Commentary

On "Risk-Adjusting Acute Myocardial Infarction Mortality: Are APR-DRGs the Right Tool?"

Norbert Goldfield and Richard Averill

The key portion of the Romano and Chan article (hereafter referred to as "Dr. Romano") can be excerpted as follows:

> [The performance of the APR-DRGS] was largely attributable to its inclusion of both comorbidities and complications. When conditions diagnosed after admission were not used to assign APR-DRGs, the predictive performance of both ROM and SOI classes fell.

Although we disagree with Dr. Romano's decision to exclude all conditions diagnosed after admission, we view his article as providing the reader with an excellent springboard for further discussion of issues pertaining to risk adjustment and complications. In this response to the article, we will both directly respond to its main points and summarize the broader policy issues that the article raises. This is a vital discussion because the need for comparative information concerning the performance of healthcare providers has greatly increased. The publication of comparative provider profiles—already complete or under way by more than 20 states—identifies "winners" as well as "losers." Since the comparisons are often publicly available, the consequences of being a "loser" can be significant: reputations, careers, and even financial viability can be at stake. Hospitals should be given every reasonable doubt in the methodology used in the provider profiles because, in the final analysis, it is far more acceptable to fail to identify a hospital as a winner than it is to falsely identify it as a loser. In terms of outcome measures, inpatient mortality is the outcome measure most commonly considered for inclusion in provider profiles. Reliable identification of complications is a key to the development of a valid risk-adjustment methodology for mortality. The purpose of this

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Norbert Goldfield, M.D. is Medical Director, 3M/Health Information Systems in Wallingford CT, and Editor of *The Journal of Ambulatory Care Management*. Richard Averill, M.A. is Research Manager, 3M/Health Information Systems.

response to Dr. Romano's article is to evaluate the issues associated with the use of mortality rates in provider profiles. We focus first on the accurate identification of complications and move from there to a discussion of risk adjustment of mortality.

ACCURATE IDENTIFICATION OF COMPLICATIONS

The development of any risk-adjusted outcome measure such as mortality must reflect the strengths and limitations of the coding system that is used to record the data. Critical to risk adjustment of mortality is the reliable and valid identification of complications, as clearly identified complications should not be included in risk adjustment of mortality. For diagnoses, ICD-9-CM is the coding system that is currently used. The first part of this discussion on complications assumes that only standard UB-92 data are available and that no information exists on whether or not each secondary diagnosis was present at admission. In the absence of such knowledge, three basic issues are associated with the use of ICD-9-CM for identifying complications:

- Whether a diagnosis constitutes a complication is dependent on the patient's underlying disease and procedure;
- A single ICD-9-CM code can specify both the underlying disease and a complication; and
- The section of ICD-9-CM that explicitly deals with complications lacks any clear definition or consistency of usage.

Unless all three of these issues are addressed, it is simply inappropriate for risk-adjustment methodologies to make a blanket statement and, for example, to drop all secondary diagnoses that occur after admission, as Dr. Romano appears to recommend ("When conditions diagnosed after admission were not used to assign APR-DRGs, the predictive performance of both ROM and SOI classes fell.") The problems associated with using ICD-9-CM codes and UB-92 data to determine complication rates are inherent and in many cases unresolvable. In a recent article, Iezzoni further documented the difficulty in reliably identifying complications. She found that patients with a complication that was identified using ICD-9-CM codes were no more likely to have a quality of care problem, as measured by explicit criteria, than were patients without a complication (Iezzoni 1999).

