Finding Pure and Simple Truths With Administrative Data

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The pure and simple truth is rarely pure and never simple.
—Oscar Wilde

ADMINISTRATIVE DATA HAVE BEEN USED TO ASSESS quality of care and variations in health care delivery for nearly 3 decades. Indeed, administrative data have provided important insights on racial disparities in care,[1] geographic differences in utilization,[2] and variations in outcomes across hospitals.[3] In the absence of national clinical registries, administrative data will continue to be an important source of information about health care delivery in the United States because of their ready availability, low cost, and ability to span multiple years and health care settings. Moreover, in contrast to data from randomized controlled trials, administrative data reflect real-world treatment settings and unselected populations. However, users must be aware of the inherent limitations of administrative data to avoid erroneous conclusions.

In this issue of *JAMA*, Lindenauer and colleagues[4] illustrate the complexity in deciphering simple temporal trends in hospital mortality for pneumonia. Using a nationally representative database—the Nationwide Inpatient Sample—the authors found that the rate of hospitalizations with a principal diagnosis of pneumonia decreased by a relative 27% from 2003 to 2009 while in-hospital mortality decreased by 28%. During the same period, rates of hospitalization for sepsis and respiratory failure with a secondary diagnosis of pneumonia increased by 178% and 9%, respectively. When these 3 groups were combined, the authors' assessment of trends in pneumonia admissions and mortality changed substantially, with a 12% relative decline in pneumonia-related admissions and a 6% increase in mortality during the study period.

This study highlights the importance of understanding nuances and vagaries of administrative data to evaluate trends over time or compare clinician performance. Even rela-

See also p 1405.

tively pure and simple measurements may be marred by a failure to appreciate the dynamic circumstances that affect how *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes are recorded. These issues go beyond pneumonia and may have affected many studies based on administrative data. For example, relative decreases in risk-adjusted hospital mortality between 2000 and 2007 for congestive heart failure (CHF), acute myocardial infarction (AMI), and stroke have also been reported—49%, 36%, and 26%, respectively.[5] Given that this study identified patients using principal diagnoses, it is possible that the reported decreases also resulted from changes in coding practices in which patients with more severe disease were given other principal diagnoses (eg, pulmonary edema or respiratory failure for CHF).

Nuances in the assignment of principal and secondary diagnoses can also affect assessments of hospital performance. Since 2005, the Centers for Medicare & Medicaid Services (CMS) has monitored the provision of recommended care to patients hospitalized with AMI, CHF, pneumonia, and chronic obstructive pulmonary disease (COPD). Because sampling of patients for specific performance measures is usually defined by principal diagnoses,[6] the sequencing of *ICD-9-CM* codes may affect performance assessments. For example, a study by Wu et al[7] in 2002 reported lower use of aspirin, heparin, β-blockers, and primary angioplasty among AMI patients with CHF compared with AMI patients without CHF, although patients with CHF were more likely to receive angiotension-converting enzyme inhibitors. If AMI is not recognized as the principal diagnosis, inadequate use of aspirin, heparin, β-blockers, or primary angioplasty among these patients may be underreported.

Because administrative data are derived from claims submitted by clinicians to receive payment, the selection of pri-

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mary and secondary *ICD-9-CM* codes in administrative data is often driven by reimbursement policies. Moreover, the diagnosis codes change over time, and advances in diagnostic technologies may affect the likelihood that certain diagnoses will be identified clinically and then recorded on administrative claims. Four examples highlight these influences.

