Care Bundles in the Adult ICU: Is It Evidence-Based Medicine?

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Abstract Sepsis and hospital acquired infections (HAI's) are considered major public health risks and leading causes of death in hospitalized patients. These HAI's may be preventable if addressed with bundled care processes, which are felt to be powerful drivers for improving the reliability of delivery of evidence-based care to impact patient outcomes. In addition to HAI, much attention has now been shifted to delirium and sedation practices in ICUs, with recent data showing the untoward effects of delirium with regards to increased ICU lengths of stay, costs, mortality and long-term cognitive impairment, and the realization that our sedation practices may in part contribute to this delirium.

Keywords Evidence-based bundle of care · Quality metric · Improved outcomes · Preventable

Introduction

Healthcare quality and cost are major driving forces in our evolving U.S. healthcare delivery system. “Evidence-Based Bundle” of care, a concept developed by the Institute for Healthcare Improvement (IHI) usually involves 3–5 structured interventions based on scientific evidence, which when carried out consistently improve patient outcomes

[1]. Many of these “Bundles” have focused on reduction and prevention of HAI's (VAP, CLABSI, sepsis), which are considered preventable, as demonstrated in the landmark NEJM article describing the outcome of The Michigan Keystone ICU Patient Safety Program, which resulted in a large (66 %) and sustained decrease rate of catheter-related blood stream infections from 7.7 per 1,000 to 1.3 per 1,000 catheter days [2].

These bundles and their outcomes have become measurable and reportable quality metrics for ICU's and hospitals because they can be easily audited. They are now drivers for payment of care delivered under the newly implemented (2011) Final Payment Rule of the Healthcare Affordability Act, either in the form of Pay-4-Performance (P4P) or in the form of non-payment for “never” events (No-pay-for-harm) [3]. This encourages hospitals and providers to adopt practices that reduce errors and prevent hospital acquired illnesses or injuries in the attempt to reduce overall costs. The Affordable Care Act focuses on hospital-acquired conditions (HAC) that could have been prevented through the application of evidence-based guidelines (VAP, CLABSI, surgical site infections, catheter-related urinary tract infections etc.) [3].

The Ventilator Care Bundle

Ventilator associated pneumonia (VAP) remains a vaguely defined entity [4, 5] and a diagnostic conundrum [6], though the National Healthcare Safety Network (NHSN), the Centers for Disease Control and Prevention's (CDC's) Healthcare-Associated Infection (HAI) surveillance arm is currently redefining VAP as the Ventilator Associated Condition (VAC) with a far less ambiguous set of diagnostic criteria, which include three or more days on mechanical ventilation, with deteriorating oxygenation,

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and active SIRS criteria with the initiation of new antimicrobial agents, which are then continued for >4 days [7]. Mortality of patients who develop VAP is increased by an average of 9 % [8] with all-cause mortality of up to 50 % and a substantial added cost to the health care system [9]. These clinical outcomes have led to the aggressive implementation of patient care bundles to reduce VAP rates over the last decade. The rush to develop such ventilator care bundles (VCBs), gauging hospital performance on VAP rates, and a Medicare proposal to deny reimbursement for VAP care, have galvanized the use of VCBs across intensive care units (ICUs) in the United States [10] and elsewhere [11, 12].

Elements that are generally incorporated into VAP bundles include:

- Elevation of the head of the bed,
- Daily “sedation vacations” and assessment of readiness to extubate,
- Stress ulcer prophylaxis,
- Deep venous thrombosis prophylaxis
- Daily oral care with chlorhexidine [13]

Elevation of Head of Bed

Head-of bed elevation to 45° had been recommended in most VCBs, when feasible. A recent review of available literature through 2010 showed poor quality of evidence that this elevation was effective in reducing VAPs or its associated mortality. Potential harm from recumbent positioning includes increased risk of thromboembolism, interference with nursing tasks such as wound care and pressure ulcer prophylaxis. Given the potential harm and the weak evidence of VAP reduction, some groups do not recommend elevation of head of bed for routine ventilator care. [14] It is unclear if 45° is required to attain the benefit or simply any elevation above supine position (e.g. 10°) is simply as effective.

