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INVITED COMMENTARY

Collective Statistical Illiteracy

The article by Galesic and Garcia-Retamero reports that a probabilistic sample of Americans and Germans could answer only two-thirds of simple statistical numeracy questions correctly. The most difficult task was to express 1 in 1000 as a percentage (question 3), which only 24% of the Americans and 46% of the Germans mastered. Furthermore, the answers reflected wider disparities between poor and rich and between less educated and higher educated respondents in the United States than in Germany. For US citizens with less than a high school education, only 40% of the questions could be answered correctly (compared with 83% for those with a college education or higher), whereas, for Germans, these percentages were only 62% and 81%, respectively. This disparity may reflect not only the stronger emphasis on math and science education in Germany but also the different attention their media pay to science. Unlike the United States, Germany has seen a boom in science journalism during the past decade, with newspaper science sections increasing by 50% and reporting on science outside of the regular sections by even more than 100%.[1]

What do these results tell us about medical decision making? First, one might object that the results are limited to the specific panels of households sampled by the two survey companies and to the use of nonmedical content such as the Bingo Lottery (question 2) and the Daily Times Sweepstakes (question 3). On the other hand, a national sample of 450 US adults aged 35 to 70 years that used the same basic numeracy questions but with medical content—allergic reactions from a drug—found similar results in terms of correct answers for questions 1 to 3 in Galesic and Garcia-Retamero's statistical numeracy scale.[2]

Limited basic numeracy would not matter so much if all physicians were able to explain to patients what the percentages mean, assuming they have the time. Physicians indeed score better than the general public in basic numeracy; of 85 physicians at Dartmouth-Hitchcock Medical Center in Lebanon, New Hampshire, 100%, 91%, and 75%, respectively, correctly answered questions 1 to 3.[2] However, the flip side is that 25% of the physicians could not correctly convert 1 in 1000 into a percentage.

For both patients and physicians, understanding health statistics involves more than basic numeracy. In a European-wide study with more than 10 000 face-to-face interviews, 92% of women overestimated the cancer-specific mortality reduction of mammography screening by an order of magnitude or more, or did not know.[3] Similarly, 89% of men overestimated the benefit of prostate-specific antigen screening. For instance, 27% of British women believed that, among 1000 women who participate in screening, 200 will be saved from dying of breast cancer. The randomized trials, in contrast, suggest a reduction from about 5 to 4 in 1000 women.[4] One possible source for this overestimation is the common framing of this absolute reduction as a 20% relative risk reduction, which

many appear to interpret as 200 of 1000 women. Many physicians are also fooled by relative risk reductions. For instance, one-third of 150 gynecologists whom I trained in risk communication as part of their continuing education had never previously understood what "a 25% reduction of breast cancer mortality by mammography screening" means. Most of them believed that 25 or 250 fewer women out of every 1000 will die.[2] This example points to a second factor besides limited basic numeracy: the choice of nontransparent framing of health statistics, which is sometimes intended to manipulate or persuade patients. In such cases, asking one's physician for clarification may be of only limited help.

The inability of many physicians, patients, journalists, and politicians alike to understand what health statistics mean—often without recognizing their inability—has been called *collective statistical illiteracy*.[2] The problem has been noted since statistical information entered medicine, but most medical schools still fail to teach prospective physicians how to understand health statistics and how to communicate these in a transparent way to patients.[5,6] Shared decision making is a beautiful democratic ideal, but collective statistical illiteracy guarantees that it remains an unreachable dream.

What to do? I believe there are 3 steps. First, all medical schools need to begin to train their students in risk literacy, including transparent ways to communicate health statistics efficiently to patients. Proposals for such curricula exist.[2,5,6] Second, we need incentives for complete and transparent reporting of health statistics in journals, pamphlets, and advertisements. For instance, an analysis of *BMJ*, *JAMA*, and *The Lancet* from 2004 through 2006 showed that, when both benefits and harms of interventions were reported, 1 in 3 studies reported benefits in big numbers (eg, as relative risk reductions) but harms in small numbers (eg, as absolute risk increases).[7] Editors of medical journals must lead the effort to call for complete and transparent statistical reporting so that numbers are clear to journalists and the public. Finally, we need to change school curricula. Our children learn the mathematics of certainty, such as geometry and trigonometry, but not the mathematics of uncertainty, that is, statistical thinking. Statistical literacy should be taught as early as reading and writing are.

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