Perspectives in Medical Humanities

The Art of Evidence and the Morality of Medical Decisions

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Abstract

This essay looks at epistemological challenges to the tenets of evidence-based medicine (EBM) by focusing on some of the ways that statistical data is presented as evidence. Using a framework from the history quantification and digitization in biomedicine, I discuss the uses of the "graphic method" and the status of producing pictures from numbers. The essay draws attention to the complicated relationship between statistical representation within EBM and the way risk factors are communicated in the physician-patient relationship for decision-making. The essay questions the position of morality underlying the art of evidence.

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Introduction

Dr. Thomas Newman is a professor of clinical epidemiology and pediatrics at the University of California, San Francisco, who specializes in the study of neonatal jaundice. He is an expert in a disease called kernicterus, which means "yellow kern," referring to the discolored appearance of parts of the brain revealed at autopsy. It is caused by hyperbilirubinemia, an excess of a chemical compound that also causes the yellowish halo to form around bruises. That the name of the condition was derived from morbid anatomy suggests the severity of its neurotoxicity.

The frequency of the disease seems to have hit a trough after a peak in the 1950s and 1960s, only to reemerge in the 1990s. However, it was at this unfortunate time that Dr. Newman and his colleagues had been suggesting that jaundice in newborns was being overtreated. In a commentary published in the *British Medical Journal*, Dr. Newman expressed concern that his opinion might

have led to clinical oversight in such cases.[1] However, a statistical correlation is unlikely. The disease is extremely rare. A registry of kernicterus cases in the United States that was maintained between 1984 and 2002 recorded 125 babies diagnosed with the condition, five of which died from it. Newman states that a Kaiser Permanente database shows no cases out of 239,000 births during the 1990s.

But in 2000, seven mothers whose children had been diagnosed as having kernicterus formed PICK (Parents of Infants and Children with Kernicterus), an advocacy group that promotes awareness, prevention, and treatment of the disorder. (Sheridan, 2005) Since kernicterus was linked to high levels of bilirubin, they wanted the American Academy of Pediatrics to recommend that all newborns have a blood test to screen for risk before they were discharged from the hospital. Newman, a physician, a specialist in the field, and an expert witness in malpractice cases relating to this issue, wrote about how much he admired those women who were "heroically fighting to prevent an awful disease," but he hesitated to join their crusade. "I am a proponent of evidence-based medicine," he explained, "and am reluctant to endorse a new screening recommendation that is not based on good evidence."[2] The problem, suggestive of a moral dilemma in the practice of modern medicine, was that the experiences these women had did not amount to enough (or the right kind of) evidence to take medical action.

The power of narrative, as Dr. Newman as well as media pundits, political strategists, and novelists recognize, is beguiling. However tragic and heartbreaking an individual's experience is—and an emotional chronicle of them is archived on PICK's web site—they do not meet the rigors of EBM. As the oft-quoted aphorism asserts, "the plural of anecdote is not data." Stories are emotive, and they often distort the way people estimate probabilities. As Newman wrote, "if we are trying to estimate the risk of kernicterus, one method we use is to base the estimate on how readily we can recall or imagine a case, and in what level of detail. This technique, called the availability heuristic, leads us to overestimate probabilities of events that we can easily and vividly imagine."[3] In essence, clarity of expression correlates with persuasiveness.

It is no small irony (and subject of rhetorical analysis) that Western science has relied on enumeration instead of narration to gain credibility.[4] There is further irony in the fact that a key technique for representing the data used to underwrite evidential claims is itself subject to the same strictures as story-telling. Precisely owing to the complexity of statistical investigation, the "graphic method" is employed to produce succinct snapshots of its results.

1. Newman, "The power of stories."

2. ibid., p. 1425.

3. ibid., p. 1426.

4. Gross, *The rhetoric of science*.

As stated in a recent article in the *Journal of Clinical Epidemiology*, which examined the uses of graphs in medical publications, "Often, a graph is a more attractive presentation format than text or tables. … There is evidence of a substantial advantage in recall for graphical over textual information."[5] For this reason, physicians are increasingly encouraged to use the graphic method to discuss risk assessment to their patients about life and death decisions. The beauty of graphs is the allure of their simplicity. Logically, the same critical lens should be used to scrutinize the construction of graphs themselves, just as philosophers of language examine semiotics and "language games."[6] In short, the art of evidence that is deployed in the process of making moral decisions cannot be taken for granted.