However, a recent article in *The New England Journal of Medicine* does provide empirical support for the position that, for certain diagnoses, mortality

rates adjusted using the APR-DRGs correlates to superior care processes (Chen, Radford, Wang, et al. 1999). The authors examined a recent report published in *U.S. News & World Report* that identified "America's Best Hospitals." For each hospital listed in the periodical the authors used APR-DRGs to develop a risk-adjusted mortality rate that was used as one factor in determining a hospital's ranking. Chen et al. found that the hospitals identified as top-ranked had lower 30-day mortality rates for AMI patients than did other hospitals. Further, the lower 30-day mortality was associated, within the top-ranked hospitals, with specific care processes such as the use of aspirin and beta-blocker therapy. The APR-DRG mortality risk adjustment used in the *U.S. News & World Report* included all secondary diagnoses. Thus, Chen et al. found that, for AMI patients, APR-DRG risk-adjusted mortality rates computed using all secondary diagnoses appear to be effective in identifying hospitals with superior care processes.

Given the results of the Chen and Iezzoni studies, we would be very reluctant to exclude any secondary diagnoses, other than the most obvious examples of complications (e.g., instrument left in after procedure), from the computation of the risk-adjusted mortality rate. In Version 15 of the APR-DRGs released in April 1998, some measured steps were taken to address the preventable-complication issue. As previously mentioned, a section of diagnosis codes in ICD-9-CM identifies complications of surgical and medical care (996–999). These codes are used when the diagnosis or condition has a causal connection with a specific surgical or medical intervention. For example, code 997.1 relates to cardiac complications such as cardiac arrest or heart failure "during or resulting from a procedure." One can be relatively confident that these codes represent complications that may have been preventable. In APR-DRG Version 15 codes in the 996–999 range are excluded (except for the complications of a transplant organ, which were felt to be related to rejection and thus were not preventable) from the risk of mortality and severity of illness adjustment. In addition, a number of newly designated APR-DRGs are based on the 996–999 codes (when they occur as the principal diagnosis), such as an APR-DRG for cardiac bypass performed as a consequence of a malfunctioning bypass graft. These DRGs can assist in the tracking of patients readmitted for complications of previous care.

RISK-ADJUSTING INPATIENT MORTALITY

In order to include inpatient mortality in provider profiles it is necessary to risk-adjust the data. When the indicators for "present at admission" are

available for each secondary diagnosis, Dr. Romano argues that all conditions that occur after admission represent a preventable complication and, therefore, should not be used in the risk adjustment. The challenge is to give hospitals credit for diseases and conditions that represent a natural progression of the patient's underlying problem, but not to give credit for preventable complications. Yet the ability to identify complications is enhanced if one knows whether or not the secondary diagnosis is present on admission. It is important to provide definitions for several terms to be used throughout this discussion of conditions that are present on admission:

- *Comorbidity.* A disease or condition that is present prior to admission
- *Preventable complication.* A disease or condition that occurs after admission and is preventable if care is appropriate.
- *Sequela.* A disease or condition that occurs after admission, represents a natural progression of the underlying disease, and is not preventable even with appropriate care.

As these definitions emphasize, not all diseases or conditions that occur after admission are preventable complications. Some diseases or conditions that develop after admission represent a natural progression of a disease (referred to as *sequelae* in this discussion). With respect to acute myocardial infarction it is clear that many secondary diagnoses that occur after admission most likely represent *sequelae* of the AMI. Thus, if a patient develops a complete AV-block on the second day after admission, it is likely that the AV-block represents a *sequela* of the AMI and not a preventable complication. The above example demonstrates the error in assuming that all postadmission secondary diagnoses are preventable complications. In short, no diagnosis should be considered a preventable complication unless research validates that the occurrence of the diagnosis is associated with substandard processes of care. "Innocent until proven guilty" is the best approach, especially in light of the situation in which hospitals find themselves today, with their mortality data subject to public dissemination.