Sedation Vacation

The susceptibility to develop VAPs is directly related to duration of mechanical ventilation. Measures like daily sedation vacations and weaning protocols facilitate weaning and extubation and are part of most VCBs (discussed in more detail in the sedation section further in the chapter) [13]. Both measures come as level II evidence in the American Thoracic Society recommendation [15]. It appears that combining both measures is synergistic in decreasing ventilator days on average by three days [16].

Stress Ulcer Prophylaxis

Stress ulcer prophylaxis has become standard of care in most VCBs as “stress ulceration” of the gastric mucosa has been associated with worse outcomes in critically ill patients with respiratory failure, hypotension and sepsis [17]. Institution of stress ulcer prophylaxis has been shown to reduce upper gastrointestinal (GI) bleeding as well as VAPs in ventilated ICU patients [17–20]. Proton pump inhibitors (PPIs) and histamine 2 receptor agonists (H2RAs) both prevent clinically significant GI bleeding by raising the gastric pH, and have been shown to be more superior than acid suppressors such as sucralfate in reducing VAPs. The raised stomach pH has heightened the concern that PPIs and H2RAs will increase the incidence of VAP, though this has not been proven, and when PPIs are compared to H2RAs in a recent large meta-analysis, no significant differences in VAP rate were seen [21].

Deep Vein Thrombosis (DVT)

The risk of potentially fatal pulmonary emboli (PE) in critically ill patients on ventilators is high and thus prophylaxis is recommended for this patient population [22]. The DVT prophylaxis is effective in preventing PE's and can be in the form of low molecular weight heparin or unfractionated heparin products in conjunction with mechanical methods (intermittent compression devices and graduated compression stockings) if there is no contraindication (thrombocytopenia, coagulopathy, active hemorrhage, intracerebral hemorrhage) to anticoagulation. How to administer anticoagulation for prophylaxis is complex and difficult and is dependent on the patients' clinical condition. While there are many regimens to choose from, there is no single superior regimen [23–25]. Mechanical methods can be utilized alone if anticoagulation is contraindicated [26].

Oral Decontamination with Chlorhexidine

Oral decontamination with chlorhexidine is popular in many VCBs and was recently evaluated in many studies. In a meta-analysis of published work from 1996 to 2008, its effectiveness was clear and found to be an attractive and cost-effective intervention to reduce VAPs but again without effect on mortality [27, 28]. Povidone–iodine has also been used for oral decontamination and its effectiveness, if any, is inferior to chlorhexidine [28].

The VAPs occur following instrumentation of the airway [29] and many institutional VCBs are implementing methods to reduce ETT colonization and prevent contaminated micro aspiration. These methods can include: (1) silver coated ETT (NASCENT trial), which reduced

microbiologically confirmed VAP, but had no effect on hospital length of stay (LOS) or mortality; [30] (2) subglottic suction mechanisms to decrease subglottic secretions pooling and reduce contaminated micro aspirations, which has been shown to reduce VAP's but did not have a mortality benefit [31–34]. Another attempt at reduction of intubation time is by performing early tracheotomy to facilitate pulmonary care and weaning [35]. In a randomized trial of early versus late tracheostomy, there was no statistically significant difference in the incidence of VAPs despite a trend favoring early tracheostomy [36]. Multiple other interventions thought to reduce VAPs have not shown benefit when studied, but remain part of daily practices around the world and in some VCB's. Those include, scheduled ventilator circuit changes; closed endotracheal suctioning systems and routine chest physiotherapy [37].

