TABLE 1. Potential Risk Factors Associated with Peripherally Inserted Central Catheter (PICC) Infections

Potential risk factor	No. (%) of infections with associated risk factor, $N = 20$
Out of hospital with PICC line	15 (75)
Foley catheter	13 (65)
Active chemotherapy or immunosuppressive therapy	6 (30)
Total parental nutrition	8 (40)
Ventilator	4 (20)
Chest tube	1 (5)

stream infection. The catheters in that study included but were not limited to PICCs. Additional potential risk factors included associated chemotherapy or immunosuppressive therapy and exposure to medical devices such as mechanical ventilators or chest tubes.

The data from this small study are quite limited but deserve further investigation, especially when considering hospital risk factors (Table 1). These risk factors have not been extensively evaluated in the literature. To expand our understanding of PICC infections, we have implemented a prospective trial involving close, concurrent monitoring of a cohort of patients who received a PICC in the hospital, for the life of the PICC. We are further analyzing characteristics identified in this retrospective study as potential risk factors, including out-of-hospital care of a PICC, duration that a PICC is in place, and comorbid conditions including paralysis, recent surgery, receipt of immunosuppressive agents, and obesity.

PICC use has become a mainstay in health care, and associated complications tie directly to patient safety and quality. As modifiable risk factors are identified, we anticipate that attempts can be made to correct these risks to improve patient care and safety in both the inpatient and outpatient environments.

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Surveillance for Influenza Using Hospital Discharge Data May Underestimate the Burden of Influenza-Related Hospitalization

To the Editor—In New Zealand, as in other places, a number of complementary surveillance systems are used for monitoring influenza activity. These systems include laboratory-based surveillance using virological data, sentinel surveillance of influenza-like illness (ILI) presentations in primary care, and monitoring of influenza-associated hospitalizations.[1-3] Coded hospital discharge data are often used as an epidemiological tool to monitor influenza disease burden.[4] However, the accuracy of this approach for determining the true burden of influenza in hospitalized patients is not well established, and to date, few studies have specifically evaluated the validity of hospital discharge data for influenza surveillance.

In this context, we performed a retrospective cross-sectional analysis of all patients with laboratory-confirmed influenza infection at our hospital over 2 influenza seasons. Our aim was to determine the sensitivity and specificity of coded hospital discharge data for identifying influenza infection in hospitalized patients with laboratory-confirmed influenza.

Auckland District Health Board in New Zealand is an 1,100-bed tertiary level institution serving a population of approximately 500,000 inhabitants. By searching our laboratory database, we identified all patients admitted to our hospital who had a sample sent for influenza testing between January 2010 and December 2011. To exclude patients for whom there was a clinical suspicion of nosocomial influenza, we included only those patients who had a sample sent for influenza testing within the first 72 hours of hospital admission. Samples were tested for influenza virus by real-time reverse-transcription polymerase chain reaction (RT-PCR) using previously described methods.[5]

TABLE 1. Correlation of Influenza Discharge Codes J09 and J10 with Influenza PCR Results

PCR result	No. of patients with J09 or J10 as principal diagnosis	No. of patients with J09 or J10 as any-listed diagnosis	No. of patients without J09 or J10 as principal diagnosis	No. of patients without J09 or J10 as any-listed diagnosis
Positive	92	150	83	25
Negative	10	21	960	949

NOTE. Based on *International Classification of Disease, Tenth Revision* (*ICD-10*) codes J09 ("influenza due to certain identified influenza virus") and J10 ("influenza due to other identified influenza virus"). PCR, polymerase chain reaction.

Using our hospital information database, we identified all patients who were discharged with influenza-related diagnoses between January 2010 and December 2011. In our institution, discharge coding uses the *International Classification of Disease, Tenth Revision* (*ICD-10*) diagnostic codes.[6] All patients are assigned a principal discharge diagnosis (first-listed) and may receive multiple additional diagnoses. We analyzed 3 broad diagnostic categories: (1) influenza discharges where the presence of an influenza virus was confirmed (*ICD-10* code J09 or J10), (2) influenza discharges where a virus was not identified (J11), and (3) pneumonia discharges (J12–J22). We then matched these data with the corresponding influenza PCR results.

Using influenza PCR positivity as a "gold standard" for influenza infection, we assessed the sensitivity and specificity of J09 and J10 discharge codes for identifying patients with laboratory-confirmed influenza. We analyzed J09 and J10 codes as principal diagnoses alone and then again as any-listed diagnoses. We also assessed the additional sensitivity of including all influenza (J11) and pneumonia (J12–J22) diagnostic codes for identifying laboratory-confirmed influenza in hospitalized patients.

A total of 1,145 patients were included. Of these, 175 patients (15.2%) tested positive for influenza. Of these 175 patients, 92 (53%) had a principal discharge diagnosis of confirmed influenza (J09, J10). Of the 970 patients testing negative for influenza, 10 had a principal discharge diagnosis of either J09 or J10 (Table 1). Using influenza PCR positivity as a gold standard, the sensitivity, specificity, and positive predictive value (PPV) of influenza-associated J09 or J10 principal discharge diagnoses for identifying patients with laboratory-confirmed influenza were 53%, 98%, and 90%, respectively. When J09 or J10 discharge codes were considered as any-listed diagnoses, the sensitivity, specificity, and PPV were 86%, 98%, and 88%, respectively (Table 1).