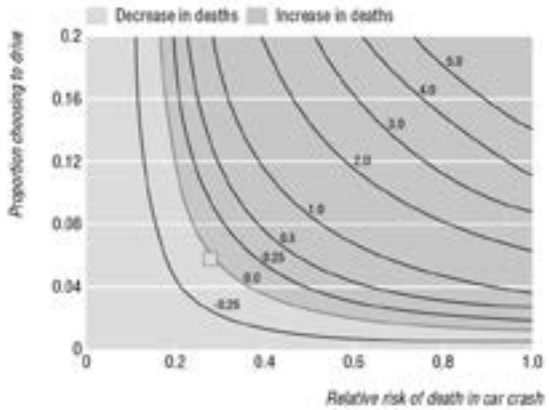
The graphic method is a multifaceted approach to producing pictures of numbers. It can be similar to the line graph that Newman reproduced which illustrated his own statistical projection of mortality from car crashes[7] (Fig. 1) or something like the smiley-face portrayal of risks for certain therapies (Fig. 2).[8] The magnificence of graphs is that they appear so simple, and, as anthropologist Bruno Latour pointed out, that they are conveniently flat. A graph represents information that can be moved around easily. It can be printed in the space of a few square inches. And from the time the late eighteenth-

5. Puhan, et al., "More medical journals," p. 1017.

6. Salehi-Nejad, *Wittgenstein and language games.*

7. Newman, "The power of stories," p. 1426.

8. Edwards, et al., "Explaining risks," p. 829.



Estimated numbers of deaths per year in the United States that could be caused or prevented by a regulation requiring safety seats on commercial aeroplanes for children <2 years old, as a function of the proportion of families choosing to drive and their relative risk of death (per 100 million vehicle miles travelled) compared with the US national average. Square indicates the base case estimate, in which the relative risk is about 0.3; the policy will lead to a net increase in deaths if more than about 6% of families choose to drive

Fig. 1 from *BMJ* (Newman 2003)

Fig 2 Portrayal of risks and benefits of treatment with antibiotics for otitis media designed with Visual Rx, a program that calculates numbers needed to treat from the pooled results of a meta-analysis and produce a graphical display of the result

Fig. 2 from *BMJ* (Edwards 2002)

century, when the Scottish political economist William Playfair first recognized their utility, statistical "information may be obtained in five minutes as would require whole days to imprint on the memory, in a lasting manner, by a table of figures."[9] The immediate impression they make on the mind and memory make them powerful. But what exactly is it that impressed upon the mind? Ironically, as the Yale statistician Edward Tufte showed in his work on the aesthetics of statistics, if one sits down and closely examines the uses of graphs as a mode of communication, they often do not assist anyone in "envisioning information."[10] Inspired by the poignancy of Tufte's analysis, the philosopher of science Ian Hacking wondered "whether the point of the representations is to convey information at all, or rather to convince us that this is solid stuff, not to be challenged, not challengeable."[11]

Graphs are in-your-face statements of (ostensible) fact. As such, they often feature in professional disputes *about* facts. When alleged to be worth no more than the paper they are printed on, graphs become points of departure for scientists who venture into laboratory spaces in order to examine the process by which such inscriptions were produced. Sociologists of science such as Latour, Steve Woolgar, among others, have invited us to "follow" scientists into such arenas where claims about the signified are reasserted through new means, where instruments rather than their inscriptions are scrutinized.[12] In statistical representation there is a certain amount of "black-boxing" that occurs which is difficult to illuminate. Like the original, literal, "black box"—the apparatus called a hemostat developed by British scientist W. Ashby Ross in the 1950s—the point of the process is to turn all inputs, however many and variable, into a single output.[13] (Fig. 3) The figurative act of black-boxing refers to the act of taking complex preparations and packaging them in a way for presentation that appears simple and elegant. The process renders invisible the raw material and

