Editorial

The new irrationalism in weaning

A nova irracionalidade no desmame

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To be a good doctor is quite challenging. The challenge is to spot clues that unveil an unsuspected diagnosis and then decide on the right therapy. Sometimes, however, when medical matters are not especially difficult, problems arise because irrational recommendations have been promulgated which often prove more persuasive to clinicians than do scientifically corroborated findings.[1] Having watched the approach to ventilator weaning for more than 30 years, I believe that this field has now become a prototype of this irrationality.

The discontinuation of mechanical ventilation involves three diagnostic steps: measurement of weaning predictors; a trial of unassisted breathing (T-tube trial); and a trial of extubation. Because a spontaneous breathing trial always precedes an extubation trial, one might argue that one could skip predictor tests and start the weaning process with a spontaneous breathing trial. Indeed, this is the recommendation of the Evidence-Based Medicine (EBM) Task Force on weaning.[2,3] The recommendation, however, misses the very purpose of weaning predictors. The sole purpose of weaning predictors is to act as a screening test: to prompt a doctor to consider doing a T-tube trial sooner than is his or her custom—for the trial to occur earlier than would otherwise happen. A positive result on a weaning-predictor test acts as a "physician alert" and aids in the cognitive process known as diagnostic triggering.[4]

In every subspecialty of medicine, the approach to diagnosis is identical[5]: to first screen for a suspected condition and then try to confirm it. The approach is the same for endocrinologists, gynecologists, orthopedic surgeons, and every subspecialist. Examples abound: a dipstick is used to screen for diabetes, followed by a glucose-tolerance test to confirm or exclude the diagnosis; a chest X-ray is used to screen for lung cancer, followed by bronchoscopy to confirm the suspicion; an electrocardiogram is used to screen for myocardial infarction, followed by angiography to confirm it—the list is endless. In weaning, however, the EBM

Task Force proposes the opposite direction. They recommend that clinicians start with a spontaneous breathing trial (a confirmatory test) and use the initial few minutes of the trial as a screening test.[2] This is analogous to saying that when you suspect diabetes, start with a glucose-tolerance test and then, as the test gets underway, ask the patient for a urine sample in order to do a dipstick.

The initial randomized trials on weaning techniques revealed that 60-80% of patients who had been ventilated for a week had the ventilator removed on the first day they were evaluated for weaning.[6,7] If weaning-predictor tests had been performed sooner in these patients, it is likely that many could have had the ventilator removed a day, or several days, earlier. A recent trial on computerized weaning provided further evidence that physicians are too slow in screening patients for weanability.[8] A computer system automatically screened patients for weanability at a point when physicians were not measuring weaning predictors (because their pre-test probability was too low). Compared with usual care, the computerized system decreased weaning duration from 5 to 3 days. But physicians do not need a computer to expedite weaning: they can achieve the same by performing a screening test when their pre-test probability of weanability is low (20-40%).

The recommendation to skip screening tests and begin with a spontaneous breathing trial fosters the delays observed in the just-discussed studies. The recommendation also ignores extensive research in cognitive psychology that has revealed the causes of faulty decision making. Psychologists have repeatedly demonstrated that people make wrong decisions because they are more confident in their judgments (such as deciding that a patient is not ready for a T-tube trial) than is validly justified by the data on which the decisions are based.[9] In particular, psychologists have shown that insufficient attention to prior probability leads to major errors in decision making.[10] By alerting an unsuspecting physician to a patient's

readiness to tolerate unassisted ventilation hours or days before he or she would otherwise order a spontaneous breathing trial, weaning-predictor tests circumvent the cognitive errors inherent in clinical decision-making. The whole purpose of diagnostic screening is to perform a simple test at a time when a physician's pre-test probability is low (less than 50%).[5] A screening test should be inexpensive, easy to perform, pose minimal risk to patients, and provide a quick answer. A spontaneous breathing trial that involves 30-120 minutes of monitored performance is the antithesis of a screening test.

The EBM Task Force's recommendation to skip predictors would be understandable if the tests performed poorly. The predictor test most widely employed is the frequency-to-tidal volume ratio (f/V_T).[11] Since the original report on f/V_T, its accuracy has been evaluated by at least 27 groups of investigators, making it perhaps the most re-investigated phenomenon in critical care.[12] Some investigators concluded that f/V_T was reliable, others found it unreliable. When all the data were compared against the test characteristics in the original 1991 report and Bayesian pretest probability was taken into account, the weighted Pearson correlation coefficient was 0.82 or higher (p < 0.0001), providing *de facto* confirmation of the sensitivity and specificity of f/V_T in the original study.[12] The essential ingredients of a good screening test are a low number of false-negative results together with a high number of true-positive results (high sensitivity).[12] In the 27 studies that have evaluated f/V_T, the average sensitivity was 0.87—higher than that of most tests in critical care medicine.

The evaluation of diagnostic tests is fraught with difficulties: it is a perilous zone for the uneducated. Naïve investigators entering this minefield end up with mangled limbs in the form of erroneous inferences and invalid claims. Based on a meta-analysis, the EBM Task Force concluded that f/V_T was not a reliable predictor of weaning outcome.[2,3] Throughout all branches of medicine, every diagnostic test is based on Bayes' theorem. Likewise, analysis of research studies on the performance of diagnostic tests must be founded on Bayesian principles. The main hazard for the unwary researcher is to turn a blind eye on pre-test probability and ignore spectrum bias and test-referral bias; such

carelessness completely mangles the calculations of sensitivity, specificity, and likelihood ratio.[13] In their meta-analysis, the EBM Task Force committed at least 15 major errors, any one of which was sufficient to scupper their conclusions.[14] The Task Force does not contend against even one of these errors but instead views them as side issues that do not detract from their recommendations.[15] To ignore test-referral bias in the evaluation of a diagnostic test is analogous to a physiologist who claims that a PaO_2 of 80 mmHg is always better than a PaO_2 of 60 mmHg, and the fact that the measurements were made at inspired oxygen concentrations of 50% and 21%, respectively, is an academic distraction best ignored.

Having watched the field of weaning for more than 30 years, I find this new irrationalism difficult to fathom. For the first 15 years, there was considerable progress, largely derived from a better understanding of the pathophysiologic mechanisms of weaning failure.[16] Over the past 15 years, the field has regressed, largely through disregard for basic scientific principles: failure to comprehend the different goals of screening tests and confirmatory tests, blindness to the Bayesian foundation of all diagnostic testing, a cavalier approach to test-referral bias, and other irrationalities. It is time for thoughtful physicians to reclaim the field and apply logic to achieve better care for their patients.

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