Health Benchmarks®
Clinical Quality Indicator Specification 2007

Client	HEALTH BENCHMARKS, INC. STANDARD ALGORITHM *Implemented for Blue Cross Blue Shield of Illinois*
Measure Title	RISK-ADJUSTED COMPLICATION LIKELIHOOD FOR SURGERIES: APPENDECTOMY AND CHOLECYSTECTOMY
Disease State	Appendectomy Cholecystectomy
Indicator Classification[1]	Complication Rate
Strength of Recommendation[2]	Not applicable
Clinical Intent	To assess the complication rate for appendectomy and cholescystectomy. Of note, this measure is risk adjusted.
Physician Specialties	Mixed Specialty, General Surgery

Clinical Rationale

Disease Burden

- Appendicitis is a very common condition, with an incidence of over 40,000 cases per year, [1] and is most often treated by appendectomy.[2]
- In 1997, over 5% of appendectomy procedures resulted in post-operative complications, including infection.[3]
- Similarly, cholecystectomy has an annual rate of 260.8 per 100,000 population.[4, 5]
- Complications related to cholecystectomy procedures occur in about 3-6% of cases.[6]

Reason for Indicated Intervention or Treatment

- Cohort studies have shown that appendectomy is an effective treatment for appendicitis.[7] Likewise, for gallstones and other digestive disease, cholecystectomy is an effective treatment.[8]
- Open and closed appendectomy and cholecystectomy have shown to be safe procedures.[9, 10] Most often, complications are usually limited to elderly patients with comorbid conditions or are attributable to physician error or oversight.[11]

Evidence Supporting Intervention or Treatment

- Studies have shown that there are substantial costs associated with post-operative complication management, which can oftentimes be avoided. [12, 13] Surgical outcomes have also been shown to vary substantially by provider.[14, 15]
- Risk-adjustment methodologies have been used in several studies utilizing outcomes data to accurately reflect quality of care.[16, 17]
- Comorbidities have been shown to significantly increase the risk of death after surgery.[18]
- The National Surgical Quality Improvement Program (NSQIP) also recommends the use of risk-adjusted outcomes to identify aspects of surgical care that are in need of improvement.[19]

Clinical Recommendation

- NSQIP was created by the Department of Veteran Affairs as a result of the poor surgical care they were providing at the VA hospitals. Since the

introduction of NSQIP, several VA hospitals have significantly reduced surgical complication rates.[20]

- NSQIP and other surgical improvement programs have developed valid risk adjustment methodologies that permit the use of outcomes data to assess quality.[15, 16, 21, 22]
- Medical centers that perform surgery need to implement these risk-adjustment and measurement techniques in order to point out areas in which quality improvement efforts such as NSQIP can be deployed to improve the quality of surgical care. [13, 15, 20, 23, 24]

Source Health Benchmarks, Inc.

DERIVING THE UNADJUSTED RATE FOR A PROVIDER

Denominator Any member who underwent either an appendectomy, laparoscopic appendectomy, cholecystectomy, or laparoscopic cholecystectomy surgery during the measurement year.

Denominator Exclusion N/A

Numerator Members who underwent an appendectomy or cholecystectomy who did **NOT** have evidence of a complication. (Note that this definition allows the measure to be reported as an inverted rate to facilitate a meaningful score interpretation across measures that are scored on the same scale)

Interpretation of Score High score implies better performance

Physician Attribution Score only the physician that performed the surgery.

DERIVING THE PREDICTED RATE FOR A PROVIDER

Statistical Methodology

Patient populations are inherently variable, ensuring that providers will treat an array of patients that are likely different in composition of risk compared to patient pools treated by other providers. This variability, particularly with regard to general health status, can account for a large proportion of the measured quality of care differences between providers and lead to incorrect findings and conclusions if not considered. To generate a meaningful statistic that reflects only differences in provider practice patterns, appropriate statistical method such as the conventional logistic regression is used to model the probability of occurrence of the surgery complication by controlling for a variety of patient mix and severity of illness factors such as demographics (age, gender), comorbidities, types of procedures and disease severity during a specific period.

Model specification

For j-th patient who received a surgical procedure from physician i, we modeled the complication indicator variable Y_{ij} (1 for complication and 0 otherwise) as follows:

$G(E(Y_{ij})) =$
$\beta 0i$ (physician) i
$+ \beta_1$ procedure indicator (appendectomy, laparoscopic appendectomy, cholecystectomy, or laparoscopic cholecystectomy)
$+ \beta_2$ Disease severity
$+ \beta_3$ Groups of patient disease comorbidities (e.g., diabetes, etc.)
$+ \beta_4$ Patient demographics (age and gender)

Where $E(Y_{ij})$ is the expected value of Y_{ij} and G is a monotonic differentiable link function that describes how the expected value of Y_i is related to the predictors. A binomial distribution for Y and logit link function, i.e., logistic regression will be applied to estimate the physician effect (indexed by $\beta 0i$) on the likelihood of developing a complication after surgical procedure, controlling for the patient level characteristics variables.

Patient Disease Comorbidities include 18 broad categories: a severity ranking for the comorbidity, adhesion, anemia, cancer, nutritional, renal, urologic, vascular, cardiac, diabetic, endocrine, gastrointestinal, immune, infectious, neurologic, orthopedic, other, and pulmonary.