Bundles of care combine multiple measures aiming to improve quality of care. It is evident that implementation of such bundles of care improve, in most cases, the quality of care and usually reduces the incidence of the targeted problem. In the case of VBCs, many studies of “before and after” have shown significant reduction in VAP rates [10, 38]. While the evidence for many of the measures used in VBCs is weak or non-existent on an individual basis, bundles bring focused and consistent care that may prove to be more important in improving quality of care than the sum of their components. Finally, it may be that combining certain measures, augments the overall effect to above the threshold of detection. In addition, most, if not all, measures do not appear to improve patient mortality despite its effect on the reduction of VAP. Some advocate deconstruction of the current bundles and starting over to standardize diagnosis and sort out preventive facts from fiction [5].

Example of Implementation of a VAP Bundle A real time bedside dashboard (See Fig. 1) was developed to track and report adherence of each component of the bundle; and it was integrated with nursing and respiratory therapy documentation and physician orders. Real-time updates occurred to the dashboard at 5 min intervals and components were color coded as being in compliance (green), nearing expiration (yellow) and out of compliance (red). Outcome measures which include bundle compliance and VAP rates are reported out daily to the Physician and Nursing leadership of the ICU's and monthly to the staff who work in the ICU. This has led to a significant decrease in VAP rates, costs and hospital days.

Central Line Bundle

Intravascular catheterization is a cornerstone of medical management of the critically ill patient, and these catheters

are required for fluid administration, invasive monitoring, laboratory work, blood transfusions, transvenous cardiac pacing, medication administration, and dialysis access. These invasive catheters result in about 250,000 central line associated blood stream infections (CLABSI) every year with a financial cost of \$18,432–\$36,500/CLABSI and have been associated with 2,400–20,000 deaths annually [2]. Although numerous single interventions can decrease the rate of CLABSI, the Centers for Disease Control and the Society for Critical Care Medicine recommend a bundle approach [39]. Best practices for the prevention of CLABSI include education of healthcare personnel involved with the insertion and maintenance of the CVCs about indications for catheter use, risks of placement, maintenance and general infection prevention strategies. The use of a catheter insertion checklist with a dedicated procedure assistant for monitoring and documentation improves compliance with the aseptic technique and infection prevention [40].

The key components of the Central Line Insertion Bundle are:

- Hand Hygiene
- Maximal barrier precautions during insertion
- Chlorhexidine skin antisepsis
- Optimal catheter site selection, with avoidance of the femoral vein for central access in adult patients
- Daily review of line necessity with prompt removal of unnecessary lines and disinfecting catheter hubs before accessing the catheter.

Hand Hygiene

Hand hygiene may be the most obvious of all infection control techniques, but it is a step often overlooked. Hand washing should be done prior to either catheter insertion or manipulation and is not obviated by the use of sterile gloves [41, 42].

Maximal Barrier Precautions

Maximal barrier precautions include mask, cap, gown and sterile gloves used by the proceduralist, and patients are to be covered by a large sterile drape, for insertion of new and during exchange of a line over a guidewire [43].

Chlorhexidine 2 % Solution

Chlorhexidine 2 % solution for skin prep is more effective than both 70 % alcohol and 10 % povidone iodine for prevention of CLABSI [44].