We also analyzed the additional sensitivity of using all influenza and pneumonia discharge codes (J11–J22) for identifying hospitalized patients with laboratory-confirmed influenza. When these codes were considered in addition to J09 and J10, the sensitivity increased from 53% (92/175) to 62% (108/175) as principal diagnoses and from 86% (150/175) to 94% (165/175) as any-listed diagnoses.

Our aim was to assess the performance of hospital discharge data for correctly identifying patients with laboratory-confirmed influenza. We found that in patients who tested positive for influenza, only 53% had a principal discharge diagnosis of confirmed influenza (J09 or J10). Sensitivity was increased to 86% if we included cases where additional discharge diagnostic codes were used. This finding may reflect the fact that many of those found to be positive for influenza virus had been admitted to hospital for an influenza-related complication such as pneumonia and so (correctly) had a different condition recorded as their principal diagnosis.

Using both principal and additional discharge diagnostic codes specifically for confirmed influenza infection (J09 and J10) greatly increased sensitivity without reducing specificity of coding as a method for detecting influenza. Moreover, using a broad-based syndromic approach incorporating pneumonia-related principal diagnostic codes resulted in only a modest increase in sensitivity, from 53% to 62%. Therefore, epidemiological studies that utilize principal discharge diagnoses alone for influenza surveillance may considerably underestimate the true effect of influenza on morbidity within a population.

In keeping with other reports, we found that using both influenza and pneumonia discharge codes as any-listed diagnoses was the most sensitive method for determining the influenza burden in hospitalized patients.[4] Ultimately, however, the most important limitation on the sensitivity of hospitalization data for measuring influenza morbidity is that much of this contribution may not be recognized clinically or even tested for. For example, many influenza-related hospitalizations may present clinically as cardiovascular events.[7] In addition, another recent study showed that only 33% of hospitalized children with influenza infection identified by surveillance had an influenza test as part of their routine clinical care.[8]

In conclusion, using principal influenza discharge diagnostic codes alone markedly underestimated the burden of laboratory-confirmed influenza in hospitalized patients. Future studies using prospective surveillance for ILI are required to assess the validity of hospital discharge data as a tool for determining influenza-related morbidity.

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An Analysis of the Accuracy of Physician-Entered Indications on Computerized Antimicrobial Orders

To the Editor—Healthcare-associated technologies such as computerized physician order entry (CPOE), electronic medical records (EMRs), and clinical decision support systems are becoming increasingly widespread. The use of CPOE may provide healthcare institutions the opportunity for computer-assisted antimicrobial stewardship as well as the potential to capture data for management, research, and quality monitoring.[1,2] The validity of collected data may be limited by the accuracy of physician documentation within the COPE framework. An analysis of the accuracy of physician-documented indications on paper antimicrobial order forms has suggested a high (~95%) rate of concordance with clinical indications, as determined by reviewers.[3] To our knowledge, the accuracy of physician documentation of indication for treatment on antimicrobial orders when using a CPOE system has not been evaluated. This accuracy would, understandably, be of concern when such data are to be used for research and benchmarking.

Northwestern Memorial Hospital is a 900-bed urban academic teaching hospital that has had a CPOE system in place since 2004 and a requirement that physicians document the indications for use of antimicrobials since 2011. A list of indications is imbedded in the CPOE system. Indications are generally organized by organ system and/or defined by common clinical infectious syndromes, for example, genitourinary (GU)–urinary tract infection, GU-pyelonephritis, and GU-prostatitis. Prescribers also have the option to enter a free-text indication in the comments of the order. We sought to assess the accuracy of the indications entered in the electronic antimicrobial orders by the prescribers, to validate further analysis of the data.

Data on all antimicrobial orders for the month of October 2011 were accessed via an electronic data warehouse for analysis by the antimicrobial stewardship program. A total of 12,601 orders for antimicrobials were made during the designated study period. These orders were stratified by surgical or procedural prophylaxis and by treatment indications to provide representative samples of both populations. A random sample of 50 patients from each group was selected. The indication on the electronic antimicrobial order was compared with the indication noted in the physician's progress notes in the EMR. Any discrepancies were deemed an inaccurate CPOE indication.

Of the randomly sampled prophylaxis orders, all 50 orders (100%) reflected accurate CPOE indications. In the antimicrobial treatment order group, 43 (86%) of the 50 CPOE indications were accurate. A total of 7 indications were designated as inaccurate. These consisted of 2 orders where the CPOE indication did not match what was documented in the patient's progress notes and 5 orders where "other—please note in comments" was chosen as the indication but nothing was documented in the comments. A majority of these (3 of 5) were for labor-and-delivery patients receiving antimicrobials for group B *Streptococcus* prophylaxis. This indication was subsequently added to the indications list and prepopulated in the labor-and-delivery order sets to minimize this documentation issue in the future. Assuming that this will resolve documentation issues with this population, it is anticipated that the future accuracy of indication selection will increase to approximately 92% in the treatment category overall.

The use of computer technology offers many opportunities for internal analysis, benchmarking with peers, and assisting in antimicrobial stewardship efforts. We present a validation of the accuracy of indication selection on CPOE antimicrobial orders. On the basis of the results of this integrity evaluation, we feel confident moving forward to undertake analysis of