9. Wainer, "Graphical visions."

10. Tufte, *Visual Explanation*; Tufte, *Beautiful evidence*; Tufte, *Envisioning information*.

11. Hacking, "Matters of graphics."

12. Salk, Latour, and Woolgar, *Laboratory life*.

13. Pinch, "Opening black boxes."

Fig. 3 The original "black box." From *Social Studies of Science* (Pinch 1992)

construction that went into producing the result, and as such defers attention from *how we got here* to *what we have*. But putting aside the issue of how numbers can be manipulated and how impractical in certain circumstances it would be to revisit hundreds of informatics labs to reexamine calculations—that is to say the means of production that give value to the graph—I wish to focus on the problems of interpreting the final product.

Acts of interpreting the final product—assessing the meaning and value of a graphical chart, for instance—in this story differ from assessing the value of information based on the character of who delivers it. The latter is an analysis familiar to us through the work of sociologist of science Steven Shapin, who charts how over centuries the honesty ("gentlemanliness" in early-modern days) of a scientist determined the public credibility of their knowledge and statements.[14] My attempt here is to find a way of examining what is taken as evidence when making decisions that are informed by interpretations of pictures of data. Beyond rearticulating the message of the psychologist-sociologist Robert M. Young that "science is social relations," meaning both its process and product are socially shaped, I examine the way the "epistemic system" works to remind us of the important point that theories as well as practices are value-laden.[15] Even a "closed system" of logic such as mathematics—the language of science—is value-laden. "Of" science—with that genitive, mathematics becomes an instrument, and as an instrument of analysis and representation its uses need to be thoughtfully considered. The first moral decision with regard to evidence (mathematical or otherwise) is how to present it.

14. Shapin, *Social history of truth*.

15. Rheinberger, *Toward a history of epistemic things*; Young, "Science *is* social."

The value of numbers

The UCLA professor of history of science Theodore Porter informed us some time ago that "The credibility of numbers … is a social and moral problem."[16] Things seem to gain significance when there are numbers behind them. Not much is thought of the value of zero. Yet zero—a sign that represents nothing—is immensely important. It is where counting necessarily begins. It is the foundation of statistics. It would mean the world to someone to be told they had zero chance of getting sick. But zero does not correspond to anything: by that I mean it does not (cannot) represent nothing. Semioticians such as Brian Rotman have enjoyed demonstrating that never-the-less meaning is made of the value of nothing, the sign that stands in place of the invisible.[17] It is a fundamental point in philosophy, and a concept that mattered to Nietzsche. Truth, he says, is what happens when the illusionary nature of illusions is forgotten. What seems to me to be pertinent about the semiotics of numbers is

16. Porter, *Trust in numbers*.

17. Rothman, *Beginnings count*.

that it gives us a way into the conceptual world where symbols that are assigned "value" take on literal currency in moral, political, and fiscal economies.

Similar to zero, there is an illusory nature to probability—where statisticians run numbers against imaginary complete data sets, for instance. To bolster evidence-based medicine, meta-analyses are used to aggregate the results of underpowered individual studies that are individually incapable of drawing positive conclusions.[18] It is an interesting way of speaking on behalf of the unspeakable. The selection of data to be analyzed and the choice of statistical tests are critical to such acts of quantitative synthesis and sometimes the results of "meta," as opposed to individual, clinical trials are interpreted wildly differently.[19]

18. Sterne, et al., "Publication and related bias"; Turner, et al., "The impact of study size."

19. Kirkwood, et al., "Use and abuse of statistics."

This is not a condemnation of statisticians or their work. I suggest that regardless of the reality behind the representation, we need to pay attention to how users interpret results. It is the epistemological question: not *what* we know but *how we come to know* it. Before we get to action (administering doses, screening for risk, etc.), we need to focus on the moment of understanding, because that is what determines decision making. The experimental evidence—the diagram, the picture—that works to allow facts "to speak for themselves" and establish scientific credibility does not speak for itself. Contrary to the position taken by Enlightenment *philosophes* that there are truths to be taken as "self-evident," by suggesting that nature speaks for itself, nothing is self-evident and moral principles are established through informed action.[20]