Bed	Patient name	Age	LOS	Orders			SBT	DVT	SUP	RASS	Pl.	Hob	swab	teeth	hySx
							Vent	Scrn	Trial						
3002B	T, V W	72y	6 d		flowsheet	MAR	v F		v v	-4 -4	30				
3003X	N, D	60y	17 d		flowsheet	MAR	v F		v v	0 -2	45				
3004B	T, P L	64y	34 d		flowsheet	MAR	v		v v	-1 -1	30				
3005A	C, D E	61y	7 d		flowsheet	MAR			v v	0 -1	30	v	v		
3005B	B, J	66y	7 d		flowsheet	MAR	v F		v v	-1 -3	30				
3006X	W, A A	20y	66 d		flowsheet	MAR	v		v v	-1 -2	30				
3007X	W, L E	49y	9:14		flowsheet	MAR			v	0 -1	30				
3008X	P, J L	69y	50 d		flowsheet	MAR	v F		v v	0 0	30				
3009X	R, C	72y	15 d		flowsheet	MAR	v F		v v	-1 -2	30				
3011A	P, J E	88y	9 d		flowsheet	MAR			v v	0 0	45	v	v		
3011C	J, W D	69y	2 d		flowsheet	MAR			v v	0 -1	30				
3011D	P, P J	55y	10 d		flowsheet	MAR	v P	P	v v	0 -3	30				
3011E	R, R E	74y	9 d		flowsheet	MAR			v v	0 0		v	v		
3011F	N, E Y	55y	3 d		flowsheet	MAR			v v	-1 0	30	v	v		
3012A	S, J D	56y	14 d		flowsheet	MAR	v F		v v	0 0	30				
3012B	R, M	63y	10 d		flowsheet	MAR	v F		v v	-2 -2	30				
3013A	N, B D	60y	8 d		flowsheet	MAR	v F		v v	-3 -2	30				
3013B	H, S M	66y	16 d		flowsheet	MAR			v v	0 -1	30	v	v		

Fig. 1 Ventilator bundle compliance dashboard. This real time bedside dashboard tracks and provides feedback with regards to timely compliance with and adherence to each component of the VAP bundle. The color code represents elements that are in compliance (green), nearing expiration (yellow) and out of compliance (red). Interpretative example: In the first patient in room 3002B, the patient was on a ventilator (denoted as a “v”), had a timely spontaneous breathing trial (SBT) screen, which she failed (denoted by the “F”) but within a green box noting the compliance of doing the SBT), had a

ordered/updated Richmond Agitation-Sedation Score (RASS) score, a patient actual RASS score and head of bed elevation documented at the scheduled intervals (hence, compliant and in green), but had no documented oral hygiene or hypopharyngeal suctioning (“swab” and “hySx” boxes red). The **bolded “v”** under DVT denotes ordered deep venous thrombosis prophylaxis; the “v” that is not bolded under SUP is to bring to the providers notice that stress ulcer prophylaxis is not ordered (Color figure online)

Access Site

Avoiding the femoral vein for central venous access in adults due to the increased risk of infection and DVT is recommended, though these complications may be limited to overweight adult patients with a body mass index > 28 [45–47].

Maintenance of CVCs

There is now intense focus on the maintenance aspect of CVCs with the use of needless ports, disinfecting hubs before accessing the line, replacements of medications and medication tubing and dressing changes which are all shown to impact CLABSI rate [48, 49]. Daily surveillance and removal of nonessential catheters at the earliest possible opportunity is also essential [50].

Implementation of a bundled approach for prevention of CLABSI has been shown to systematically decrease CRBSI

rates at both university hospitals [51] and in community hospitals [52, 53]. Likewise, this bundle approach has been shown to decrease arterial catheter related infections [54] and is, therefore, also included in the CDC guidelines for arterial catheters. Alternatively, it has been shown that lack of compliance with a bundle for insertion of a central venous catheter results in a 1.62 higher relative risk of infection [55], while compliance with the bundle can increase the average infection free period by two days [56]. Finally, continuous improvement of the bundle through provider feedback and incorporation of new evidence can help us drive the infection rate to our goal of zero [57].

Example of Implementation of Central Line Bundles The complete integration of the Central Line Bundle into our daily work flow in the ICU and the operating room with the help of an electronic checklist and immediate feedback from providers in the room (real time process measurements) have decreased our CLABSI rates significantly.

Surviving Septic Campaign (SSC) Guideline: Bundled Care for Septic Shock

The SSC guideline is designed to improve patient outcomes by combining effective component therapies in the care of septic patients and represents current best practice. What makes this guideline unique is that it was devised by the SSC Guidelines Committee, which is made up of 68 international experts, and after being first published in 2004, was revised in 2008 and updated in 2012. The SSC Guideline is the most robust evidence-based medicine (EBM) guideline in that it is the integration of relevant and valid research evidence, which is constantly updated, applied with sound clinical judgment and incorporates the patient's clinical state.

