

Chapter 17

A Systemic Approach: ABCDEF Bundle



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17.1 Introduction

Aristotle said, “the whole is greater than the sum of its parts.” A *care bundle* is a little set (3–5) of evidence-based interventions, behaviors, and/or practices, aimed at a specific category of patients and care settings, to improve the outcomes. The base of *bundle* concept is to apply jointly and correctly its single parts, improving the quality and outcome of healthcare processes with larger effects than those obtained if every strategy is implemented separately [1].

Since 1996 many studies have questioned: how can we reduce tube time and days of MV? How can we reduce ICU LOS? How can we reduce hospital LOS? How can we improve patients’ survival rates? The answers were found in some practices as light level of sedation, protocol-led weaning from MV, spontaneous breathing trials, delirium prevention and management, and early mobility. The evolution of ABCDEF begun in the middle of the 1990s and is summarized in Table 17.1.

Table 17.1 Evolution of ABCDEF concept

Year	Concept	Authors	Outcomes/messages
1996	SBT protocol	Ely et al. [2]	-1.5 days MV
2000	SAT—daily sedative interruption	Kress et al. [3]	-2 days MV -3.5 days ICU LOS
2001	CAM-ICU validated	Ely et al. [4]	Delirium prevalence 87%
2002	Sedation-analgesia guideline revision	Jacobi et al. [5]	
2004	ICU delirium mortality risk	Ely et al. [6]	10% per day of delirium
2005	SAT and targeted sedation	Breen et al. [7]	-2.2 days MV
2006	Analgesia/sedation protocol titrated to BPS and RASS	Chanques et al. [8]	-21% pain -17% agitation -2.2 days MV -50% infection rates
2007	Feasibility, safety of early mobilization in MV respiratory ICU patients	Bailey et al. [9]	
2008	SAT + SBT = ABC (awakening and breathing controlled trial)	Girard et al. [10]	-3 days MV -4 days ICU and hospital LOS -32% risk of death
2008	ABC + EM	Morris et al. [11]	-1.4 days ICU LOS -3.3 days hospital LOS
2010	ABCDE protocol proposed	Vasilevskis et al. [12]	
2010	Duration of ICU delirium predicts long-term cognitive dysfunction	Girard et al. [13]	

Table 17.1 (continued)

Year	Concept	Authors	Outcomes/messages
2011	Confirmation of ABCDE bundle as organizational approaches to improve the management of mechanically ventilated patients	Morandi et al. [14]	
2013	Revised PAD guidelines	Barr et al. [15]	
2015	Systematic review of strategies for delirium	Trogrlić et al. [16]	Strategies targeting ICU delirium assessment and prevention and treatment and integrated within PAD or ABCDE bundle have the potential to improve clinical outcomes

The single studies aiming to implement specific practices should be seen as “improvement vectors” with different intensities, but having coordinated directions and orientations to a common goal. This target is the improvement of “hard” outcomes in ICU patients: morbidity and mortality rate reduction.

Therefore, the evidence-based *ABCDE bundle* is an integrated, systemic, and interdisciplinary approach to the management of MV patients. Spontaneous awakening and breathing trials have been combined into *awake and breathing coordination*, with the aim to reduce the duration of mechanical ventilation and ICU and hospital LOS and improve the survival rates. *Delirium monitoring* improves the recognition of this disorder,

but data on pharmacologic treatment are conflicting. *Early mobility and exercise* may reduce physical dysfunction and delirium rates [14].

Many institutions have expressed the concept of ABCDE bundle (or ABCDEF bundle, if we insert also the family involvement in patient's care) in different practice guidelines. The main models are those released by the American Association of Critical-Care Nurses (ACCN) [17] and Society of Critical Care Medicine (SCCM) [18] (Table 17.2).

The following paragraphs describe the ABCDEF bundle as a mix of two different approaches, highlighting the main topics of each one.

