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Development and Implementation of an ICU Quality Improvement Checklist

Steven Q. Simpson, MD
Douglas A. Peterson, MS, RN
Amy R. O'Brien-Ladner, MD

ABSTRACT

Hospitals, especially their intensive care units, are not particularly safe for patients. Life-threatening mistakes and omissions in care can and do occur. To deter omissions and mistakes wherever possible, our medical intensive care team developed a checklist of care issues that must be addressed daily for every patient in our intensive care unit. The checklist augments our daily, multidisciplinary quality rounds and informs all personnel when important items have been missed. It is too soon to tell whether the checklist has had an impact on our survival rate or length of stay, but we have documented clear imrovement in our attention to these core intensive care issues. In addition, our team's collegiality and team bonding are enhanced by using an evidence-based tool to achieve our care goals. We share our checklist, so that others can use and/or adapt it in their pursuit of optimal care for their critically ill patiens.
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Hospitals are not particularly safe places for patients.[1] Physicians, nurses, pharmacists, and other personnel, being human, routinely make mistakes. In fact, it may be said that medical personnel make mistakes as a matter of their routine or, more precisely, their lack of an evidence-based and standardized routine. Although some mistakes lead to little change in patient status, the potential for complications that bring harm to patients is clearly present. Although mistakes may be made throughout the hospital, the intensive care unit (ICU) surely provides abundant opportunities for making them, while ICU patients are perhaps among those who are least able to withstand the consequences of a mistake.[2,3] Seemingly innocuous actions or omissions in the ICU, such as failure to maintain head of bed elevation at greater than 30° in a mechanically ventilated patient, can result in serious, even fatal, complications. In this article, we describe our experience with one means of preventing mistakes and their complications, which we call the ICU Daily Quality Checklist.

Opportunity for Change

As physicians and nurses, we have always cared deeply about the quality of the care we deliver. Because we work in a university hospital, we feel responsible for maintaining cutting-edge skills and passing those skills on to our trainees. We have always worked, in our

Steven Q. Simpson is Associate Professor, Division of Pulmonary and Critical Care Medicine, University of Kansas Medical Center, 3901 Rainbow Blvd, Kansas City, KS 66160 (e-mail: ssimpson3 @kumc.edu).

Douglas A. Peterson is Director, Medical Intensive Care Unit, the University of Kansas Hospital, Kansas City, Kan.

Amy R. O'Brien-Ladner is Associate Professor, Division of Pulmonary and Critical Care Medicine, University of Kansas Medical Centre, Kansas City, Kan.

respective disciplines, to understand which components of care are state of the art and represent the best available medical evidence. As is typical of physicians and nurses, we were prone in previous years to believing that we were delivering the highest quality care. We believed that because we knew what to do, we must have been good at doing it.

However, our attitude began to change several years ago when we collected data regarding the Joint Commission core measures in our institution. Shortly afterward, we participated in a University Health Systems Consortium quality improvement project involving ventilator-associated pneumonia. In collecting and analyzing our data we found that we were, in many instances, not following best practices—even though medical and nursing staff could all agree on what the best practices should be. It became obvious that we needed tools that would help us to more consistently use well-accepted clinical principles and guidelines.

With this aim in mind, 3 years ago we initiated a set of interdisciplinary morning quality rounds. This set of rounds in our intensivist-led and closed-model medical ICU is held first thing in the morning, separately from daily teaching and work rounds involving house staff and medical students. Participants include the ICU nurse manager or a substitute, most often the charge nurse, the attending intensivist, individual staff nurses, respiratory therapists and respiratory therapy supervisor, the ICU pharmacist, the ICU social worker, and a physical therapist. The goal of these rounds is to give all team members an idea of the major plans for the day, to identify potential medication interactions, to plan for ICU discharge, and to identify any deficiencies in care, including those involving routine, easy-to-miss items, such as prophylaxis for deep vein thrombosis and stress ulcer. We also determine whether staff have used the unit's evidence-based, standardized order sets for admission, sedation, analgesia, neuromuscular blockade, skin surface protection, and severe sepsis. However, in spite of routine quality rounds, we found that we continued to miss patient care details that clearly had the ability to affect patient safety and prognosis.