In summary, we disagree with Dr. Romano's conclusions (superior performance of APR-DRGs depends on the inclusion of complications), because he excludes all secondary diagnoses that occur after admission and not just those diagnoses that are preventable complications. Chen's *New England Journal of Medicine* article documents conclusively the correlation of the APR-DRG risk of mortality for myocardial infarction to validated outcomes and processes of care. In addition, we do believe that an approach to risk adjustment favoring innocence until guilt is proved, in combination with an

aggressive effort to develop data sets that better distinguish complications from comorbidities, represents a successful strategy for hospital quality improvement efforts. Some states, such as New York and California, have expanded the standard UB-92 to include an indication of whether or not each secondary diagnosis is present at admission. With the availability of a present-at-admission indicator it may be possible to develop a better understanding of which secondary diagnoses not present on admission should be excluded from risk adjustment of, for example, mortality rates. However, such information is relatively new, and little data are available on the reliability of recording the present-at-admission indicator. We have begun an active pursuit of this dual track in a variety of research projects currently under way.

REFERENCES

Chen, J., M. Radford, Y. Wang, T. A. Marciniak, and H. M. Krumholz. 1999. "Do America's 'Best Hospitals' Perform Better for Acute Myocardial Infarction?" *The New England Journal of Medicine* 340 (4): 286–92.

Iezzoni, L. 1999. "Does the Complications Screening Program Flag Cases with Process of Care Problems? Using Explicit Criteria to Judge Processes." *International Journal for Quality in Health Care* 11 (2): 107–18.

Reply

Patrick S. Romano

In their response to our manuscript, Dr. Goldfield and Mr. Averill offer several arguments that merit further discussion. At the outset, we readily acknowledge that special circumstances may exist under which it is completely appropriate to adjust for conditions that develop after admission (e.g., "complications") in a severity-adjustment tool. For example, clinical logic may suggest that a condition was actually present at admission, even if it first caused symptoms and was first detected after admission. Chronic conditions such as hypertension, diabetes, asthma, and cancer are examples of this phenomenon. In addition, certain "complications" are inextricably linked to the principal diagnosis and therefore should be considered for inclusion in any severity-adjustment tool.

Examples of this phenomenon include aphasia with stroke, and fever with pyelonephritis or pneumonia. We do not mean to imply that it is necessary to remove all conditions diagnosed after admission from severity-adjustment tools; however, we continue to believe that recent versions of APR-DRGs err significantly toward overinclusiveness.

Dr. Goldfield and Mr. Averill first argue that "hospitals should be given every reasonable doubt in the methodology" and that "it is far more acceptable to fail to identify a hospital as a 'winner' than it is to falsely identify it as a 'loser'." This argument seems reasonable on its face, but it overlooks two important facts. First, the primary stated purpose of most severity-adjustment tools, including 3M's APR-DRGs, is not to promote public reporting of risk-adjusted outcome data, but to foster providers' own quality improvement, resource allocation, and marketing activities.[1] Second, deliberately introducing bias into severity-adjustment models by adjusting for potentially preventable complications can have subtle and unanticipated effects. If the probability of death is overestimated for patients who experience such complications, then it is underestimated for patients without complications. If the expected mortality rate is overestimated at hospitals with many potentially preventable complications, then it is underestimated at hospitals with few such complications. As a result, the latter hospitals could be unfairly denied "better than expected" ratings or unfairly assigned "worse than expected" ratings. One cannot predict whether adjusting for potentially preventable complications would lead to more, or fewer, falsely labeled "losers."

We agree with Dr. Goldfield and Mr. Averill that "the section of ICD-9-CM that explicitly deals with complications lacks any clear definition or consistency of usage." Recent work by Lawthers and others confirms that the validity of these complication codes is questionable (Lawthers et al. 1998; Romano and Schembri 1995). Indeed, this is all the more reason to avoid including these codes in severity-adjustment algorithms. Epidemiologists recommend extreme caution in adjusting for putative risk factors that are subject to substantial ascertainment error (Rothman and Greenland 1998), especially when differential misclassification by outcome status seems likely.

