The Art of Oversimplification: The Challenge of Measuring Hospital-Acquired MRSA

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(See the article by Avery et al, on pages 114–121.)

Sir Karl Popper, the eminent philosopher of science, once wrote, "Science may be described as the art of systematic over-simplification."[1(p44)] While simplification can be useful for modeling and understanding complex dynamic systems such as the human body or the solar system, it does not come without potential costs. The goal of simplification, as noted by others,[2] is to remove inappropriate complexity while not significantly affecting validity or credibility. In our current age of public reporting of hospital information, extreme oversimplification may lead to measurements that suffer from unacceptable misclassification.

Healthcare facility rankings, such as those generated through hospital public reporting and the Hospital Compare Web site, have recently gained momentum through the Affordable Care Act.[3-5] The goal of these rankings is to encourage hospitals to monitor and improve quality and to increase transparency of hospital performance to payers, consumers, and regulatory bodies.[3] These rankings have financial repercussions both through reimbursement via the Hospital Value-Based Purchasing Program and through the potential loss of patients to higher-ranking institutions.[5]

This type of public reporting and hospital comparison requires that we develop measures for the quality of care within our hospitals. Yet this becomes challenging when the outcomes being measured, such as hospital-acquired infections with methicillin-resistant *Staphylococcus aureus* (MRSA), are inherently difficult to classify and traditionally involve manual chart review with subjective judgment on the part of a human reviewer. Manual chart review is a laborious, time-consuming, and inefficient way to collect quality of care data. Thus, it becomes necessary to generate electronic surveillance systems to measure the quality of hospital care.

Any system that is devised to perform this type of surveillance using methods that convert a traditionally subjective judgment call into an objective classification involves a process of simplification. The more simplified the classification system is and the more assumptions that are necessary lead to greater potential for introducing bias and misclassification. These issues become amplified when the measurements are used to rate and rank hospitals.

In this issue of *Infection Control and Hospital Epidemiology*, Avery et al[6] address the postdischarge measurement of MRSA infections as an important concern related to the oversimplification of the measurement systems used for MRSA ranking. Avery and colleagues used data from a large system of hospitals to demonstrate that the current methodology of ranking according to incidence of MRSA is flawed by not assessing and including postdischarge MRSA infections. These infections are certainly undercounted, and as such their source is not attributed appropriately. The authors reveal that the accurate assignment of postdischarge hospital-associated MRSA infections significantly impacts measurement and ranking, demonstrating that careful thought about measurement methodologies and addressing deficiencies can result in more valid approaches to ranking. The authors were successful at expanding the previously oversimplified measurement process to account for postdischarge cases, producing a more valid measure for ranking.

Of the different ways to classify and count MRSA infections, the one used by Avery and colleagues involves *International Classification of Disease, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes. Even with the advances introduced by their work, the use of *ICD-9-CM* codes for measuring MRSA infections remains an oversimplification of a complex process. MRSA *ICD-9-CM* codes must still be validated against medical chart review, as there are many reasons why codes may not be assigned consistently across hospitals. For instance, the purpose of *ICD-9-CM* coding is to bill third-party payers, and there are multiple versions of medical billing software that may be used by a hospital. Some versions include a prompt asking whether the patient had MRSA, while others do not; in this situation, some hospitals may "overcode," while others may "undercode." Other examples of overcoding include coding for prior history of MRSA or coding for an MRSA test even though the test result was negative. With respect to the latter, Dubberke et al[7] found

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that 54% of patients without *Clostridium difficile* infection but with a *C. difficile ICD-9-CM* code had a negative *C. difficile* test result. Additionally, we previously found large interhospital variation in MRSA *ICD-9-CM* coding, potentially because one hospital listed prior history of MRSA prominently in patient medical records for infection control purposes, while in the charts of other hospitals the documentation was less prominent.[8]

Furthermore, it is important to note that *ICD-9-CM* codes may identify both MRSA infection and colonization. Measurements that include patients only colonized with MRSA may unfairly penalize some hospitals. For example, hospitals that perform death or discharge surveillance might receive a lower ranking than hospitals that do not perform this surveillance. The introduction of an active surveillance program for MRSA, which would arguably raise infection control quality, could potentially lower a hospital's ranking. This is because readmissions that occurred soon after the introduction of the system would count as postdischarge MRSA acquisition even if the patient had been persistently colonized with community-associated MRSA for years.