First, as Lindenauer et al[4] reported, the use of sepsis as a principal diagnosis among patients with pneumonia increased substantially from 2003 to 2009, from 0.4 to 1.1 per 1000. Under prospective payment, there is wide variation in reimbursement for different diagnosis related groups (DRGs), creating incentives to identify principal diagnoses associated with higher reimbursing DRGs. For example, in 2009 the CMS DRG weights (which are proportional to reimbursement) for pneumonia (DRGs 193-195) ranged from 0.73 to 1.43, while the DRG weights for sepsis (DRGs 870-872) ranged from 1.15 to 5.83.[8] In addition, for sepsis, it is possible that coding professionals adapted to the increased awareness of sepsis following the 2002 Surviving Sepsis Campaign[9] and to clarification of the complex coding criteria for sepsis, which depend on the availability of key clinical findings in the medical record, such as body temperature, white blood cell count, heart rate, respiratory rate, and organ dysfunction.[10]

Second, these nuances are further complicated by the introduction of new diagnosis codes over time. For example, before 1992, a patient admitted for chronic bronchitis with acute exacerbation would have been coded with a primary diagnosis of 466.1 (acute bronchitis) and a secondary diagnosis of COPD. In 1992, a new *ICD-9-CM* code for COPD was introduced (491.21, chronic bronchitis with acute exacerbation), increasing the likelihood that COPD would be recorded as the primary, rather than secondary, diagnosis. During the year after the introduction of the new code, there was a 42% relative increase in hospitalizations with a primary diagnosis of COPD and an 80% relative increase within 3 years. In comparison, during the 3 years preceding the new code, hospitalizations for COPD increased by only 23%.[11] Moreover, there was a concurrent decrease in the use of COPD as a secondary diagnosis. From 1983 to 1991, up to 58% of patients with a primary diagnosis of acute bronchitis had a secondary diagnosis of COPD; this percentage declined to 10% or less during 1992-2000.[12]

Third, differences in the use of diagnostic tests may further affect reported temporal changes and variations across clinicians. Consider the occurrence of deep vein thrombosis (DVT) during hospitalization, which is used as an indicator of hospital quality[13] and is a common inpatient complication for trauma patients. A study by Pierce et al[14] found that DVT rates were 7-fold higher in trauma centers that routinely screened for DVTs. Similarly, Haut et al[15] found a 4-fold increase in the proportion of trauma patients undergoing screening at an urban trauma center from 1995 to 2008 and a 10-fold increase in DVT rates. With wide variation across hospitals and physicians in practice patterns related to DVT screening,[16] it is unclear whether high rates of incident DVT among hospitalized patients reflect inadequate care (eg, nonuse of DVT prophylaxis) or better screening.

Fourth, a well-recognized limitation of administrative data is the lack of important prognostic indicators, such as vital signs, laboratory and diagnostic test results, and functional status. As a result, measures of complexity in administrative data are limited to demographics and comorbidity, as measured by secondary *ICD-9-CM* diagnosis codes. However, assignment of secondary diagnoses is subject to large variations across clinicians and over time—variations that also affect the relationship of comorbid conditions to mortality.[17] For some conditions (eg, obesity, diabetes), the actual prevalence is increasing. Thus, increases in these conditions in administrative data are expected and consistent. For other conditions, however, increases in prevalence observed in administrative data have exceeded increases in the general population. For example, the prevalence of hypertension in the general population aged 60 years and older increased by only 10% from 1988 through 2004.[18] In contrast, the prevalence of hypertension in administrative data for elderly Medicare beneficiaries hospitalized for AMI increased by nearly 50% during a similar time frame.[17] Such increases may reflect greater attention to coding secondary diagnoses, changes in the characteristics of patients admitted for AMI, or changes in blood pressure thresholds for diagnosing hypertension.

The increasing availability of administrative data, of algorithms for identifying specific diseases and comorbid conditions, and of user-friendly statistical software has made it easier to use administrative data in assessing health care delivery and quality of care. Moreover, enhancements to diagnosis coding (eg, introduction of the *ICD-10-CM* taxonomy to provide greater specificity and the adoption of present-on-admission codes) hold great promise for improving the validity of analyses of administrative data. Nevertheless, the potential for misleading interpretation of findings based on naive analysis of administrative data and a lack of appreciation of the nuances in diagnostic coding will continue to be a problem. Such factors will hinder the ability to find "pure and simple" truths from administrative data.

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