Dr. Goldfield and Mr. Averill cite Chen et al.'s finding that hospitals listed by *US News & World Report* as among "America's Best" for cardiology provide better care to elderly AMI patients than other, similarly equipped hospitals (Chen, Radford, Wang, et al. 1999) as evidence of the validity of APR-DRGs, as they are currently constructed. We do not find this argument persuasive. First, *US News & World Report*'s rankings are based on three equally weighted components: risk-adjusted mortality (using APR-DRGs),

structural factors, and reputation among board-certified cardiologists. How can Dr. Goldfield and Mr. Averill presume that their product accounts for the observed association between *US News & World Report*'s rankings and process measures of quality? Second, it is quite possible that a model less biased by the inclusion of potentially preventable complications would achieve an even stronger correlation with process measures of quality. It is even possible that raw, unadjusted mortality rates would achieve a stronger correlation. Before we can accept Chen et al.'s study as evidence of the validity of adjusting for potentially preventable complications, we would need to assess how less biased severity-adjustment tools compare with APR-DRGs, using the same metric.

Finally, Dr. Goldfield and Mr. Averill suggest that "some diseases or conditions that develop after admission . . . simply represent a natural progression of a disease." They attempt to distinguish between "*sequelae*" and "preventable complications." In practice, we find this distinction to be highly problematic and fraught with controversy. What is the "natural progression" of a disease? It is well recognized, for example, that prompt thrombolytic therapy can actually abort myocardial infarctions and strokes, leading to improved clinical outcomes. Prompt antibiotic therapy can prevent the "natural progression" of pneumonia to respiratory failure, empyema, and death. So how can we distinguish the "natural progression" of an illness, with optimal medical care, from "unnatural progression" of the same illness, with suboptimal care?

Finally, Dr. Goldfield and Mr. Averill argue that "no diagnosis should be considered a preventable complication unless research validates that the occurrence of the diagnosis is associated with substandard processes of care." This is why we prefer to use the term "potentially preventable complication," which does not imply that we have complete knowledge about a condition's preventability when, in fact, we rarely do. We do not believe that hospitals should be *penalized* for having "potentially preventable complications," but neither do we believe that they should be *rewarded* for experiencing more adverse events (especially when these adverse events are often antecedents of death). Dr. Goldfield and Mr. Averill seem to argue that "if you don't know whether a complication is preventable, include it in your model anyway." We argue instead that "if you don't know what you are measuring, but you think it may be at least potentially preventable, don't include it in your model." Given how different severity-adjustment models lead to quite different judgments of hospital performance (Iezzoni 1997), no model, no matter how carefully designed, should be used to determine whether a hospital is

"innocent" or "guilty." Instead, severity-adjustment models simply help us understand whether a hospital *may* have more adverse outcomes than we *might* expect, based on the patient's severity of illness and other characteristics at presentation (Selker 1993). Let us not expect our severity-adjustment tools to deliver more than they realistically can.

REFERENCES

All Patient Refined DRG Software.
http://www.3m.com/market/healthcare/his/product/apr_drg/brochure/menu.htm

Chen, J., M. J. Radford, Y. Wang, T. A. Marciniak, and H. M. Krumholz. 1999. "Do 'America's Best Hospitals' Perform Better for Acute Myocardial Infarction?" *The New England Journal of Medicine* 340 (4):286–92.

Iezzoni, L. I. 1997. "The Risks of Risk Adjustment." *Journal of the American Medical Association* 278 (19):1600–07.

Lawthers, A. G., E. McCarthy, H. Palmer, and L. Iezzoni. 1998. "The Challenge of Identifying In-Hospital Complications from Claim Data [abstract]." *Association for Health Services Research Annual Meeting Abstract Book* 15:192–93.

Rothman, K. J., and S. Greenland. 1998. "Precision and Validity in Epidemiologic Studies." In *Modern Epidemiology*, edited by K. J. Rothman and S. Greenland, pp. 132–33. Philadelphia: Lippincott-Raven Publishers.

Selker, H. P. 1993. "Systems for Comparing Actual and Predicted Mortality Rates: Characteristics to Promote Cooperation in Improving Hospital Care." *Annals of Internal Medicine* 118 (10):820–22.