20. Schaffer, "Self-evidence."

Scientific evidence is not merely descriptive. It does not create a portrait of reality. Scientific evidence is a set of instructions about how to look at reality. Statistics and graphs do not provide answers, they stimulate the very questions to be answered. Mathematical proofs themselves, as Brian Rotman pointed out, are injunctive: "define A, compute B, consider C …" The logic of mathematics allows one to venture into another world. "Mathematics creates imaginary worlds," writes Rotman, "brought into being and controlled through the agency of specialized signs."[21] Another virtual reality. But it is in such a space that the future is imagined, where meaning is made through the art of evidence.

21. Rotman, *Beginnings count*, p. 14.

The slippery slope

Here is an anecdote from a physician's autobiography.

> One day when I was a junior medical student, a very important Boston surgeon visited the school and delivered a great treatise on a large number of patients who had undergone successful operations for vascular reconstruction. At the end of the lecture, a young student at the back of the room timidly asked, 'Do you have any controls?' Well, the great surgeon drew himself up to his full height, hit the desk, and said, 'Do you mean did I not operate on half of the patients?' The hall grew very quiet then. 'Yes, that is what I had in mind.' Then the visitor's fist really came down as he thundered, 'Of course not. That would have doomed half of them to their death.' God, it was quiet then, and one could scarcely hear the small voice ask, 'Which half?'[22]

22. Tufte, Beautiful evidence, p. 145.

The legalistically labeled concept of "evidence-based medicine" has generated a new kind of consciousness in biomedical practice. EBM declares that it is important to think about how decisions are made. The phrase is really phenomenal. Evidence based … on what? Research. Collecting the evidence shows that one is aware that someone else has thought about a problem and reached some conclusions. The phrase means also that "medicine"—as both a practice and a product—has evidence of its own development. It is not *sui generis*, but constitutive of a history of research. Understanding the complexity of that research and the means by which the results of it are represented can help give meaning to EBM, for there is nothing self-evident about the evidence upon which medicine is based, or the research upon which the evidence is based.

Since the publication in 1954 of Darrell Huff's insightful book *How to Lie with Statistics*, notice has been made of the different ways that data can be manipulated for various ends. "The secret language of statistics," he writes, "so appealing in a fact-minded culture, is employed to sensationalize, inflate, confuse, and oversimplify."[23] Neither the data nor the designer of the results need to actually "lie"—an accurate graphic representation of the statistics might still mislead the reader. A classic example is in the use of the visual slope used in line graphs. (Fig. 4)

23. Huff, *How to lie*, p. 10.

The information presented in each graph in Figure 4 is the same, as is the "curve." Nothing is falsified, yet a glance at them could easily mislead the

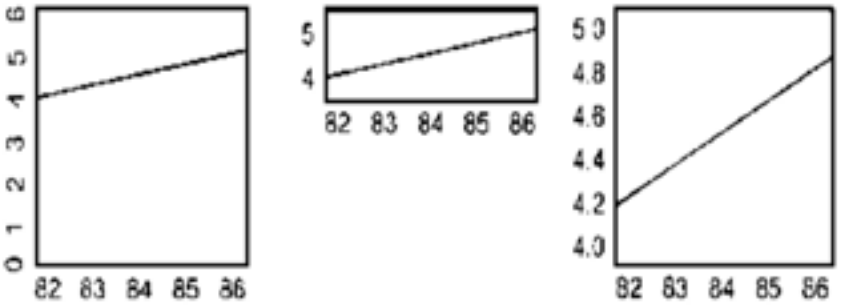


Fig. 4 "Flattening the curve" by changing the frame but not the data.

reader, or be easily misinterpreted. While a thoughtful look at the ordinate and abscissa of each graph would help clarify the relationship between the data, graphs are meant to present information quickly, not requiring meditation. While much attention to has been given to the use of manipulative graphic techniques, especially in advertising, political campaigning, etc., the act of misleading readers might not be intentional.[24]