Checklists for Outcomes Improvement

It appeared to us that even when working collectively we were unable to always detect our errors and omissions and that we needed a means of ensuring every detail was covered for every patient every day. We took inspiration from the aviation industry and decided to develop a checklist of care parameters that must be carried out for every patient. Commercial aviation makes use of checklists in a variety of ways, including preflight and in-flight checklists, approach (to landing) checklists, and maintenance checklists. NASA makes use of checklists in nearly every aspect of space flight.[4] The purpose and function of a checklist is simple, yet profound—to prethink the problems that are likely to be encountered and to prompt an operator to check for appropriate functioning in all systems that are crucial to successful completion of the mission. In the case of commercial aviation, that would mean carrying passengers safely from point A to point B. For NASA, that may mean getting an individual to the moon and back in one piece. For us, that means seeing a critically ill patient through his or her ICU stay with a minimum of complications and in the shortest possible time.

Best known among the aviation checklists is perhaps the preflight checklist, which was developed by the US Army Air Corps previous to World War II in response to the crash of an advanced Boeing bomber, the Model 299.[5] This particular aircraft was technologically superior to its competitors and had outperformed them in all but the last demonstration flight that would have decided the awarding of a contract for the delivery of hundreds of aircraft. In that final flight, the pilots forgot to unlock the elevators—components that are critical to the flight of the aircraft—and the plane crashed on takeoff. The contract for hundreds of aircraft was awarded to Douglas Aircraft, which produced airplanes that were not as advanced but were perceived as airworthy. The Air Corps did purchase a few of the Boeing aircraft, and it was the pilots charged with flying the Model 299 who originated the preflight checklist, so as to avoid fates similar to that of their colleagues. The practice soon became standard for the military and for all aviation. The analogy to, for example, patients with severe pancreatitis and acute lung injury who are weaning successfully and improving on all fronts until they develop central catheter—related sepsis or ventilator-associated pneumonia, is readily apparent. The analogy is especially apt if precautions for

preventing one of these complications have been overlooked.

Checklists have been used successfully in the ICU for specific purposes. Several studies have shown that real-time use of catheter insertion and maintenance checklists reduces the incidence of central catheter—associated bloodstream infection.[6–8] In one study, the incidence of central catheter—related bloodstream infection was decreased from 11.3 per 1000 catheter days to 0 per 1000 catheter days by use of an insertion checklist, along with other interventions.[6] Likewise, Berenholtz et al successfully used a daily checklist of therapies as a component of a plan to improve care of ventilated patients in their ICU.[9] In response to a sentinel event, physicians and nurses at the VA Ann Arbor Healthcare System instituted a safety checklist as a part of their successful development of a culture of safety in the ICU.[10] In addition, real-time patient safety audits using checklists of specific parameters were used to improve outcomes in a neonatal ICU.[11] All authors report a high level of acceptance of the checklist on the part of ICU personnel. In an exhaustive literature search, we failed to find a checklist that encompassed all of the issues that we desired to address in our ICU, so we determined to create one ourselves.

ICU Quality Checklist: Development and Description

Having decided that we needed a checklist, we approached the problem using Shewhart and Deming's plan-do-study-act methodology, also referred to as "small tests of change."[12] We developed an initial screening tool, which was circulated to various nursing and physician personnel for comments and corrections. We printed several checklists for use in daily quality rounds. Within 2 days, we identified additional items that were needed and added them to the checklist. Then we printed enough lists for a rollout to the entire ICU, and made more changes. We asked the nurses to fill out the checklist daily just before change of shift, at 7 AM. Ultimately, we believed the checklist was complete enough to be printed in a larger quantity for a longer trial. However, the checklist has undergone continual revision to achieve its current form, each revision correcting a deficiency or enhancing the usability of the form. Most recently, during the writing of this article, we made more revisions and published to the unit.

