institution compared with patients admitted from acute care facilities. Long-term care facility patients who are brought to the hospital by family members directly from outpatient clinics or for a scheduled procedure, for example, receive the default designation of a non-health care facility source because they sometimes arrive without identifying documentation (such as ambulance paperwork) from their institution. This could be improved by having registration personnel ask each patient or family member a similar question to what we asked in our study: “Where were you staying immediately before being admitted to Rush University Medical Center?” A significant proportion of patients from long-term care facilities in our study (32.9%) were nonverbal and unable to provide this information, but we suspect that all of these patients were brought to the hospital by ambulance personnel (and therefore accompanied by an ambulance report form and/or face sheet) or by a family member. Of the 7 long-term care facility patients who were incorrectly classified as “non-health care facility” by the point of origin code, 6 were brought to the hospital by a family member and could have been correctly identified as facility patients if registration personnel interviewed the patient’s family.

A limitation of our study was the small sample size of long-term care facility patients (n = 14), which contributed to the poor sensitivity and wide confidence interval of the point of origin code in detecting patients from long-term care facilities. Further studies should be performed to assess the sensitivity of the point of origin code in this specific population. Another limitation of our study is that it was performed at a single site; the performance of the point of origin code may vary from one hospital to another depending on local strategies in collecting the point of origin code information. Theoretically, point of origin information may be collected > 24 hours following admission because the UB-04 form is not submitted until the patient is discharged. However, because accurate documentation of the point of origin code affects hospital reimbursement, we believe that hospitals have similar incentives to optimize collection of point of origin code information in a timely manner, and the most opportune time to interview the patient is at the time of admission. A third limitation is that our tertiary academic institution may admit a patient population that differs from others in the prevalence of admissions from other health care facilities. Although variation in the prevalence of prior health care facility types would alter the positive and negative predictive values of the point of origin code from one institution to another, sensitivity and specificity are intrinsic to the point of origin code itself and are not affected by prevalence.

The UB-04-based point of origin code is an accurate and efficient tool to identify patients admitted from other health care facilities. Such information can increase infection control situational awareness and allow identification of patients at risk for carriage of multidrug-resistant organisms.

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Table 1

Point of origin codes from UB-04 form

Health care facility		Non-health care facility		Not applicable	
4	Transfer from a hospital, including LTACHs and emergency departments	1	Non-health care facility source of origin	9	Information regarding point of origin not available
		2	Clinic referral	F	Transfer from hospice
5	Transfers from a skilled nursing or intermediate care facility	8	Court/law enforcement		
		E	Transfer from ambulatory surgery center		
6	Transfers from another health care facility				
D	Transfer from one distinct unit of the hospital to another unit within the same hospital				

LTACH, Long-term acute care hospital.

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Table 2

Test characteristics of the point of origin code and physician-documented history in identifying patients admitted from all health care facilities, from long-term care facilities, and from acute care facilities, as compared with patients' self-report

	Sensitivity		Specificity		Positive predictive value		Negative predictive value	
Admission source	**%**	**(95% CI)**	**%**	**(95% CI)**	**%**	**(95% CI)**	**%**	**(95% CI)**
All health care facilities (n = 85)								
Point of origin code	86	(77-92)	98	(97-99)	91	(83-96)	97	(95-99)
Physician-documented history	75	(65-84)	98	(96-99)	88	(78-94)	95	(93-97)
Long-term care facilities (n = 14)*								
Point of origin code	50	(23-77)	86	(82-89)	9	(4-17)	98	(97-99)
Physician-documented history	71	(42-92)	88	(84-90)	14	(7-24)	99	(98-100)
Acute care facility (n = 71)†								
Point of origin code	93	(84-98)	97	(95-98)	83	(72-90)	99	(97-100)
Physician-documented history	76	(64-85)	96	(94-97)	74	(62-84)	96	(94-98)

*Long-term care facility includes skilled nursing and intermediate care facilities.

†Acute care facility includes hospitals, emergency departments, and long-term acute care hospitals.

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