The issue is that graphs are often meant to stimulate action. Risk graphs, for instance, are meant to inform readers of an absolute risk (X amount of radiation causes cancer), or relative risk (Y amount of cigarettes each day has an X chance of causing cancer). Studies show that the location of a risk on a graphic risk ladder was more important than the numbers involved. Graphs also make people more risk averse.[25]

One would not think that graphs published in articles in medical journals would intentionally mislead—and I am not suggesting malicious intent in the following examples—but graphs are nonetheless subject to misinterpretation. Consider a study that examined how patients interpreted survival graphs relating to outcomes of disease treatments. (Fig. 5a, b, c) When

24. Wainer, "Graphical visions."

25. Lipkus and Hollands, "The visual communication of risk."

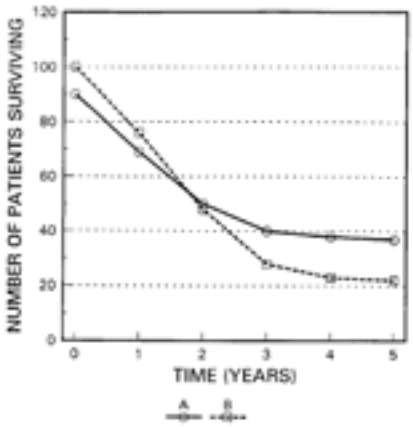


Fig. 5a

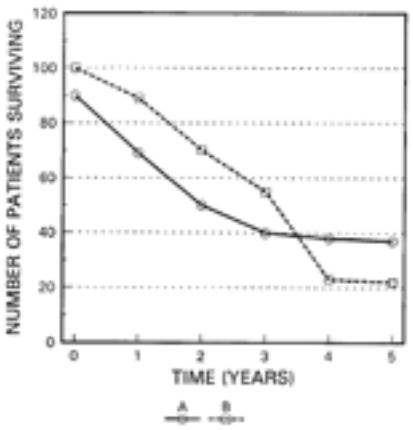


Fig. 5b

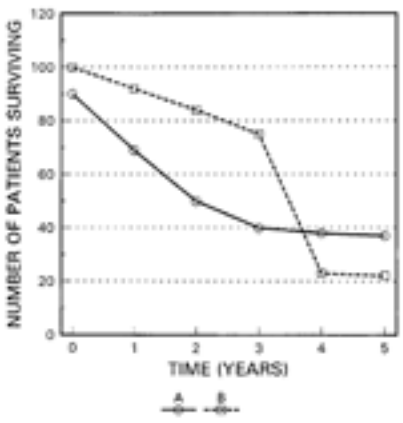


Fig. 5c

shown three different survival charts corresponding to two different treatment options (treatment A and B), physicians and patients were independently asked to decide based on year-by-year survival rates over five years. The only difference between the charts was the amount of space under each curve, representing major differences in outcomes during first four years of treatment. The result was that patients were consistent with their decisions for one treatment when presented with each graph, with 67% (of 119 patients in the study) opting for the treatment with better long-term, but worse short-term, survival rates. The authors of this study concluded that "A graphic survival curve appears to provide enough information to assess patient preferences between two alternative treatments." When asked what information in particular they learned from the graph, the authors reported that "Patients appeared to differ from physicians and medical students in their interpretation of the curves."[26]

26. Mazur and Hickam, "Interpretation of graphic data."

On the other hand, the majority of patients and medical students (62% of 110 participants) changed their mind as to what they would recommend for patients when comparing the three graphs. One possible reason for this is that physicians were more concerned with average life expectancies than patients, who seemed focused on endpoint results ("endpoint" being the five-year mark in the graph). But overall what was revealing about the study was that—despite the same beginning markers and endpoints in each graph—physicians appeared more comfortable than patients in basing their recommendations on different aspects of the curves over time. It suggested that patients and physicians focused on different parts of the same picture.