In its more recent iterations, that is, for the past 14 months, the checklist involves 15 separate categories of items that we deem too important to overlook. Figure 1 shows the checklist in its most recent form. Column 1 begins with items that deal with patient comfort, including sedation, analgesia, delirium, and neuromuscular blockade. In each case, it asks the operator to indicate whether or not the standard ICU protocol has been used. We view this question, wherever it is found in the form, to be of utmost importance. We believe the issues on the checklist to be important enough that the decision making should not be haphazard, nor left in the hands of an intern or resident. For that reason, the ICU medical, nursing, and respiratory therapy staffs have developed standard protocols that are proactive in their content, based on the best and most recent medical evidence, and that address nearly any contingency that may arise. We say "nearly any contingency" because experience has taught us that we are not consistently prescient, and we revise these protocols whenever we discover some outcome that we have not previously encountered. The ICU's standards of practice committee meets monthly to review literature and update its current protocols, as well as to institute new ones when evidence supports doing so. Our policy is that whenever the medical or nursing staff has determined that an issue deserves a written protocol or standardized orders, then we would use those items unfailingly. This is, indeed, one of the more important issues that the checklist addresses.

Column 1 continues by addressing issues of prophylaxis for deep vein thrombosis, stress ulcer, ventilator-associated pneumonia, and skin breakdown. Again, we check whether these prophylactic items are ordered by protocol on standard order sets, to be sure that we are actually using our pre–thought-out, evidence-based strategies. The skin breakdown section also queries whether any areas of concern were present on admission to the ICU and whether the wound team has been consulted. This helps us understand whether and when our skin breakdown protocols are effective, that is, whether a patient developed skin problems in spite of our prophylactic interventions or the problems were present on admission. It also tells us whether our therapeutic interventions are working.

Date: **University of Kansas ICU Daily Quality Checklist** Place Patient Sticker Here

1) **Sedation:** Protocol ordered? ☐ Yes ☐ No
☐ Midazolam ☐ Dexmetetomidine
☐ Propofol ☐ Study drug ☐ none
☐ Sedation interrupted this AM
☐ MAAS score @ 0400: ____ ☐ RASS score @ 0400: _____

2) **Analgesia:** Protocol ordered? ☐ Yes ☐ No
☐ Fentanyl ☐ Morphine ☐ None

3) **Neuromuscular blockade:**
Protocol ordered? ☐ Yes ☐ No
☐ Vecuronium ☐ Cisatracurium
☐ None
☐ Train of 4: _____

4) **Delirium:** Protocol ordered? ☐ Yes ☐ No
☐ None noted
☐ As-needed haloperidol/risperidol
☐ Current CAM ICU: _____

5) **DVT prophylaxis:** Standard ICU orders? ☐ Yes ☐ No
☐ Sub-Q unfractionated heparin ☐ Sub-Q enoxaparin
☐ SCDs ☐ Foot pumps
☐ *Full anticoagulation with*:
☐ Heparin: PTT _____ ☐ Enoxaparin
☐ Warfarin INR _____
☐ Major bleeding _____ Minor bleeding _____ Location: _____

6) **Stress ulcer prophylaxis**
☐ Lansoprazole: ☐ enteral ☐ parenteral: ☐ twice daily ☐ drops
☐ Esomeprazole: ☐ enteral ☐ parenteral: ☐ twice daily ☐ drops
☐ Famotidine: ☐ enteral ☐ parenteral: ☐ twice daily ☐ drops
☐ TPN– drug: _____

7) **Head of bed**
Mechanically ventilated? ☐ Yes ☐ No
≥30°? ☐ Yes_____ No Recorded on bedside chart? ☐ Yes ☐ No

8) **Skin condition**
Braden score recorded ☐ Yes ☐ No Score:_____
Specialty bed ordered ☐ Yes ☐ No
Lesion present on transfer to ICU ☐ Yes ☐ No
Wound team consulted ☐ Yes ☐ No ☐
Additional wound(s):
Location_____