Prediction

Physician must have at least 10 denominator cases (either appendectomy or cholecystectomy procedures) to be scored. Based on the parameter estimates of physician indicators from the above model, the average risk adjusted likelihood of complication for physician i was obtained using the following equation:

$P_i = \exp(\beta_{0i} + X\beta)/(1+\exp(\beta_{0i} + X\beta))$
Where,
Exp: exponential function;
$\beta 0i$: parameter estimates indexed physician effects;

$X\beta$: the estimated regression coefficients from the model*mean values for each covariate.
P_i can be interpreted as the expected complication rate physician *i* would have if he/she treated all surgical procedures at his/her actual level of performance. Comparing risk adjusted complication rates across physicians would measure physician *i*'s performance assuming that this provider encountered the typical or average case distribution experienced by his/her peers.

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[1] **Indicator Classification** (Adapted from Health Plan Employer Data Information Set (HEDIS®) technical specifications)

Diagnosis	Measures applicable to patients receiving diagnostic workups for a symptom or condition that delineate appropriate laboratory or radiological testing to be performed (e.g. evaluation of thyroid nodule; pregnancy test in patients with vaginal bleeding or abdominal pain)
Effectiveness of Care	
Prevention	Measures applicable to asymptomatic individuals that are designed to prevent the onset of the targeted condition (e.g. immunizations).
Screening	Measures applicable to asymptomatic patients who have risk factors or pre-clinical disease, but in whom the condition has not become clinically apparent (e.g. pap smears; screening for elevated blood pressure).
Disease Management	Measures applicable to individuals diagnosed with a condition that are part of the treatment or management of the condition (e.g. cholesterol reduction in patients with diabetes; radiation therapy following breast conserving surgery; appropriate follow-up after acute event).
Medication Monitoring	Measures applicable to patients taking medications with narrow therapeutic windows and / or potential preventable significant side effects or adverse reactions (e.g. thyroid stimulating hormone (TSH) testing after levothyroxine dose change; hepatic enzyme monitoring for patients using antimycotic pharmacotherapy)
Medication Adherence	Measures applicable to patients taking medications for chronic conditions that are designed to assess patient adherence to medication (e.g. adherence to lipid lowering medication).
Utilization	Measures applicable to patients receiving treatment for a symptom or condition that advocate appropriate utilization of laboratory and pharmaceutical resources (e.g. conservative use of imaging for low back pain; inappropriate use of antibiotics for viral upper respiratory infection).

Strength of Recommendation Based on a Body of Evidence

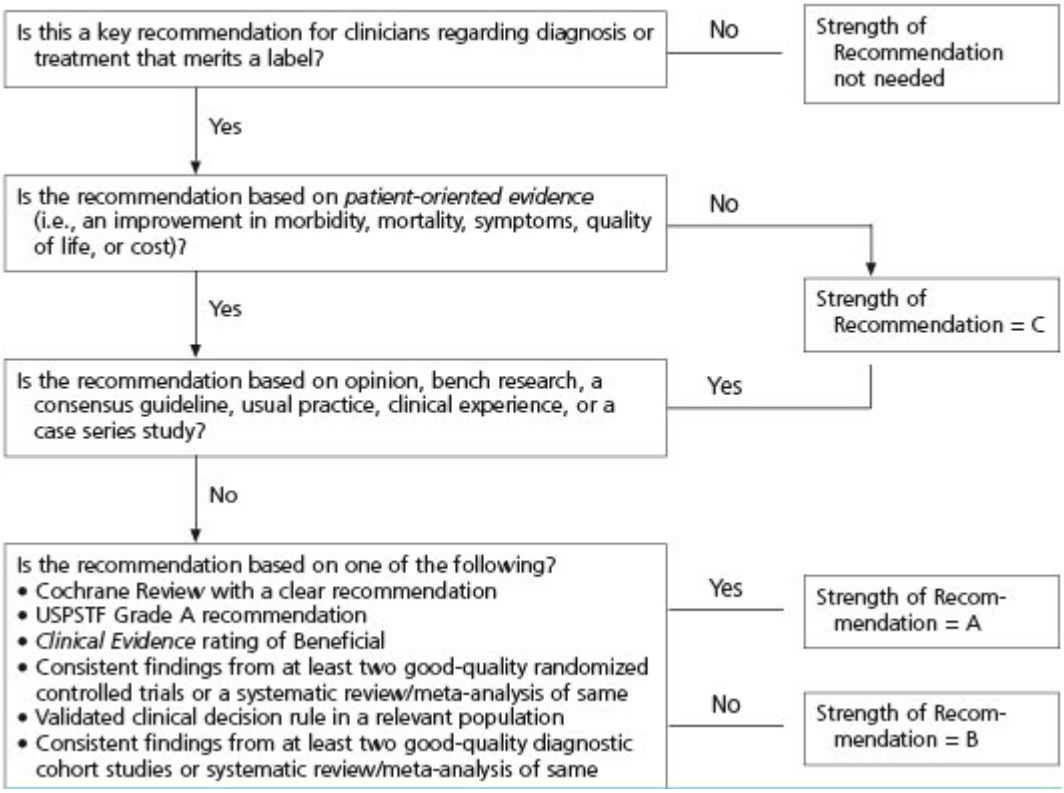

FIGURE 2. Algorithm for determining the strength of a recommendation based on a body of evidence (applies to clinical recommendations regarding diagnosis, treatment, prevention, or screening). While this algorithm provides a general guideline, authors and editors may adjust the strength of recommendation based on the benefits, harms, and costs of the intervention being recommended. (USPSTF = U.S. Preventive Services Task Force)