Beyond issues related to *ICD-9-CM* coding, hospital ranking systems should also be adjusted for hospital case mix. As Avery and colleagues state, it is possible that the true source of some postdischarge-detected MRSA was the community or another healthcare facility. This risk increases among patient populations that have high healthcare utilization (eg, hemodialysis patients) or patient populations at risk for community-associated MRSA, such as intravenous drug users, patients who are homeless or live in overcrowded conditions, or patients with exposure to the penitentiary system. Hospitals that serve such high-risk patient populations should not necessarily be penalized in a ranking system.

However, the study by Avery and colleagues provides optimism that a valid electronic ranking system for MRSA can evolve over time. Even merely the addition of microbiology data from electronic health records could increase the validity of the ranking system, as one study found that among all positive clinical cultures for MRSA, 82% were clinical infections as defined by the National Healthcare Safety Network.[9] Researchers could devise an MRSA ranking system that utilizes algorithms derived from models that use structured, coded data, such as laboratory, pharmacy, and microbiology data, to classify the presence or absence of MRSA infection. In the future, researchers could augment such a system by tapping into the unstructured text data in clinical notes to make the inference of MRSA infection by means of natural language processing methods. Although potentially more accurate than systems that rely solely on *ICD-9-CM* codes, these would still be subject to biases concerning data acquisition, storage, and availability, as well as individual documentation practices.

In summary, there continue to be many challenges and opportunities to improve the objective measurement of MRSA infections in hospitals for the purposes of ranking and comparison. The study by Avery and colleagues demonstrated significant changes in hospital rankings upon improvement of the measurement system. Yet until we can fully integrate additional improvements, the oversimplification of MRSA measurement using *ICD-9-CM* coding will continue to be controversial and its appropriateness for hospital ranking systems questioned.

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REFERENCES

1. Popper K. *The Open Universe: An Argument for Indeterminism.* Bartley WW, ed. London: Routledge, 1982.
2. Innis G, Rexstad E. Simulation model simplification techniques. *Simulation* 1983;41(1):7–15.
3. Agency for Healthcare Research and Quality (AHRQ). *National Healthcare Quality Report, 2010.* AHRQ publication no. 11-0004. http://www.ahrq.gov/qual/qrdr10.htm. Accessed November 4, 2011.
4. US Department Health and Human Services. Hospital Compare Web site. http://www.hospitalcompare.hhs.gov/. Accessed November 4, 2011.
5. US Department of Health and Human Services. Administration implements affordable care act provision to improve care, lower costs [press release]. April 29, 2011. http://www.hhs.gov/news/press/2011pres/04/20110429a.html. Accessed November 4, 2011.
6. Avery TR, Kleinman KP, Klompas M, Aschengrau A, Huang SS. Inclusion of 30-day postdischarge detection triples the incidence of hospital-onset methicillin-resistant *Staphylococcus aureus. Infect Control Hosp Epidemiol* 2012;33(2):114–121 (in this issue).
7. Dubberke ER, Reske KA, McDonald LC, Fraser VJ. ICD-9 codes and surveillance for *Clostridium difficile*–associated disease. *Emerg Infect Dis* 2006;12(10):1576–1579.
8. Schweizer ML, Eber MR, Laxminarayan R, et al. Validity of *ICD-9-CM* coding for identifying incident methicillin-resistant *Staphylococcus aureus* (MRSA) infections: is MRSA infection coded as a chronic disease? *Infect Control Hosp Epidemiol* 2011;32(2):148–154.
9. Harris AD, Furuno JP, Roghmann MC, et al. Targeted surveillance of MRSA and its potential use to guide empiric antibiotic therapy. *Antimicrob Agents Chemother* 2010;54(8):3143–3148.