9) **Nutrition** ☐ **None**
☐ Enteral: ☐ OG tube ☐ NG tube ☐ Salem sump
☐ soft feeding tube ☐ GJ tube
☐ Goal rate: _____ ☐ current rate: _____ ml/h
☐ Interrupted >4 hours in past 24 h
☐ Parenteral: ☐ TPN ☐ PPN ☐ at goal rate
☐ Oral diet: ☐ clear liquids ☐ mechanical soft
☐ regular (including specific diets)
Nutrition team assessment updated in record ☐ Yes ☐ No

Your Name: _____

10) **Disposition/code status**
☐ DNR ☐ DNI ☐ Full code
☐ Advance directive in chart ☐ DPOA in chart
☐ Palliative care consulted
☐ SW consulted

11) **Glucose control**
☐ Insulin protocol ordered? ☐ Yes ☐ No
☐ conventional (100–150) ☐ tight (80–110)
Hours in parameters (0400 to 0400): _____

12) **Severe Sepsis:** Present? ☐ Yes ☐ No
Protocol ordered? ☐ Yes ☐ No
Central line placed? ☐ Yes ☐ No
Svo_2 monitored? ☐ Yes ☐ No value? _____
Lactate documented? ☐ Yes ☐ No value? _____
Drotrecogin-α protocol active? ☐ Yes ☐ No

13) **Therapies**

PT	OT	Speech
☐ ordered	☐ ordered	☐ ordered
☐ active	☐ active	☐ active

14) **Central line** ☐ None
#1 ☐ Subclavian ☐ Internal jugular ☐ Femoral
☐ PICC ☐ Non-SC
☐ Left ☐ Right ☐ Tunneled Date placed: _____
If non-SC, reason documented? ☐ Yes ☐ No
#2 ☐ Subclavian ☐ Internal jugular ☐ Femoral
☐ PICC ☐ Non subclavian
☐ Left ☐ Right ☐ Tunneled _____ Date placed: _____
If non-SC, reason documented? ☐ Yes ☐ No
#3 ☐ Subclavian ☐ Internal jugular ☐ Femoral
☐ PICC ☐ Non-SC
☐ Left ☐ Right ☐ Tunneled _____ Date placed: _____
If non-SC, reason documented? ☐ Yes ☐ No
Patient location when line placed?
#1 ☐ MICU ☐ ED ☐ Ward ☐ OR ☐ Other ICU
☐ Outside hospital
#2 ☐ MICU ☐ ED ☐ Ward ☐ OR ☐ Other ICU
☐ Outside hospital
#3 ☐ MICU ☐ ED ☐ Ward ☐ OR ☐ Other ICU
☐ Outside hospital

15) **Mechanical ventilation?** ☐ Yes ☐ No
☐ NPPV ☐ ET tube size: _____ ☐ Trach size: _____
☐ ALI/ARDS protocol ☐ Lung protective strategy
☐ Peak pressure: ____ ☐ Plateau pressure: _____
Weaning protocol active? ☐ Yes ☐ No

Figure 1: The University of Kansas intensive care unit quality checklist.
MAAS indicates Motor Activity Assessment Scale; RASS, Richmond Agitation Sedation Scale; CAM ICU, confusion assessment method for the intensive care unit; Sub-Q, subcutaneous; SCDs, sequential compression devices; PTT, partial thromboplastin time; INR, international normalized ratio; TPN, total parenteral nutrition; OG, orogastric; NG, nasogastric; GJ, gastrojejunal; PPN, partial parenteral nutrition; DNR, do not resuscitate; DNI, do not intubate; DPOA, durable power of attorney; SW, social worker; Svo_2, mixed venous oxygen saturation; PT, physical therapy; OT, occupational therapy; PICC, peripherally inserted central catheter; non-SC, nonsubclavian; MICU, medical intensive care unit; ED, emergency department; OR, operating room; NPPV, noninvasive positive pressure ventilation; ET, endotracheal; ALI, acute lung injury; ARDS, acute respiratory distress syndrome.

