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Eye of the beholder: Risk calculators and barriers to adoption in surgical trainees ☆☆☆

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ABSTRACT

Background: Accurate risk assessment before surgery is complex and hampered by behavioral factors. Underutilized risk-based decision-support tools may counteract these barriers. The purpose of this study was to identify perceptions of and barriers to the use of surgical risk-assessment tools and assess the importance of data framing as a barrier to adoption in surgical trainees.

Methods: We distributed a survey and risk assessment activity to surgical trainees at four training institutions. The primary outcomes of this study were descriptive risk assessment practices currently performed by residents, identifiable influences and obstacles to adoption, and the variability of preference sets when comparing modified System Usability Scores of a current risk calculator to a purpose-built calculator revision. Risk calculator comparison responses were compared with simple and multivariable regression to identify predictors of preferentiality.

Results: We collected responses from 124 surgical residents (39% response rate). Participants endorsed familiarity with direct verbal communication (100%), sketch diagrams (87%), and brochures (59%). The most contemporary risk communication frameworks, such as best-worst case scenario framing (38%), case-specific risk calculators (43%), and all-procedure calculators (52%) were the least familiar. Usage favored traditional models of communication with only 26% of residents regularly using a strategy other than direct verbal discussion or anatomic sketch diagrams. Barriers limiting routine use included lack of electronic and clinical workflow integration. The mean modified System Usability Scores domain scores were widely dispersed for all domains, and no domain demonstrated one calculator's superiority over another.

Conclusion: Risk assessment tools are underutilized by trainees. Of importance, preference sets of clinicians appear to be unpredictable and may benefit more from a customizable, bespoke approach.

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Introduction

Accurate surgical risk assessment is complex and hampered by psychological and cultural factors for both patients and surgeons. Although patients have difficulty understanding all-cause risks incurred with surgery,^{1–3} new work has also shown that surgeons have limited ability to utilize their knowledge and experience to provide a patient-specific risk assessment at the bedside. Experienced surgeons tend to overemphasize idiosyncratic factors specific to their practices;^{4–6} and surgical trainees tend to systematically overestimate risks for complex surgical patients.^{7–10} These risk assessment limitations may have clinical implications.

* **Data confidentiality:** P.E.W., A.C.W., and M.I.G. are the program directors for the general surgery residency programs at their respective institutions. Each made essential contributions to study design, interpretation of analyzed data, and critical manuscript revision, but they did not have access to the primary data to preserve anonymity of respondents.

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For example, the costs of inappropriate therapeutic decisions have been estimated to increase total costs of care by 20%.¹¹

Appropriate risk assessment may improve decision-making, but many common risk assessment tools are typically one-dimensional. The literature is filled with nomograms and other risk-prediction tools, but patients expect holistic approaches to the uncertainty after surgery and want to understand their comprehensive risk profile.¹² Newer tools, such as spectrum-based best-case and worst-case diagrams and all-outcome risk calculators, have been developed to address these limitations.¹³ One of the largest implementations of risk-based decision support is the American College of Surgeons' National Surgical Quality Improvement Program's (NSQIP's) Risk Calculator (RC). This tool has been shown to forecast more consistent and empirically valid assessments of complications for a broad range of general surgery operations.^{9,14} Enhanced use of RCs for patient communication, preoperative risk profiling, and targeted interventions may improve the care received by patients—particularly those with surgically complex disease or high-risk traits.^{8,15}

For a surgical trainee to master enhanced risk counseling with patients, they must understand the complications of surgery and effectively communicate with patients. The American Board of Surgery has recognized these precepts in the current Milestone Project, delineating core competencies of surgical education.¹⁶ Risk calculators and other forms of decision support offer important opportunities for residents to receive real-time feedback and assistance as their knowledge and communication abilities mature during the course of their residencies.¹⁷ However, no studies have reported the effective use of all-procedure risk calculators as part of training institution practice. The purpose of this study was to identify barriers to routine use of all-procedure RCs and assess the relative importance of current data framing as a potential barrier to adoption in surgical. We hypothesized that ease of access, workflow integration, and user-specific preferences would be major barriers to increased adoption of modern RCs. Identifying such obstacles to implementation would provide a roadmap for further RC development and innovation.