This guideline is more complicated than the usual 3–5 step bundle and can be broken down to a resuscitation bundle to be completed in the first 3–6 h of care and a stabilization guideline with many aspects of best clinical care practices for critically ill patients. Sepsis bundles have been associated with significant increase in survival and a decrease in the time on antibiotics and more appropriate antibiotic choices [58]. The efficacy of this guideline remains dependent on the early recognition of and, intervention in, a septic patient.

For details of the sepsis bundle, the readers are directed to the SCCM guidelines [59•]. Key elements of the Sepsis Bundle include the following—again for details of each element the reader is directed to the SSC guidelines and the references articles [60–67].

To be completed within 3 h:

1. Measure lactate level
2. Obtain blood culture prior to administration of antibiotics
3. Administer broad spectrum antibiotics
 - a. Within 1 h of recognition of septic shock
4. Administer 30 ml/kg crystalloid for hypotension or lactate >4 mmol/l

To be completed within 6 h:

1. Apply vasopressors (for hypotension that does not respond to the initial fluid resuscitation) to maintain a mean arterial pressure (MAP) >65 mmHg
2. In the event of persistent arterial hypotension despite volume resuscitation (Septic shock) or initial lactate >4 mmol/l:
 - a. Measure central venous pressure (CVP)—target >8 mmHg
 - b. Measure central venous oxygen saturation (Scvo₂)—target >70 % and normalization of lactate
 - c. Re-measure lactate if initial lactate was elevated

This guideline is comprehensive and complex but it is the early recognition of sepsis through screening, early administration of broad-spectrum antibiotics and the protocolized resuscitation of the severe septic patient or the patient in septic shock, evaluated by the serial measurement and clearance of lactate as perfusion improves, which have shown to impact mortality [68–70, 71•].

While the focus in the surviving sepsis guidelines is on early identification and treatment, the guidelines also recommend early attention to supportive therapies such as imaging, management of sedation, avoidance of steroids unless indicated, use of restrictive transfusion practices, glucose management, and restrictive fluid resuscitation in ARDS after hemodynamic stability is achieved.

In a multinational and multicenter performance improvement program undertaken by the Surviving Sepsis Campaign, the researchers recruited a large number of severe sepsis and septic shock patients into a large outcomes study based on the use of the sepsis bundle. They found that the integration and compliance with the sepsis bundle measures resulted in decreased hospital mortality in these patients, though direct causality was difficult to ascertain as it was not a randomized controlled trial [72].

Example of Implementation of the Sepsis Bundle and a Sepsis Alert: We have developed an electronic alerting system to alert providers when patients trigger at least two of the four SIRS criteria for sepsis. The provider then evaluates the patient and ascertains whether or not they are septic. If a provider declares a patient is septic, an electronic decision support tool will provide decision support to address the resuscitation phase of the sepsis bundle and prompts to optimize care of the critically ill septic patient in accordance with the surviving sepsis guideline.

Bundling Elements of ICU Care: Sedation and Delirium

Patients admitted to the intensive care unit (ICU) and on mechanical ventilation (MV), require analgesia and sometimes additional sedation, to tolerate being intubated, to prevent ventilator-patient dyssynchrony, to reduce oxygen consumption and metabolic stress, and to allow health care professionals to perform lifesaving procedures. Unfortunately, continuous infusions of sedatives as well as excessive/deep sedation have been associated with worsening patient outcomes including increased time on mechanical ventilation, delirium, neuropsychological sequelae and even long-term mortality [73, 74•, 75]. These data attest to the importance of balancing the need of using sedatives with the risks associated with overzealous use. Recent studies have helped guide us in optimal strategies to reduce unnecessary sedation use (sedation protocols, targeted sedation, daily sedation interruption) [16, 76, 77], in determining best sedative choices (reducing benzodiazepine use in favor of propofol or alpha₂ agonists)