The remainder of the checklist addresses therapeutic issues. Some of them, such as disposition planning, nutrition, blood glucose control, and ancillary services, are required for every patient. Others, such as central catheters, the sepsis protocol, and mechanical ventilation checks, are not. However, these latter items are common enough in our ICU—and we dare say most ICUs—to make their inclusion important. The majority of our patients require one or another of these items. Likewise, insulin infusion is not required for control of blood glucose in all patients, but we order the insulin protocol for all patients. The protocol, of course, calls for insulin infusion only under certain circumstances, but by having it in place proactively, we ensure that when needed it is addressed without delay. Having the protocol in place also ensures frequent blood glucose measurements, so that glucose levels are not allowed unwittingly to be out of bounds.

In addition to helping us ensure that all of the categories are addressed, the checklist helps to see, at a glance, whether certain of our prophylactic and therapeutic strategies are effective. For example, users are requested to indicate whether enteral nutrition has been interrupted for more than 4 hours in a day. Likewise, we determine the number of hours that blood glucose falls within the specified parameters. In this way, the tool will, over time, help us ensure the adequacy of the protocols that we have instituted.

Over the last 4 months the checklist has undergone a major change. Working with our hospital's information technology department, we converted the checklist to an electronic format. The questionnaire now resides on the hospital intranet, available by Internet browser and tied to a structured query language database. Each of our ICU's patient care rooms has a computer terminal just outside the door in the same spot as the bedside flow sheet. In addition, a number of the nurses prefer to use the ICU's computers on wheels, which, because we are from Kansas, we refer to as COWs. These notebook computers can be rolled from bedside to bedside and are connected wirelessly to the network. The principal advantage to this change is that it allows us to more efficiently collect data regarding how well our efforts are working. Daily reports are printed and kept with the bedside flow sheet, as was our practice with the all-paper format.

The conversion to electronic format was not completely without incident. We had several sessions with the information technology department to ensure all questions were in an appropriate format and were easily addressable. Data entry in our program has transitioned very smoothly. However, we did not spend a comparable amount of time designing the report to be generated from the data. In its first iteration, the report was far less readable than our paper format and, in fact, was frustrating to read. During this period, our use of the checklist flagged to a degree, in spite of the fact that the data were entered every day. We have now redesigned the report, so that it is easily readable and that the information is as easy to use as before.

Even during this period, the new system had advantages that we did not experience using paper alone. Although the individual patient reports were difficult to read, we could run a daily summary report that told us if we were missing details somewhere in the unit. For example, if the report showed only 13 instances of stress ulcer prophylaxis, and we knew there were 14 patients in the ICU, all we had to do was hone in on everyone's stress ulcer orders to look for the mistake. Conversely, if there were 10 instances of sedation interruption and only 10 ventilated patients, then we could feel comfortable about that issue, even though the individual reports were less than ideal.

Our nurses and physicians have embraced the use of the quality checklist. The information is straightforward and easy for the nurses to collect and record. For all, the form is easy to read and understand. We are able to very quickly process necessary and important changes in patient care. The speed and efficiency of our daily quality rounding have improved greatly, since we are no longer working from memory as we run through these categories. It takes approximately 30 to 60 seconds to peruse the checklist and identify any problem areas that need to be addressed. Frequently, we have already identified the omission or error and have either corrected it or obtained an order to do so before we begin our multidisciplinary rounding.

Impact of the ICU Quality Checklist

We are unable to measure, with certainty, the exact impact that the checklist has had on discovering errors and omissions in our ICU care. We know for certain that there was a

need for improvement, but upon recognizing that need, we did not attempt to quantify the extent of our omissions, nor the related complications. Instead, we chose to correct them. We are, therefore, unable to provide a quantification of our improvement. We continue to miss certain items at the time of admission to the ICU, and it is likely that this problem will always plague us, because ICU admission orders are usually written by house staff, who rotate monthly, and who often do not initially have the experience to realize the importance of a checklist, or of standardized ICU orders. Nevertheless, conversion to the structured query language database helps us track just how often items are missed, how long they are missed, and which items are actually the most problematic. From that information we aim to further improve our checklist and mechanisms for improving the quality of care.

