

THE FALLIBILITY OF CERTAINTY

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An old-timer physician of New York, who was forever questioning the methods and purpose of his colleagues, concluded a Grand Rounds in his department with the observation, “No patient is in real danger until all his doctors agree on his diagnosis.” Those of us at the session dutifully applauded and laughed, left the meeting, but never forgot his perceptive warning.

We all crave certainty, yet sadly it is an aspect of our existence that we are usually denied. Benjamin Franklin’s annoyance on the nature of certainty was summed up in his well-worn adage, “But in this world nothing can be said to be certain except death and taxes.” We share his frustration and try to overcome it by creating intricate matrices to give a perception of certainty, structured out of probability. Even before the time of Socrates, philosophers were warning that perception and reality could differ. Now we seem to be more comfortable living with perceived truths, rather than making the effort to define what is real.

In healthcare, we have chosen to accept the probability of an outcome of an intervention as proved if it has a 1:20 chance of being happenstance ($P=0.05$). Therefore, it is not surprising that we live in an environment where today’s “truths” can become tomorrow’s fiction. Even lawyers recognize our plight. They do not ask for truth in an opinion, but for “reasonable medical certainty.”

The desire for certainty, and the inability to obtain it, is well recognized in engineering and spills over into our clinical practice. This is true for a simple apparatus, such as an infusion pump. We may think an infusion pump will deliver 10 mL per hour when it is set to deliver 10 mL per hour. The engineer will consider the specifications, as we all should, and realize the pump with this setting is designed to deliver

between 9.5 to 10.5 mL per hour. This is a reasonable range for almost all therapeutic maneuvers. Absolute accuracy is not considered an engineering option, but an acceptable range is permissible. The engineer and possibly the intensive care unit (ICU) staff will consider an infusion pump that performs outside the specified limits as unacceptable. To increase the probability of a pump almost never performing outside the specified range, the manufacturer may opt to make a more accurate and possibly more expensive device designed to deliver between 9.95 and 10.05 mL per hour when set to 10. Even at this level, it would be impossible to be certain that the pump would never over- or underperfuse the patient, just that the pump would be less likely to do so. One of the arts in the field of probability is to engineer enough accuracy or safety into equipment and keep the equipment at a reasonable price to maintain a market share against competitors. For various and obvious reasons, an over- or underinvestment in safety or accuracy will ultimately prove too expensive. The assumption of accuracy will always be haunted by a lack of certainty.

The scientist who developed the rocket engine for the NASA Apollo space program nicely summed up the problem: “You want a valve that doesn’t leak and you try everything possible to develop one. But the real world provides you with a leaky valve. You have to determine how much leaking you can tolerate.”¹

In the search for greater certainty, we critical care practitioners love to leap upon the latest bandwagon. Our desire to be at the cutting edge frequently establishes an intervention before proper evaluation has taken place. Proper evaluation is then delayed because the intervention has become established—a vicious circle. Sometimes we are lucky. Those who first used intrathecal spinal opiates deemed them so effective that they became an established modality in the treatment of acute pain, particularly in cancer patients, before any meaningful trials on safety and efficacy were conducted. On the other hand, the pulmonary artery catheter, introduced around 1970, is a tale of how a

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monitoring device with no outcome evaluation created an industry. ICUs were equipped with multichannel pressure and cardiac output monitors, nurses and physicians spent thousands (perhaps millions) of hours inserting pulmonary artery catheters and taking measurements, and hemodynamic data came pouring in. Considerable sums were paid by catheter and electronic monitor manufacturers to support teaching programs on the insertion and use of the catheters. There seemed to be an innate certainty that these devices were beneficial to patient care.

In 1979, \$2 billion was spent on ICU pulmonary artery catheterization, yet nothing had been published showing improved outcome.² By this time, there were more than 700 articles and other communications on the complications of the procedure. In the 1990s, data began to surface that the use of pulmonary artery catheters could have a negative effect on patient mortality and morbidity.³ Some of the reaction was that the device should be withdrawn.⁴ It should be remembered that consensus on the use of pulmonary artery catheterization published around this time could find no evidence to support the continued practice.^{5,6} Despite this, critical care practitioners were so certain that the use of pulmonary artery catheters was beneficial, that indications were given. This may seem like bizarre behavior on the part of some otherwise very sane individuals, but they could not suggest that the mechanism of evidence-based medicine could be at fault!⁷

This saga is still wading through the mists of uncertainty. The Canadian Critical Care Trials Group recently published an investigation showing that using pulmonary artery catheters in high-risk surgical patients has no benefit.⁸ A more recent Canadian study⁹ shed light on the problem by demonstrating that the intervention could be deleterious to the less compromised patient. On the other hand, the data showed a positive effect on the outcome of more severely ill patients (APACHE > 26).

Invasive monitoring does seem to have a considerable cost-benefit ratio, particularly when patient complications such as sepsis are considered part of the cost. Another challenge to the growing consensus is that invasive monitoring does not confer sufficient benefit to justify the risk of sepsis. The current national benchmark on catheter-related bloodstream infections in surgical ICUs is 5.2 per 1,000 central catheter days.¹⁰ By assiduous attention to insertion technique and management, a critical care group at Johns Hopkins was able to virtually eliminate catheter-related bloodstream infections (and there were no infections during the last months of their study).¹¹ The interventions were all simple and grounded on evidence-based practice.

The first step was to provide orientation sessions, explaining the protocols, for all involved ICU staff. A cart with absolutely everything necessary for catheterization was assembled. A checklist for the protocols was placed at every bedside. A mechanism was established for stopping the procedure if the protocols were not being followed. A protocol was established to remove catheters as soon as they were no longer needed. Feedback and encouragement were given regularly to the staff. (This study¹¹ is highly recommended to all our readers). Whether this new information will change the cost-benefit ratio of pulmonary artery catheterization is uncertain, but it certainly will reduce the costs associated with infectious complications.

Subglottic secretions as a possible cause of nosocomial pneumonia is another subject in which certainty is developing. In the early days of critical care, endotracheal tube cuff pressures would be checked every few hours. A usual part of the procedure was to deflate the cuff while the patient was being "bagged" to blow any puddle of accumulated secretions into the mouth. In the early 1990s, the continuous aspiration of subglottic secretions was introduced.¹² The outcome measure of benefit to the patient was reduced bacterial colonization. A modified endotracheal tube is easily obtainable, with a dorsal orifice above the cuff that can be used for continuous or intermittent suctioning. The Centers for Disease Control and Prevention now have this as part of their guidelines for the prevention of nosocomial pneumonia.¹³ It is a category II (suggested for implementation and supported by suggestive clinical or epidemiologic studies or by strong theoretical rationale) guideline, but the cost/benefit of this technique has been seriously questioned, as the studies that support it are marginal on metaanalysis.¹⁴ Recent experimental evidence shows that continuous subglottic suction can be damaging to the trachea.¹⁵ Something that seemed obvious and convincing a few years ago has already begun to develop uncertainty.

The danger of certainty is that once we feel certain about something, we tend to accept it. The process is then removed from further examination. There is a tale of a junior investigator who was bereft of ideas for further research. He went to his chairman, who was renowned for his wisdom, for advice. The chairman told him, "If you want to find out something new, look into something that everyone has taken as a gospel truth for the last 30 years!"

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