



CHECKLISTS, SPECIALIZATION, SAFETY, AND AUTOMATION IN THE INTENSIVE CARE UNIT

by Jeff Borrink BS, RRT

Dr. Atul Gawande, an author and general surgeon at Brigham and Women's Hospital in Boston Massachusetts, recently wrote an article in *The New Yorker* discussing how something very simple can transform the Intensive Care Unit (ICU); a checklist.

In his article, Dr. Gawande writes about Peter Pronovost MD PhD, a critical care specialist at Johns Hopkins hospital in Baltimore Maryland, who is one of the first in medicine to recognize the power of a checklist to save lives in the ICU.

In 2001, Dr. Peter Pronovost decided to tackle the problem of line infections in his ICU. He plotted out the steps to take when inserting a line, a checklist, in order to avoid a line infection. These steps had been well known and taught for years. Then he asked the nurses in his ICU to observe the doctors in the ICU put lines in for a month, and record how often they completed each step. As it turns out, at least one step was skipped in more than a third of patients.

Checklists provide two main benefits: they help with recall and they lay out expected steps in a complex process

The next month, nurses received backing from hospital administration to intervene if doctors didn't follow every step on the checklist. Dr. Pronovost and his colleagues

tracked what happened for a year afterward, and found that the ten-day line-infection rate went from eleven percent to zero. They calculated that the checklist had prevented forty-three infections, eight deaths, and had saved two million dollars in costs. They subsequently tested other checklists in the ICU and found similar results.

Dr. Pronovost observed that checklists provide two main benefits: help with recall, especially with mundane matters that are easily overlooked in patients, and explicitly laying out the minimum number of expected steps in a complex process.

Dr. Pronovost was encouraged, and believed that his checklists could save lives, so he took his findings on the road, showing his checklists to doctors, nurses, insurers, etc., speaking in an average of seven cities a month. For a variety of reasons, he found few who would accept his checklists.

The limited response to his checklist procedure was easy to explain, but hard to justify. Some doubted the evidence. Some were offended by the suggestion that they needed a checklist because they were the expert. Checklists seemed to push against the traditional culture of medicine; expert audacity in complex

environments and situations of high risk. According to Dr. Gawande, "if a new drug were as effective at saving lives as Peter Pronovost's checklist, there would be a nationwide marketing campaign urging doctors to use it." He adds that, "Good medicine will not be able to dispense with expert audacity. Yet it should also be ready to accept the virtues of regimentation."

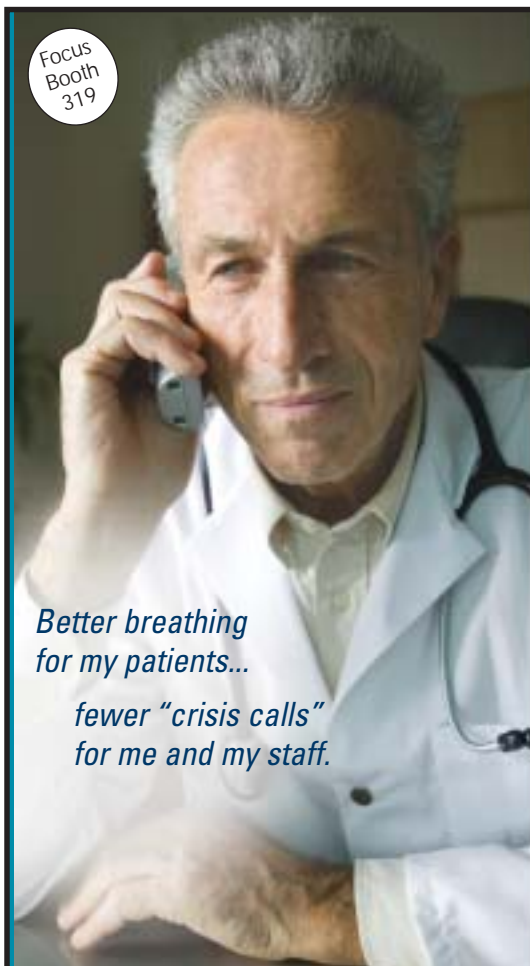
According to Dr. Pronovost, "the fundamental problem with the quality of American medicine is that we've failed to view delivery of health care as a science. The tasks of medical science fall into three buckets. One is understanding disease biology. One is finding effective therapies. And one is insuring those therapies are delivered effectively. That third bucket has been almost totally ignored by research funders, government, and academia. It's viewed as the art of medicine. That's a mistake, a huge mistake."