Conversion to an electronic format has enabled us to quantify how well we are doing with various aspects of our checklist, and we can readily discern in which areas we excel and in which we need work. One of our first tasks was to determine whether we do an adequate job of completing our checklists. We currently have tabulated data for 3 full months of use. In the first month, 287 checklists were filled out, covering 351 patient days (81.7%); in the second month, 341 checklists, for 388 patient days (87.9%); and in the third month, 395 checklists, for 399 patient days (99.0%). For the entire period, we have performed well on most elements of the ventilator-associated pneumonia bundle: deep vein thrombosis prophylaxis, 95%; stress ulcer prophylaxis, 96%; and head of bed elevated at greater than 30° more than 99.9% of the time. However, we do significantly less well in daily sedation vacations, which we accomplished only 40% of the time. Although this latter number does not make us happy, this is exactly the sort of information we were seeking when we developed the checklist. We are able to focus our change efforts, since we also know that in 95% of patients receiving sedation, our sedation protocol (which contains the nonoptional order for a 6 AM sedation interruption) was ordered.

The summary data similarly show that we excel in some of the remaining areas, while in others there is room for significant improvement. As we did throughout the development process, we can now see ways in which the checklist and its reports can be improved. For example, the summary data indicate that deep vein thrombosis prophylaxis is present 95% of the time, while patients are fully anticoagulated 11% of the time. We are skeptical that 106% of our patients are affected by any measure. It is likely that some raters view full anticoagulation as being adequate prophylaxis, while others may be more literal, stating that no prophylaxis is present, because none is needed. It is also possible that some fully anticoagulated patients are simultaneously provided with sequential compression devices. At any rate, we must clarify our checklist questions, so that our results have clear meaning. We view this and other problems like it as opportunities for additional plan-do-study-act cycles.

There have been unforeseen benefits of the daily quality improvement rounds and ICU quality checklist, mostly as a result of the furthering of our already collegial culture in the medical ICU. The bedside registered nurses feel empowered by an increased comfort level in discussing patient-specific items with the attending physician. This is especially evident among the younger nurses, who have an evidential basis for feeling confident in these interactions and who have traditionally found such interactions to be a bit intimidating. We believe that relying on clinical evidence that both nursing and physician staff agree is essential allows the less experienced nurses to gain a more rapid understanding of what components of their care are important, in a truly structured manner. In turn, the attending physicians are able to use the information they gain during the daily quality rounds to be more informed during their rounding with the house staff. Indeed, the attending physicians are able to demonstrate by their actions the importance of using tools to improve the care we give our patients. In addition, the nurse manager and unit coordinator have the opportunity to observe the comfort level of each registered nurse with both reporting and current patient assignment.

At the time of this writing, only our medical ICU has adopted the ICU quality checklist, although other ICUs within our hospital have shown interest. Clearly, initiating this tool has been easier because we are a closed-model ICU, which other units in the institution are not. However, we believe that ICUs can make significant headway in improving the quality of care if the nursing staff simply use a checklist and make it available for perusal by

physicians. In the act of completing the checklist, the the care team gets to know what elements, if any, are missing, so that physicians or nurses can initiate the changes needed. We believe that having the opportunity to ensure quality of care is something that all members of the team would appreciate.

To help any colleagues interested in using this approach to improving patient care, we have posted the most recent paper version of the ICU Quality Improvement Checklist on the Web site of the Kansas Critical Care Collaborative at www.kscritcare.org. We encourage its downloading, use, and modification by any interested party. We intend for all ICUs and, more important, all patients in those ICUs to benefit from our experience, should nursing and medical staff be so inclined.

In summary, we used proven quality improvement principles to develop and refine an ICU Quality Improvement Checklist. The process, along with our use of the list, has solidified an already cohesive team in our ICU and has helped us to improve the quality of care we provide to our patients and to prevent complications that may result from omissions in standard therapy. We have moved to an electronic version, which allows us to track our data better and improve our performance further. We are glad to share our tool with all who are committed to providing the highest quality of care for their patients.

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