Methods

Study population and recruitment

We recruited residents from four US-based general surgery residency programs, including categorical residents, designated preliminary residents, and nondesignated preliminary residents. Each residency program sent two sequential recruitment E-mails to its own residents, with responses collected via a self-directed, internet-based questionnaire (REDCap, Nashville, TN). Responses and individual completion performance were masked from program leadership at participating institutions. The Johns Hopkins Medicine Institutional Review Board (Baltimore, MD) evaluated this study design and deemed it exempt from review.

Alternative risk calculator design

We created an alternative risk calculator (ARC) with the intent of addressing implementation hurdles observed at our own institution. Specifically, we aimed to achieve the following: (1) increased ease of use, (2) enhanced prioritization of outcomes, and (3) more detailed comparability between patient-specific risks and procedure-specific base cases (described later in this report). We used an iterative, purpose-driven design methodology and serially incorporated views of study authors and informal pilot testing with medical students. Because the underlying model for the NSQIP RC is proprietary and not shared publicly,^{18–20} we adopted the underlying algorithm for a previously described surgical RC that had

been validated against the NSQIP RC.²¹ We constructed a Web-based user interface (shinyapps.io, RStudio, Boston, MA) with real-time data visualization based on patient-specific factors meant to simulate a customized alternative to the existing NSQIP RC. Screenshots of this user interface are included as (eText 1).

This study intended to explore the benefit of various data visualizations in addressing the needs of various populations rather than the global superiority of one variant. We intentionally avoided demonstrating that one particular data visualization approach was superior to another. Therefore, we randomly renamed the NSQIP RC and the ARC as Risk Calculator #1 or Risk Calculator #2. The reported results intentionally conceal each calculator's identity to its assigned pseudonym.

Data collection and survey design

Part 1. Perceptions survey

All participants first completed a demographic questionnaire that included additional quantitative Likert-style and qualitative unstructured-response questions on one's typical risk-assessment practices. Specific components of risk assessment investigated were frequency of risk counseling, decision-making aid use and familiarity, and perceived burdens for increased use of existing RCs (eText 2). We also assessed respondents' general risk assessment knowledge as it related to common general surgery procedures and because early trainees frequently overestimate and underestimate surgical risk compared with prediction models.¹⁰

Part 2. Calculator-assisted risk prediction

After the demographic questionnaire, we instructed participants to complete two Web-based clinical vignettes related to the need for surgical counseling. We selected cholecystectomy and colectomy as the operative events to allow for a baseline familiarity across all residency years. In both activities, participants first completed a hypothetical risk assessment with a preoperative consultation with minimal patient-specific risk factors and then completed a second, high-comorbidity variant of the vignette (eText 3). We presented participants with the vignette and then asked them to use a provided RC to gather information that they would then use as part of a risk-counseling discussion with the patient. No data were collected to evaluate how participants would structure these conversations because the focus on this part of the study was one's conceptualization of his or her risk assessment, not the accuracy of the risk estimate.

We clustered randomized participants by program, with half of the programs completing the vignette activity with the NSQIP RC first and then the ARC; the other half of participants completed the vignette activity with the ARC first and then the NSQIP RC. Participants were informed before starting the exercise that they would ultimately use two RCs with each vignette and be asked to compare the usability of each to achieve their risk counseling goals.

After performing the vignette-based task, participants completed a modified System Usability Scale (mSUS). The original System Usability Scale provides a global subjective assessment of usability with a ten-item attitude Likert scale.^{22,23} We rephrased the original scale to apply it in a direct comparison context between the NSQIP RC and the ARC as described earlier in this report (modified scale in eText 4). Then, we recentered scoring for each mSUS domain on a visual analog scale to reflect a score of -50 to indicate strong preference for Risk Calculator #1, 0 being neutral between both calculators, and +50 to indicate strong preference for Risk Calculator #2.

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