Because Dr. Pronovost is focused on work that is not normally considered a significant contribution in academic medicine, few other researchers are helping to extend his efforts and achievements. However, in 2003 the Michigan Health and Hospital association asked Dr. Pronovost to implement three of his checklists in Michigan's ICUs. It became known as the Keystone Initiative. And in December of last year, the *New England Journal of Medicine* published a landmark article detailing the results from utilizing these checklists in the Michigan ICU's. "The typical ICU cut its quarterly infection rate to zero. Michigan's infection rates fell so low that its average ICU outperformed ninety percent of ICUs nationwide. In the Keystone Initiative's first eighteen months, the hospitals saved an estimated hundred and seventy-five million dollars in costs, and more than fifteen hundred lives." Dr. Pronovost's results from the Keystone Initiative have not gone unnoticed, and he has had requests to help New Jersey, Rhode Island, and the country of Spain do what Michigan did.

Checklists have been used successfully in other industries. The airline industry has been using checklists for years to reduce pilot error and increase safety. As airplanes became substantially more complex over the years, check-lists with step-by-step checks for takeoff, flight, and landing were implemented to improve safety, rather than relying on pilot memory alone.

Just as airplanes have become increasingly more complex, healthcare has become increasingly more complex. And more of what hospitals do is critical care. According to Dr. Gawande,

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"substantial parts of what hospitals do—most notably, intensive care—are now too complex for clinicians to carry them out reliably from memory alone. ICU life support has become too much medicine for one person to fly."

Our nation is at a crisis point in regards to quality healthcare delivery and patient safety. Checklists are not routinely used. Medical errors are common. In 1999, the Institute of Medicine (IOM) released a report, "To Err is Human: Building a Safer Health System." According to the report, between 44,000 and 98,000 deaths may result each year from medical errors in hospitals alone. These errors are due to multiple factors, but most are considered preventable.

Publication of the IOM report triggered substantial public and private sector activity.

Most Hospitals in the U.S. have been putting error reduction strategies into high gear by re-evaluating and strengthening checks and balances to prevent medical errors within their system since the release of the IOM study. Still, experts agree that there is much more work to be done.

According to Dr Gawande, "this is the reality of intensive care: at any point, we are as apt to harm as we are to heal. Line infections are so common that they are considered a routine complication. ICU's put five million lines into patients each year, and national statistics show that, after ten days, four percent of those lines become infected. Line infections occur in eighty thousand people a year in the United States, and are fatal between five and twenty-eight percent of the time, depending on how sick one is at the start. Those who survive line infections spend on average a week longer in intensive care. And this is just one of many risks. After ten days on the ventilator, six percent develop bacterial

pneumonia, resulting in death forty to fifty-five percent of the time. All in all, about half of ICU patients end up experiencing a serious complication, and once a complication occurs, the chances of survival drop sharply."

The medical profession has favored specialization over the years as a solution for the increasing complexity of healthcare. Training programs focusing on critical care have opened in every major American city in the last ten years. Responsibility has increasingly shifted to super-specialists - clinicians who have taken the time to practice one narrow thing until they can do it better than others with lesser knowledge and ability. Even many Respiratory Therapy Departments have organized into separate specialty units or teams.

"Expertise is the mantra of modern medicine. As the intricacies involved in intensive care have mounted, responsibility has increasingly shifted to super-specialists. In the early twentieth century, you needed only a high school diploma and a one-year medical degree to practice medicine. By the century's end, all doctors had to have a college degree, a four-year medical degree, and an additional three to seven years of residency training in an individual field of practice - pediatrics, surgery, neurology, or the like. Already, though, this level of preparation has seemed inadequate to the new complexity of medicine."