17.2 Assess and Manage Pain

Adult ICU patients routinely experience pain, both at rest and during routine care such as turning or endotracheal suctioning. Lack of treatment of pain can result in many complications including delirium, while assessing pain is associated with better outcomes and lower use of sedative and hypnotic agents [19].

Pain is a concept already explored in Chap. 2 and well defined by pain, agitation, and delirium guidelines [15]. It should be routinely monitored in all adult ICU patients. Self-report scales are considered the “gold standard,” and pain can be assessed in patients unable to communicate through the BPS or CPOT [20].

It is suggested that analgesia-first sedation should be used in MV adult ICU patients.

There's only one GRADE A1 PAD recommendation about pain management, concerning use of gabapentin or carbamazepine in addition to intravenous opioids, for treatment of neuropathic pain. The other recommendations are based on weak strength of evidence.

Table 17.2 ACCN vs. SCCM model of ABCDE(F) bundle [17, 18]

ACCN	Element	SCCM
Awakening and breathing trial coordination Oversedation and undersedation can lead to prolonged ventilator times for patients. <i>This “ABC” bundle component addresses daily spontaneous awakening trials (sedation vacation) and spontaneous breathing trials to promote early weaning and extubation</i>	A	Assess, prevent, and manage pain Recognize pain and find tools for its assessment, treatment, and prevention Both SAT and SBT Both spontaneous awakening trials and spontaneous breathing trails
Delirium assessment and management All of our patients are susceptible to developing delirium, often undetected and untreated in many patients, potentially leading to a host of negative long-term consequences. <i>This “D” bundle component addresses early identification and management of patients with delirium</i>	D	Choice of analgesia and sedation Recognize the importance of defining the depth of sedation, choosing the right medication Delirium: assess, prevent, and manage Recognize delirium risk factors and find tools for its assessment, treatment and prevention

(continued)

Table 17.2 (continued)

ACCN	Element	SCCM
<p>Early exercise and progressive mobility All patients with prolonged bedrest or immobility are prone to developing muscle weakness and atrophy, which can lead to a longer hospital stay and long-term muscle dysfunction. <i>This “E” bundle component provides guidance for enabling patients to become progressively more active and, possibly, walk while intubated</i></p>	E	<p>Early mobility and exercise ICU Early mobility involves more than changing the patient’s position</p>
	F	<p>Family engagement and empowerment Involving the family in patient care can help recovery</p>

17.3 Both Spontaneous Awakening Trial and Spontaneous Breathing Trial

The daily interruption of sedative administration (whether given by infusion or bolus doses) is combined with daily spontaneous breathing trials in the awakening and breathing controlled (ABC). A randomized controlled trial comparing a daily SAT + SBT protocol against a usual sedation + daily SBT approach showed a significant decrease in the 28-day and 1-year mortality in the intervention groups [10]. This set of interventions also significantly reduced the number of days on MV with a concomitant lessening in the LOS (4 days difference), when compared to SBT alone [10]. Lastly, although a higher proportion of patients in the intervention group self-extubated (10 vs. 4%, $p = 0.03$), the reintubation rates were not statistically different (3% against 2%, $p = 0.47$), showing that SAT + SBT was not less safe than traditional care [10].

The clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit recommend either daily sedation interruption or a light target level of sedation should be routinely used in mechanically ventilated adult ICU patients [21].

Both awakening and breathing trials are preceded by a safety screening to determine the possibility to stop sedatives and then to disconnect mechanical ventilation. The success of the trials is confirmed through a list of failure criteria. Many protocols for SAT-SBT are available in the web sites of hospitals and professional associations. An example of SAT/SBT strategies is synthesized in Fig. 17.1.

The American approach to SBT is performed using one of three breathing or ventilator modes reported in Table 17.3 [22]. The European approach is softer, acting a gradual weaning from ventilator supports, passing from PSV to T-piece, through CPAP systems. All methods/modes work without a clear superiority of no one [23].