What was particularly relevant about these findings was that physicians were at this exact moment being advised to use graphs as an effective way to communicate with their patients about life decisions.[27] Assumptions about the efficacy and utter simplicity of the graphic method were prevailing. In fact, this served two functions: first, it promoted physician-patient communication with the intention of encouraging the patient to make decisions about their future instead of the doctor. This is referred to as "participatory decision making," and is a feature of modern health care.[28] Second, it was another way that doctors could demonstrate their commitment to EBM, incorporating such reports into their everyday clinical practice. In effect, the clinical encounter would be something like: you have a difficult decision to make about alternative therapies, here is statistical evidence regarding respective outcomes to help you decide. Eliminating undocumented clinical judgments based on "intuition," such an episode captured the spirit of twenty-first century, personalized, evidence-based medical practice. No more ex cathedra statements about the natural order of

27. Covey, "A meta-analysis"; Naylor, et al., "Measured enthusiasm"; Wegwarth, et al., "Deceiving numbers."

28. Epstein, et al., "Communicating evidence."

things derived from incommunicable experience. Physicians now present the evidence upon which they based their recommendations for action in graphic form. (Although some have argued that while many patients want to be part of their healthcare decision making, most do not want to assume the burden of decision-making.[29])

What about the tendency of graphs to be mis- (or variously) interpreted? The decision now for the physician is which graph to present, and how to present it. Another study showed that attention to details such as consistency of graph design might help reduce confusion among physicians and patients alike. Researchers from the University of Michigan found that people misinterpreted survival rates when comparing two graphs of the same physical size where one depicted a five-year survival curve while the other depicted a fifteen-year survival curve. The study concluded that "people often fail to appropriately adjust the risk perceptions they derive from viewing survival curves to account for different lengths of time displayed."[30] This is a significant misinterpretation, the solution to which is not necessarily a matter of asking readers to be more careful.

Psychological data suggests that there is a "cognitive bias" in viewing data that is presented in certain ways. Therefore, perhaps one step to take towards fixing the problem is to suggest that publishers standardize graphic design, the way bio-ontologists have worked on standardizing biomedical nomenclature.[31] For instance, standardize the spacing used to denote units of time. This would mean that the graph depicting fifteen-years would be three times as long as the five-year graph. Interestingly, there is practically no standardization of the graphic method for publication in medical journals. In fact, in 2003, a look at 120 core clinical journals that are catalogued in PubMed showed that only 6% offered author guidelines to the preparation of graphs. That is to say, 94%, or 113 journals, left it entirely to the author's discretion. (In 2000, JAMA appointed its first graphs technical editor with the responsibility of examining graphic content.)

There may be no intention to mislead readers of graphs, but graphic designers, like the statisticians who crunch numbers, are nevertheless full of intentions with regard to the production of data. What needs to be more carefully examined is the relationship between information and evidence, the latter of which is not only subject to interpretation (as is everything), but is artfully produced.

29. Schneider and Schneider, *The practice of autonomy*.

30. Zikmund-Fisher, et al., "A matter of perspective."

31. Smith, et al., "Relations in biomedical ontologies."

Suggestive data

There are a number of problems with the need to rely on evidence to inform judgment. First, there may be no evidence. Data may be "suggestive, but not diagnostic" (or sufficient). Second, evidence may contradict the point one wishes to make or the action one desires to stimulate. Third, there is too much evidence to organize or access. As one medical researcher agonized, "to keep abreast with the continuously increasing number of publications in health research, a primary health care professional would need to read an insurmountable number of articles every day covered in more than 13 million references and over 4800 biomedical and health journals in Medline alone."[32] Information overload relates to crisis. It is what crashes the system. Information overload might be the schizophrenic condition that poses the biggest challenge to the tenets of evidence-based medicine. This is where graphs come in. So in 2006 she published a brief "practical guide" to interpreting and understanding meta-analysis graphs. (Fig. 6)