"Intensive-care medicine has become the art of managing extreme complexity - and a test of whether such complexity can, in fact, be humanly mastered. Intensive-care medicine has grown so far beyond ordinary complexity that avoiding daily mistakes is proving impossible even for our super-specialists. The ICU with its spectacular successes and frequent failures therefore poses a distinctive challenge: what do you do when

continued on page 76



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Checklists, Specialization, Safety... Continued from page 75

expertise is not enough?" One solution for some of the complexity and patient safety issues for mechanically ventilated patients is automation through closed loop ventilation. ICU Mechanical ventilators have become more complex, requiring more expertise from the clinicians that operate them. To optimize ventilation and prevent harm, more expertise is required from the clinician in regards to pulmonary mechanics, monitoring, waveforms analysis, modes, controls, etc.

Proper delivery of mechanical ventilation falls into that 'third bucket' of medical science that Dr. Pronovost was referring to; ensuring that therapies are delivered effectively. This bucket has been largely ignored according to Dr Pronovost, and that is a huge mistake. Numerous interventions are designed to prevent harm from mechanical ventilation, such as implementing lung protective ventilation strategies on day one, transitioning to a spontaneous breathing trial as soon as possible, etc. Additional strategies are designed to mitigate ventilator induced lung injury (VILI), such as utilizing lower tidal volumes and lower plateau pressures. Yet, in many instances these interventions that prevent harm are not implemented, or are implemented too late. ARDS patients are not always ventilated with a lung protective low tidal volume strategy, in fact, many times these patients are not even recognized and diagnosed with ARDS. Patients are not always assessed for their readiness to wean, sedation vacations are not always the norm, etc., all of which can create complications and safety issues for the patient. To make matters worse, forgotten steps, medication errors, mechanical breakdowns, inadequate staff training, fatigue, staffing shortages, etc., can all contribute to complications and patient safety issues for mechanically ventilated patients in the ICU.

Adverse events and serious errors involving critically ill patients are common and often potentially life-threatening.

Closed-loop ventilation can automatically implement many of the evidenced based medicine strategies designed to prevent harm from mechanical ventilation, and can improve patient safety. Closed-loop ventilation automatically ventilates to the pulmonary mechanics of the patient, and adapts breath by breath to changes in mechanics. It allows the patient to spontaneously breathe as soon as they are able to, and can ensure faster weaning than conventional modes. It automates and streamlines many setting changes, therefore eliminating many errors that can occur, and it automatically implements safe ventilation rules which can improve patient safety and quality of care.

This approach to mechanical ventilation requires a paradigm shift when it comes to mechanical ventilation. It requires change. It requires changes in how mechanical ventilation is applied within the medical system or ICU. It requires changes in thinking from doctors, nurses, and Respiratory Therapists. It may also require additional training and expertise. It may require changes in our articles and documentation. It requires us as caregivers to take the time and initiative to evaluate the latest technology that is available, and make the required changes if that is what is in the best interest of the patient. It requires a 'patient-centric' way of viewing mechanical ventilation as opposed to a 'doctor-centric', 'institution-centric', or 'provider-centric' way of viewing mechanical ventilation. It requires the 'third bucket' to be addressed.

About 90,000 people across the United States are in an ICU on any given day, 5 million Americans are in an ICU in any given year, and it is likely that almost all of us will be admitted to an ICU at some point in our lifetime. We're all patients, or eventually may be at some point in time, which may place us all at risk of medical errors or complications. The ICU environment has become increasingly more complex, requiring more specialized training, with increasingly more complex medical equipment. Scores of clinicians must carry out thousands of steps correctly throughout our stay in the ICU in order to ensure our safe return to health. Checklists, specialization, and automation can help. "Going into an ICU, being put on a mechanical ventilator, having tubes and wires run into and out of you, is not a sentence of death. But the days will be the most precarious of your life. Intensive care succeeds only when we hold the odds of doing harm low enough for the odds of doing good to prevail."



"I'll have to call you back...I'm in the middle of doing nothing."