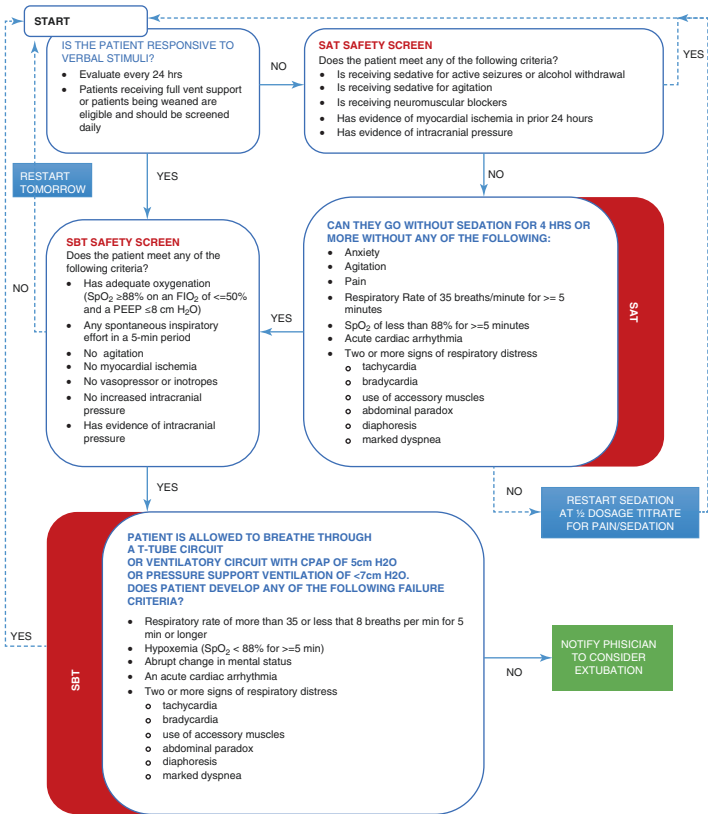


Fig. 17.1 Spontaneous breathing trial (SBT) example of protocol adapted from Girard 2008 [10]

Table 17.3 SBT methods/ventilator modes

“American approach”		“European approach”
Ventilator discontinuation:		Weaning from
Stopping ventilator if unnecessary and placing	Breathing or ventilator methods/modes	ventilator: Reducing ventilator support by
In	PSV <7 cmH ₂ O, with or without PEEP	Progressive reduction PSV
Or in	CPAP 5 cmH ₂ O	Progressive reduction PEEP
Or in	T-piece (FiO ₂ pre-SBT)	

17.4 Coordination and Communication

ABCDEF bundle necessarily needs a multi-professional team to be implemented. Usually, in the USA, the team is composed of nurses, physicians, respiratory therapists, pharmacists, and physical therapists, while in the European ICUs, frequently the team is made up only by physicians and nurses.

Effective communication and teamwork are important non-technical skills that every component of the ICU team needs to develop [21].

The value of effective teamwork for the provision of safe, high-quality care in fast-paced and unpredictable environments, such as intensive care units, has been increasingly recognized [24].

The PAD guidelines recommend to implement an interdisciplinary ICU team approach that includes provider education, preprinted and/or computerized protocols and order forms, and quality ICU rounds checklists. This approach aims to facilitate the use of pain, agitation, and delirium management guidelines and protocols in adult ICUs [15].

Several barriers to the implementation process of the ABCDE bundle were identified in literature.

The ABCDEF bundle requires coordinated care and timing among the different professionals as well as effective communi-

cation. In many circumstances, this would be best achieved via a process of multidisciplinary rounds. Formalizing the process of interdisciplinary rounds proved to be a key element to both improving interprofessional communication and improving ABCDE compliance [25].

Balas et al. found that the biggest problem about coordination of care was related to the lack of consistent interdisciplinary rounds. Also, when the rounds did occur, ABCDE bundle-related interventions and outcomes were rarely discussed [25].