32. Ried, "Interpreting and understanding."

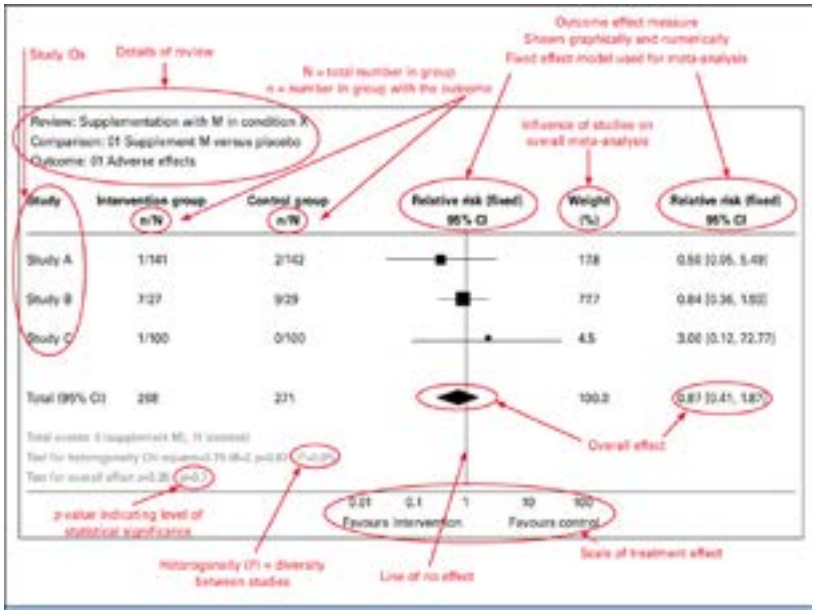


Fig. 6 from *Australian Family Physician* (Reid 2006)

These instructions on how to read the graphs (or are they tables?) are helpful, but underdetermined. There is more to it. In his 1990 book *Envisioning Information*, Edward Tufte, professor of political economy and statistics at Yale University, already wondered about the ability of members of the information age—"we"—to exist in information-thick worlds. He asked: "Doesn't data

have to be 'boiled down' and 'simplified'?" The answer happens to be yes, but he complains that the question—which he posed apparently on behalf of an imagined bewildered spectator of the times—misses the point that he wants to make. The point is that "the quantity of detail is an issue completely separate from the difficulty of reading. *Clutter and confusion are failures of design, not attributes of information*."[33] In other words, information overload is merely a condition that a good model of information management can fix. It is all about presentation.

33. Tufte, *Envisioning information*, p. 51.

For Tufte, there is nothing to fret about. However complex, the world is representational, and humans turn out to be masters of inscription, capable of selecting and editing out irrelevance to find order. (Tufte seems to think that there is a natural order that is revealed when one looks at it with the right chart, rather than imagining that such an order is a product of the design of the chart.) "Simplified" data is not a manipulation of this reality—the really complex world that is our context—but the right way of looking at the world. An inability to frame beautiful data, the inability to edit out nonsense to get that clear picture, is what renders a sense of information overload. Confusion, and therefore uncertainty, is not a reflection of the world's complexity, but a pathological state of being. It is a symptom of one's inability to edit information. His theory, as Lawrence Schehr has pointed out, is reminiscent of the anthropologist-cyberneticist Gregory Bateson's etiology of schizophrenia. In this world view, the relatively few people who are victims of a "double-bind," whereby they receive contradictory bits of information or messages that they internalize and grow incapable of sorting out, stuck in a state of confusion and undecidability.[34]

34. Schehr, "The last straw."

What makes Tufte particularly pertinent to a discussion about evidence-based medicine is that the form of communication that he analyses is so central to what constitutes "evidence" in modern medicine—the presentation of statistically-informed research. Unlike most logical positivists, post-structuralists or deconstructionists who have argued from both sides of the nature/representation divide but who share concerns to analyze the power of narrative, Tufte took on the challenge of examining how the graphic method is used to communicate matters of fact about the world.

Tufte actually says very little about medicine, but I think his analysis of the graphic method is usefully applied to the study of how biomedicine produces evidential statements. What is particularly revealing, if also somewhat disturbing, is that it appears the majority of statistical evidence presented in published biomedical research would be quarantined by Tufte for being pathological. This matters not because Tufte's theory of reality or representation

is at issue, but because it raises questions about how evidence is constituted, interpreted and eventually used to make medical decisions.

The morality of mental shortcuts

Evidence is never an end in itself but is suggestive of a course of action. Moral conduct in medicine—the morality of decision making—is not reached by appealing to evidence. It emerges in the acts of interpretation of what evidence means. Graphs that represent research only have value when they are integrated into a system of currency that defines its value.

