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The trouble with likelihood ratios

David Grimes and Kenneth Schulz (Apr 23, p 1500)[1] state that likelihood ratios are underused in patients' care. For years we have tried in vain to introduce them in clinical teaching in four continents, and we hoped desperately to see diagnostic research published as likelihood ratios. We have analysed some possible explanations for this defeat.

The first is the complex chain of calculations involved. Clinicians should transform probabilities into odds, multiply by a series of likelihood ratios, and finally reconvert odds to probabilities. Simplifying aids such as the Fagan nomogram are rarely used, should be done for every test, and need published likelihood ratios.

The second problem is the absence of an appropriate language for clinical logic. Instead of indicating what it means for clinicians, the word "likelihood ratio" states where it comes from. Let us give a corollary: should we tell a violinist he or she should play the "dominant ratio" (3/2) of the A? No, we ask him or her to play a "fifth", a logarithmic "metalanguage" traduction. A positive likelihood ratio means "confirming power" to the clinician, so why not call it that?[2] Never, in 20 years of teaching clinical logic, have we found a clinician who used the word "positive likelihood ratio". Furthermore, there is no word for "odds" in French, Italian, Spanish, Kinyarwanda, or Lao, to name but examples. So some have to start difficult calculations with a notion that does not even exist in their mind.

A third and fundamental problem is the counterintuitive scale of likelihood ratios. Why is a test with a likelihood ratio of 100 not 10 times more powerful than a test with a likelihood ratio of 10? Why is the likelihood ratio given in strange numbers such as 0·01? How to compare the excluding power of 0·03 with a confirming power of 33? And why do confidence intervals widen for high and very low likelihood ratios? Mathematically speaking, likelihood ratios and odds both have a skewed, exponential distribution. The great mathematician Turing proposed that likelihood ratios be represented in a logarithmic way, and be grouped in classes.[3]

Grimes and Schulz state that tests are most useful when used around 50% probability. This is the last (and not least) clue to the lack of success of the actual model. When an HIV ELISA test alters your probability from 0·1 to 10, is the diagnostic benefit less than if it were changed from 10 to 90? The same holds for a biopsy that pushes the probability from 98 to 99·99. The probability scale for clinicians is symmetrically skewed in both directions. In primary care, elective surgery, and oncology, clinicians work at the extremes of the probability scale.

The time has come to apply the Feynman-Tufte principle to clinical logic, to offer a visual representation of Bayesian logic.[4] Earlier attempts with natural logarithmics do not allow a simple graphic.[5] We teach a scale of $\log_{10}$ odds from −4 to +4, indicating the corresponding probabilities, and adding rounded $\log_{10}$ likelihood ratios to the pretest probability. In doing so, clinicians can apply Bayesian logic without formal calculations (figure).

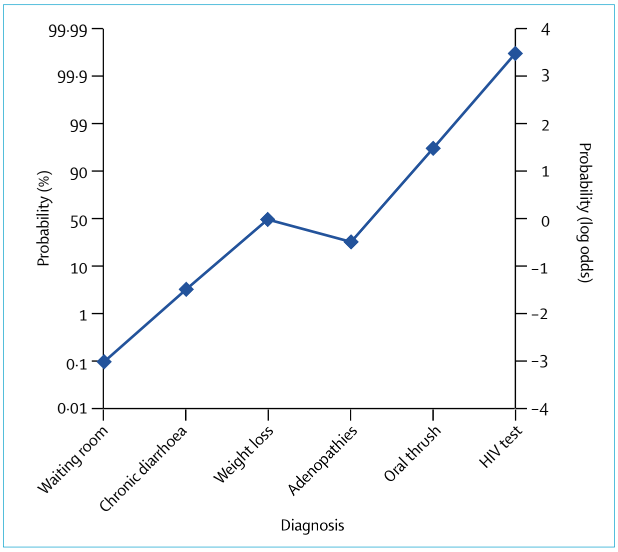

***Figure:* Evolution of probability in a patient suspected of having HIV infection, following consecutive diagnostic steps**
At the left hand side, probability is shown in percentages, at the right hand side in log odds. Log_{10} likelihood ratios, rounded to half the unit, are added to the pretest probability.

We declare that we have no conflict of interest.

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Department of Error

Kapp C. Hamilton Naki. Lancet *2005;* **366:** 22—In this Obituary (July 2), Clare Kapp described how Hamilton Naki took part in the first successful heart transplant with Christiaan Barnard. Naki was not present during this operation. The surgeons who removed the donor's heart were Marius Barnard and Terry O'Donovan. Naki was a skilled laboratory assistant employed by the University of Cape Town. He did not operate on human beings, nor did he ever work within the Groote Schuur Hospital, or its operating theatres. Naki's role was restricted to work on animals and he assisted Christiaan Barnard in the research effort that preceded the first human heart transplant.