[78, 79] and in understanding the risks associated with delirium or acute brain dysfunction in the ICU. This has led to a call to develop best sedation and delirium practices in critically ill patients and to bundle these elements into an easy to understand and to use framework. One such framework is the ABCDE bundle [80], which focuses on Awakening and Breathing Trials, Coordination of these efforts, Choosing the right sedative, Delirium monitoring and management and Early Mobility. This part of the article will describe the evidence behind each of these elements and provide practical implementation tips.

Awakening and Breathing Trials and their Coordination

Early studies evaluating best weaning strategies from mechanical ventilation have shown that a protocol that incorporates the daily evaluation for readiness for a spontaneous breathing trial (SBT), followed by a SBT in patients that pass the safety screen, reduces time on mechanical ventilation [81]. A similar approach of daily spontaneous awakening trial (SAT) in patients on mechanical ventilation showed that it too reduced time on mechanical ventilation without any untoward neuropsychological sequelae [77]. The Awakening and Breathing Trial (ABC trial) built on these landmark studies with a sequential and paired conduct of an SAT and a SBT, compared to the control group that had their sedation turned off and a SBT performed at the discretion of the medical team. They found that a linked SAT and SBT approach had an additive effect on reducing duration of mechanical ventilation, and at the same time a beneficial effect on 12-month mortality [16]. This linked approach significantly reduced the amount of benzodiazepine and propofol that patients were exposed to, which may have played a role in the improved outcomes. Conversely, the recently completed SLEAP study comparing protocolized light sedation versus a daily awakening trial in addition to protocolized light sedation, showed no significant benefit in duration of mechanical ventilation. This study had no in built safety screen to evaluate which patients should not have their sedation turned off and the amount of sedative use was significantly higher than both the intervention and control group of the ABC study, suggesting that it is important to reduce your sedative use to see any benefits [82]. Reported barriers to SATs include lack of nursing acceptance, concern about risk of patient-initiated device removal, and inducement of either respiratory compromise or patient discomfort [83]. Implementation strategies should, therefore, include a multidisciplinary approach to account for concerns of all the medical team members, focused in-services, development of specific safety screen parameters accounting for the patient population in the ICU, auditing and feedback reporting tools and having nurse and physician champions in each ICU.

Choice of Sedative

Benzodiazepines have been the cornerstone of sedative management practices globally for decades. Recent data have shown that sedation with benzodiazepines is associated with delirium and other worse clinical outcomes; the Pain Agitation and Delirium (PAD) guidelines from the Society of Critical Care Medicine (SCCM) have, therefore, recommended minimizing the use of benzodiazepines for routine sedation of critically ill patients and considering alternate sedation paradigms such as analgosedation, and the use of propofol and dexmedetomidine [84]. A landmark study by Strom et al. [85•] showed that a protocol that used morphine for analgosedation compared to propofol reduced duration of mechanical ventilation and ICU lengths of stay. Only 18 % of the patients that were in the morphine only group required rescue sedation, attesting to the fact that the majority of critically ill patients can be managed just with analgesics without the need for sedatives. Other studies have shown similar benefits of a remifentanyl based regimen over benzodiazepines [86]. With regards to sedatives, studies comparing sedation with propofol versus benzodiazepines, have, for the most part, shown beneficial effects with propofol [87]. Similarly dexmedetomidine has been shown to be superior to benzodiazepines (lorazepam and midazolam) with regards to decreasing delirium, reducing duration of mechanical ventilation and even improving mortality in a small subset of patients with sepsis [78, 79, 88]. Recent studies comparing propofol to dexmedetomidine have shown similar outcomes between these two agents making them the preferred agents for sedation, when required [89]. Health care teams, therefore, need to be educated on best sedative drugs and guided in their use. This can be through sedation protocols which first focus on analgesia and then guide teams to the right sedative to use, if the target sedation score (via use of a sedation scale) is not met. One such approach is shown in Fig. 2. Though both propofol and dexmedetomidine are more expensive than benzodiazepines, studies have shown that health care related costs are comparable or, in some instances even lower, with these drugs given the improvements in clinical outcomes [78, 79].

