

Numeracy Among Trainees: Are We Preparing Physicians for Evidence-Based Medicine?

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INTRODUCTION: In the era of evidence-based medicine, all physicians who communicate with patients need numerical literacy (numeracy). Single-institution studies suggest imperfect numeracy among medical students. Therefore, we sought to examine numeracy and understanding of risk analysis among medical students and surgical residents at several institutions.

METHODS: Following a validated 3-item numeracy questionnaire, 308 medical students and 50 surgical residents from 4 institutions were asked whether they would recommend adjuvant chemotherapy for a patient based on presented survival data. Main outcome measures included numeracy, understanding of risk with a question requiring simple calculation of risk reduction, and confidence in understanding risk reduction using a Likert score (0 = no confidence and 7 = complete confidence). Binary logistic regression analysis identified predictors of misunderstanding of risk and Pearson correlation coefficients measured differences in confidence by level of training and numeracy.

RESULTS: Students across institutions did not differ demographically and were grouped by educational level. Of all participants, 69.0% had perfect basic numeracy (score = 3), with no significant difference in numeracy across training levels ($p = 0.433$). Mean (standard deviation) confidence in recommending treatment increased from 4.5 (1.6) for first-year medical students to 4.8 (1.1) for fourth-year medical students, and 4.9 (1.5) for surgical residents ($p = 0.580$). Controlling for

other demographics, poorly numerate students had a 7-fold increased likelihood (odds ratio: 7.330; 95% confidence interval: 1.384-38.809) of misunderstanding risk compared with more numerate students.

CONCLUSIONS: A significant number of students at various levels of medical training lack numeracy skills, which increases misunderstanding and miscommunication of risk that can be communicated to patients and families. This deficiency could potentially affect patient safety and care. (J Surg 71:211-215. ©2014 Published by Elsevier Inc. on behalf of the Association of Program Directors in Surgery)

KEY WORDS: medical students, medical education, numerical health literacy, decision making, risk assessment

COMPETENCIES: Patient Care, Practice-Based Learning and Improvement, Systems-Based Practice

INTRODUCTION

Shared decision making involves the communication of risk and benefit between physicians and patients using quantitative clinical data. Given the increasing prevalence of numerical information in clinical settings, several studies have investigated patient numeracy.¹⁻⁴ However, physician numeracy has gone understudied. Unlike written health literacy,^{5,6} even highly educated samples exhibit innumeracy.⁷

Three studies raise the potential problems associated with innumeracy among physicians.⁸⁻¹⁰ In 1999, Estrada et al.¹⁰ reported that almost half of the attendees at medical grand rounds lacked complete numeracy. In 2002, Sheridan et al.⁸

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reported that nearly 25% of entering medical students at a single institution had imperfect numeracy skills. In 2003, Chao et al.⁹ reported that the method of communicating survival benefit affects students' understanding of risk. These findings reinforce prior observations that medical students, and possibly by extension physicians, may not fully grasp risk reduction statistics.

However, their study samples were from a single institution and respondents were in the same year of medical school, thus precluding definitive conclusions. Additionally, and most importantly, the potential relationship between innumeracy and understanding of risk was not explicitly assessed. We sought to evaluate the numeracy of medical students across multiple institutions, focusing on changes in numeracy and subsequent understanding of risk evaluation as students gain exposure to evidence-based medicine.

METHODS

Study Population

We conducted an online survey examining numeracy and understanding of risk. We invited medical students and residents from 4 institutions to participate. Institutions were public and private, representing a large geographic area in the United States. The Emory University Institutional Review Board approved this study.

Numeracy

Following a series of demographics questions, participants self-administered the Schwartz-Woloshin 3-item numeracy tool, a reliable, validated instrument frequently used in numeracy studies.¹ This instrument poses the following 3 questions: (1) Imagine we flip a fair coin 1000 times. What is your best guess about how many times the coin would come up heads in 1000 flips? (answer: 500 times); (2) In the BIG BUCKS LOTTERY, the chance of winning a \$10 prize is 1%. What is your best guess about how many people would win a \$10 prize if 1000 people each buy a single ticket to BIG BUCKS? (answer: 10); and, (3) In the ACME PUBLISHING SWEEPSTAKES, the chance of winning a car is 1 in 1000. What percent of tickets to the ACME PUBLISHING SWEEPSTAKES win a car? (answer: 0.1%)

Assessment of the Ability to Interpret Risk Reduction Data

Students were then asked to read a clinical cancer vignette (Appendix 1). This vignette revolved around a patient deciding whether to accept adjuvant chemotherapy for bladder cancer. This vignette was designed by a team of medical and surgical oncologists, a senior medical student, and a statistician and was modified from the vignettes employed by Chao et al.⁹

Students were provided risk reduction data in 4 commonly used formats that are increasingly used in the medical literature: relative risk reduction, absolute risk reduction, absolute survival benefit, and number needed to treat. Students were then asked a question each to assess comprehension of risk reduction from adjuvant chemotherapy. Participants were then asked a question each to assess confidence in understanding of risk reduction. Confidence was measured with a Likert score ranging from 0 (no confidence) to 7 (complete confidence).¹¹

Outcome Measures

The primary outcome measure of this study was numeracy, as measured by the Schwartz-Woloshin numeracy tool. Secondary outcome measures were comprehension of risk reduction and confidence in comprehending risk reduction.

Statistical Analysis

Descriptive statistics were used to describe the population. Multivariate binary logistic regression analysis was done to evaluate the relationship among student characteristics, numeracy, and comprehension of risk reduction. Pearson correlation coefficients were used to assess the relationship between scenario comfort and both year in training and numeracy score. Statistical analyses were conducted using SPSS, version 16.0 for Mac.

RESULTS

Our population consisted of 308 medical students and 50 surgical residents from 4 institutions (Table 1). Respondents were 50.0% male and 77.2% were Caucasian, with a mean (standard deviation [SD]) age of 25.0 (3.9) years, ranging from 20 to 43 years. More than two-thirds of respondents received either a mathematics or science undergraduate degree. Students across institutions did not differ demographically. As a result, students from different institutions were combined into groups based on years of education.

Participants were asked to self-administer the 3-item Schwartz-Woloshin Numeracy Test. Most (69.0%) participants accurately answered all 3 items (complete numeracy) (Fig. 1). However, only 1 in 5 (21.9%) answered 2 of the 3 questions correctly and just 7.5% answered 0 to 1 questions accurately. Although the percentage of participants with numeracy scores of 0 to 1 appeared to decrease with increasing training, this trend was not statistically significant ($p = 0.433$).

Multivariate analysis was conducted to identify predictors of inaccuracy in risk reduction (Table 2). Of the demographic and educational variables measured, only numeracy was significantly predictive of understanding of risk. Participants with a numeracy score of 3 had a 7-fold (odds ratio: 7.330; 95% confidence interval: 1.384-38.809) increased chance of accurate risk calculation compared with participants with a numeracy score of zero.

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