Background: Core measure sets and composite bundles are becoming more common as a means to measure patient care process quality and compliance to evidence-based medicine. The Joint Commission, CMS, Institute for Healthcare Improvement, and others have advocated such bundles for CHF, AMI, SSI, VAP, joint replacement, CABG, and others, sometimes linked to pay-for-performance and reimbursement. For example, a surgical site infection bundle includes five measures: use of appropriate antibiotics, prophylactic antibiotic administration, discontinuing antibiotics 24 hours after surgery, glycemic control, and normothermia control.

Compliance to such process elements typically can be measured via either a composite measure, a weighted composite measure, or an “all-or-nothing” (AON) measure in which a patient must receive all bundle elements to be counted as a “success”. AON measures generally are considered advantageous for creating heightened patient-centered awareness. The sensitivity of each metric, however, and the best way statistically to measure and identify changes in bundle compliance remain unclear and largely uninvestigated.

Purpose of the Study: The three objectives of this study are to (1) investigate the statistical properties of each bundle compliance measure, (2) compare their relative sensitivity for identifying improvements and differences between organizations, and (3) propose appropriate statistical tests and control charts for these purposes.

Methods: We compute and compare the statistical properties and operating characteristics (sensitivity, specificity, time to signal) of composite (weighted and unweighted) and AON measures for detecting various magnitudes of within-facility improvements or between-facility differences. Exact statistical tests and control charts also are derived for each measure, with their performance compared both mathematically and using Monte Carlo simulation.

Results: Interestingly, composite measures are shown to usually have better sensitivity than AON measures, contrary to current trends and suggestions in the literature. Although AON measures can be more sensitive for very highly reliable processes (>99%), especially as the number of bundle elements increases, this is partially attributable to reduced specificity. The new statistical methods for composite bundles produce significantly different conclusions (i.e., more accurate) than standard methods and have greater sensitivity to identify between-facility differences and to detect within-facility improvements faster. The advantage of methods for composite measures is intuitive due to the discarding of meaningful information when forming the AON measure, since “nothing” can occur in several ways (e.g, a patient receiving 4 of 5 elements versus one receiving 0 of the 5).
Conclusions and Implications: Composite measures usually have statistical advantages over all-or-nothing measures for detecting care process changes. Exact statistical methods for composite bundles similarly perform better than traditional methods. Both results have implications on the best way to measure compliance to core measure sets in order to accelerate improvement and reward performance differences. Use of AON alone may in fact slow improvement efforts.

References