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CALCULATING THE SURVIVAL PREDICTOR
SCORING OVERVIEW

OVERVIEW

The survival predictor is a simple composite measure based on a combination of surgical mortality and hospital volume. The methods used to develop these measures are based on empirical bayes techniques, where the mortality rate is weighted to the extent it is reliable and the remaining weight is placed on hospital volume. These measures were validated by assessing how well they predict subsequent mortality performance at the hospital-level. Results demonstrate that a simple composite of mortality and volume is a better predictor of subsequent performance than either measure alone for most operations. These measures will help patients and payers identify hospitals likely to have superior outcomes.

For greater detail on the methods used to develop these measures, please consult Dimick et al's February 2009 article in Health Affairs titled "Composite Measures for Predicting Surgical Mortality in the Hospital" or the Survival Predictor white paper available at http://leapfroggroup.org/ratings-reports/high-risk-surgeries.

For the 2016 Leapfrog Hospital Survey, Survival Predictor results (predicted mortality rates) are computed, scored, and publicly reported by Leapfrog for the four high-risk surgical procedures in Section 3 of the survey (Evidence-Based Hospital Referral)– Aortic Valve Replacement (AVR), Abdominal Aortic Aneurysm Repair (AAA), Pancreatectomy, and Esophagectomy high-risk surgeries.

The general composite measure calculation is as follows:

Predicted Mortality = (weight)*(mortality) + (1-weight)*(volume predicted mortality), where *mortality* is self-reported by hospitals in the Leapfrog Hospital Survey and the values for *volume predicted mortality* and *weight* are derived from a national data set (Medicare Provider Analysis and Review (MedPAR) files), as outlined further below.

SCORING DETAILS

Mortality
Hospitals self-report their raw mortality rates by answering questions #2 and/or #3 (denominator) and question #4 (raw deaths/numerator) for each high-risk procedure in the Leapfrog Hospital Survey. (For AVR, questions #2, #3, and #4 are used for denominator and numerator, respectively.)

Volume Predicted Mortality

Volume predicted mortality[1] = intercept – coefficient * ln(caseload), where

- *intercept* and *coefficient* values are derived from regression models using the MedPAR data,
- *caseload*[2] is the <u>total</u> volume of procedures reported by the hospital in its Leapfrog Hospital Survey (answer to question #2 for each high-risk procedure), and
- ln(caseload) is the natural log of *caseload*.

Weight

Weight = mortality signal/(mortality signal + [mortality sigma/caseload]), where

- *mortality signal* and *mortality sigma* are derived from the models using the MedPAR data, and
- *caseload*[3] is the <u>mortality cohort</u> volume of procedures reported by the hospital in its Leapfrog Hospital Survey (answer to question #3 for each high-risk procedure, except for AVR, where the answer to question #2 will be used).

The parameters derived from MedPAR data and used in the volume predicted mortality and weight calculations for 2015 are indicated in Table 1.

Table 1: Model Parameters

	Volume Predicted Mortality		Weight	
	Intercept	**Coefficient**	**Mortality Signal**	**Mortality Sigma**
Aortic Valve Replacement (AVR)	0.0532651	0.0011648	0.00032736	0.04531237
Abdominal Aortic Aneurism Repair (AAA)	0.0441481	0.0035592	0.00039853	0.02921503
Esophageal Resection (Esophagectomy)	0.1168133	0.0173052	0.00024999	0.06007834
Pancreatic Resection (Pancreatectomy)	0.1442892	0.0306039	0.00264176	0.04865286

For more specific details on how these input values are derived, please consult the Survival Predictor white paper at http://leapfroggroup.org/ratings-reports/high-risk-surgeries.

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[1] Any negative values for volume predicted mortality are reset to 0.0.
[2] Any total volumes reported as 0 will have their caseload reset to 1. This will result in a volume predicted mortality equivalent to the intercept derived from the MedPAR regression model.
[3] Any mortality cohort volumes reported as 0 are assigned a weight of 0. This will result in a predicted mortality equivalent to the volume predicted mortality.

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PERFORMANCE CATEGORIES USED IN PUBLIC REPORTING

A hospital's calculated Predicted Mortality for a procedure is rounded to the seventh digit after the decimal and then compared to set cut-points to determine the hospital's overall placement in a performance category which Leapfrog publicly reports. The cut-points used for determining the performance categories were derived from the MedPAR data and align the national sample of hospitals into equally-sized quartiles.

The predicted mortality rate cut-points used in 2016 for determining a hospital's placement in a scoring category, expressed as decimal rates, are as follows:

	Fully Meets the Standard	Substantial Progress	Some Progress	Willing to Report
Aortic Valve Replacement (AVR)	<= .0443859	> .0443859 and <= .0487388	> .0487388 and <= .0538113	> .0538113
Abdominal Aortic Aneurism Repair (AAA)	<= .0271855	> .0271855 and <= .0339777	> .0339777 and <= .0405741	> .0405741
Esophageal Resection (Esophagectomy)	<= .0871485	> .0871485 and <= .1039531	> .1039531 and <= .1163292	> .1163292
Pancreatic Resection (Pancreatectomy)	<= .0830336	> .0830336 and <= .1110198	> .1110198 and <= .1368581	> .1368581

On the Leapfrog Hospital Survey Results website http://leapfroggroup.org/compare-hospitals, a pop-up window for each Survival Predictor score displays the hospital's calculated predicted survival rate.

Important Note: The use of the above equations and input values was granted by the model developers (Drs. John Birkmeyer, MD, and Justin Dimick, MD, University of Michigan; and Dr. Douglas Staiger, PhD, Dartmouth) to The Leapfrog Group for use in the Leapfrog Hospital Survey. The use and application of these equations and input values by other entities requires the express written permission of the model developers.

ACCESS SCORING DETAILS FOR SURVIVAL PREDICTOR

1. Any hospital that has submitted a Leapfrog Hospital Survey with Section 3 EBHR completed can see the intermediate Survival Predictor calculations, as described on page 1 above, for those high-risk surgeries which are applicable for the hospital. These data are available on a secure basis to each hospital for its data only and are not included in the survey results that Leapfrog publicly reports.

    To access these intermediate calculations, users should login to the online survey using your hospital's 16-digit security code at survey.leapfroggroup.org. On the survey dashboard select "Details". The page that appears will display your hospital's intermediate calculations.

2. These details are updated monthly and coincident with Leapfrog's update of public results at http://leapfroggroup.org/compare-hospitals. The monthly updates typically occur by the fifth business day of the month following the (re)submission of a Leapfrog Hospital Survey. The date of the survey submission is indicated along with the data detail.

3. To understand the derivation of each of the intermediate calculations displayed there, refer to the scoring algorithm above.