A challenge to using well-designed statistical data which prevents it from having maximum value is that it is terribly boring. Biased studies produce much more interesting results. Dr. Thomas Chalmers, pioneer of meta-analysis and anointed father of evidence-based medicine, knew this. He coded a number of reports on medical techniques and demonstrated a correlation between how well a randomized control study was designed and the "enthusiasm" over its findings. He discovered that in well-designed studies, there was *zero* enthusiasm for the findings.[35]

In a world of digital data mining, the graphic method gives the impression of order and simplicity where none may exist. Original research is chaotic; it traces the contours of the unknown and presents to the world its latest sketch of what the universe might look like. Saying that one uses evidence to make decisions gives the impression that the decision is itself calculated. But this hides much that is implicit in the act of deliberation.

Physicians and patients are left in what I think is a moral conundrum. Thomas Newman, who I cited at the beginning of the paper, is an example. One evening while watching a video at home he received a call from the hospital regarding an infant with borderline high bilirubin levels but otherwise healthy looking. "I kept asking my wife to stop the film so I could fret about what to do," wrote Newman. Hospital guidelines said to admit, but statistics (and maybe his own experience) told him to ignore it. And that is what he recommended the nurse do, "and of course," he continues—throwing off the yoke of moral angst—"the baby did just fine." But the process of making the decision and the way he worked around what he might even call his "better judgment" was obtrusive. "Who needs this?" he asked himself. "Next time I'll just follow the guidelines and admit such kids to the hospital, so I don't have to worry and can enjoy my movie."[36]

Newman's reasoning and actions not only remind us of the humanity and uncertainty that underlies medical practice, but his insight to the various

35. Chalmers, et al., "Meta-analysis of clinical trials"; Williamson, *Healthcare informatics*, p. 261.

36. Newman, "The power of stories," p. 1425.

decisions facing physicians demonstrate what is at stake in working through the evidence. Newman had referred to the role of the "availability heuristic" in shaping perceptions of probability (how readily we can recall a particular case). However, there are a whole range of what the legal theorist Cass Sunstein calls "moral heuristics" which are at work all the time in human decision making.[37] According to mathematical psychologists Amos Tversky and Daniel Kahneman, people assess the probability of uncertain events by relying on a limited number of principles which "reduce the complex tasks of assessing probabilities and predicting vales to simpler judgmental operations."[38] They are referring to mental short-cuts and rules of thumb that people tacitly use. The use of these heuristics gives rise to intuitions about what is true. These theorists point out, and I think that Newman would agree, that heuristics also (of course) lead to error. But we are not analyzing human error here, we are examining the art of decision making and the construction of evidence. It is the *epistemic time* in which decisions are calculated (to use a biased word) that is of interest. As Malcolm Gladwell shows, intuitive judgment can be as fast as a *Blink*.

37. Sunstein, *How change happens*.

38. Tversky and Kahneman, "Judgment under uncertainty."

Even though decisions are often based on incommunicable knowledge, credibility rests on documentation. "Our world requires that decisions be sourced and footnoted, and if we say how we feel, we must also be prepared to elaborate on *why* we feel that way."[39] Is it obvious that the acts of documentation, inscription, representation are more reliable? In the words of a group of physicians who in 2002 wrote about diagnostic tests: "Is this the direction we wish to take?"

39. Gladwell, *Blink*, p. 52.

> The developments in how information is presented offer opportunities to put substance into commonplace healthcare discussions. But does this swing the balance away from the art of medicine? Will it become less of a 'high touch' discipline, in which professionals try to support patients through episodes of illness, and more of a 'high tech' one, in which reductionist approaches see pathways of illness as a series of dilemmas that can be 'solved'? There may be intangible, even mysterious, value in the softer art of medicine—is this being endangered?[40]

40. Edwards, "Explaining risks."

The practice of medicine will probably continue to be a matter of cherry-picking. But with the help of the social sciences, studying those who study us, it will be a practice of critical reflexivity about how it is that we think we know what we know. It may be difficult to articulate, but therein is the art of evidence.

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