Delirium monitoring and management: Delirium or acute brain dysfunction is a prevalent organ dysfunction associated with increased ICU lengths of stay, higher costs, mortality and long term cognitive impairment [90]. Most cases of delirium go unrecognized unless routine monitoring is instituted via tools such as the Confusion Assessment Method–ICU (CAM–ICU) or the Intensive Care Delirium Screening Checklist (ICDSC) [91, 92], given that most delirium in the ICU is the hypoactive subtype and not the agitated hyperactive type. While age and severity of illness are risk factors for delirium,

Fig. 2 Empiric pain, sedation, and delirium protocol. This empiric protocol focuses on provision of analgesia first (either via intermittent or then continuous infusions). If after provision of analgesia, the patient does not achieve target sedation levels, consideration for propofol or dexmedetomidine should be made. Benzodiazepines should be reserved for the few patients with alcohol withdrawal or propofol intolerance. Patients should be evaluated for delirium with a focus on non-pharmacological management. With permission from www.icudelirium.org

sedatives (in particular benzodiazepines) and sleep deprivation may be modifiable risk factors for delirium [93]. Thus, in addition to non-pharmacological approaches such as reorientation of patients, decreasing restraint use, having geriatricians evaluate older patients, providing patients with their hearing aids and glasses etc., one should attempt to reducedeliriogenic medications (benzodiazepines, anticholinergics etc.) and improve patients sleep cycle through focused interventions in improving day night cycles. Data with regards to antipsychotic use is very preliminary with one study showing the benefit of low dose haloperidol infusions to prevent delirium, another showing benefit with quetiapine and risperidone, and the MIND study showing no benefit of an atypical and a typical antipsychotic agent over placebo [94–96].

Health care teams should, therefore, focus their initial implementation processes on incorporating routine

delirium monitoring, discussing acute brain organ dysfunction during rounds and thinking about non-pharmacological management strategies. Attention should be paid to reducing unnecessary exposure to deliriogenic medications.

Early Mobility

As we change sedation paradigms to have more awake patients, a complementary strategy is to increase mobility of our ICU patients. A number of studies have shown that early physical therapy is feasible in critically ill patients and that more patients who are mobilized early return to independent functional status at time of hospital discharge. Early mobility has also been shown to reduce delirium [97•]. Progressive mobility protocols should, therefore, be considered keeping in mind the availability of therapists [98]. While therapists are critical to the success of mobility protocols, it is also important to realize that bedside nurses and families can also play an important role in providing passive range of motion, some active range of motion and even getting patients up in the bed or chair to try and get them to dangle their feet. Having a mobility safety screen similar to the ones developed for SAT and SBT may assist teams in determining which patients are safe to be mobilized. A sedation score based mobility protocol as advocated by Morris et al. [98] and then Brummel et al. [99] should be considered.

Conclusion

The conclusion we draw is that bundled care to prevent hospital acquired infections and complications do in fact improve care and avoid poor outcomes though many scientific studies lack the methodological rigor required to draw absolute conclusions regarding the scientific evidence from which the bundles are derived. Institutional leadership, frontline ownership, accountability and culture change are required for effective integration of bundled care processes into the daily workflow in the ICU to realize the benefits of these bundles. They are a standardized tool with a small number of elements, that when done consistently and meets clear-cut parameters, will result in improved clinical outcomes, but the methodology used for implementation and monitoring of the bundles is as important as the bundles themselves to realize the clinical and financial benefit.

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