A systematic review identified several best practices for ICU patient care rounds to increase providers' satisfaction, reduce rounding time, and improve patients' outcomes [26]. These included:

- Interprofessional rounds (physician, nurse, and pharmacist at minimum)
- Standardized practices
- Defined roles for all participants
- Use of structured tools
- Reduced time spent on nonessential activities
- Minimized interruptions
- Development and documentation of daily goals
- Choice of the best location for the rounds (bedside vs. conference room) to optimize patient-centeredness and efficiency
- Establishment of an open and collaborative discussion environment

17.5 Delirium Assessment, Prevention, and Management

Delirium is a concept already being explored in Chap. 2, defined as a disturbance of consciousness with inattention, accompanied by a change in cognitive status, or perceptual disturbance that

develops over a short period of time (hours to days) and fluctuates over time.

The implementation strategies to improve ICU clinicians' ability to effectively assess, prevent, and treat delirium and their effects on clinical outcomes were summarized in a recent literature review [16]. The authors concluded that multicomponent implementation including delirium-oriented interventions in critically ill patients can be useful [16]. Many studies reported improvements of both process outcomes (delirium screening adherence and knowledge) and clinical outcomes (short-term mortality and ICU LOS). Among the mentioned evidence-based interventions, early and progressive mobilization was the only intervention able to improve both delirium and clinical outcomes [16, 27].

Risk factors for delirium vary from patient to patient in ICU, and thus an individualized delirium prevention strategy should be sought. Nonetheless, three main risk factors are widespread in ICU settings: sedatives, immobility, and sleep disruption. These are often the result of clinical practice habits in most ICUs that should be changed focusing on delirium prevention. The delirium "preventive" strategies may be of benefit even in patients who have already developed this syndrome via their effect on duration of delirium [28]. The ABCDEF bundle combines the efforts to prevent delirium with the power to remind the importance of a patient- and family-centered care.

17.6 Early Mobilization

Early mobilization is a concept already explored in Chap. 5. A high proportion of survivors of critical illness suffer from significant physical, cognitive, and psychological disabilities. Profound neuromuscular weakness secondary to critical illness, prolonged bed rest, and immobility leads to impaired physical function. Physical impairment affects approximately 50% of

ICU patients, with at least half of discharged patients unable to return to premorbid levels of activity [29].

Cognitive impairment, including reduced executive function, memory, language, and attention, is widespread [30]. Evidence suggests that mobilization mitigates the physical, cognitive, and psychological complications of critical illness.

Mobilization has also been linked to decreased time on the ventilator [31], decreased LOS [32], and improved functional outcomes [33]. The mobilization of ICU patients is safe and feasible [34].

Serious adverse events following session of physical and occupational therapy in ICU patients are rarely reported, and only 4% of the sessions were interrupted for patient's instability (mainly due to asynchronies with mechanical ventilation) [27].

However, ICU patients are typically perceived as being too sick to tolerate activity. As a result they often have limited exposure to physical rehabilitation.

Protocols have been developed to describe and implement a safe and feasible early mobility practice, especially in the American context. In Europe where there is a frequent lack of physiotherapists dedicated to ICUs, nurses become protagonists in the implementation and guide of the mobilization of ICU patients. Tools, such as those represented in Table 17.4, can be useful to assist nurses in implementing mobility programs. Patients admitted to ICU should be evaluated within the first 8 h and every day for a safety screening (neurological, respiratory, and hemodynamic assessment) and then be included in the mobility protocol.

17.7 Family Engagement

The term “family” refers to persons related in any way (not only biologically but also legally or emotionally) to patients.

Table 17.4 Example of early mobilization protocol [35]

					↗	Walking
					↗	Out of bed twice a day
				↗	Dangling twice a day	Dangling twice a day
		↗	HOB 80° X 30' + At least once a shift	HOB 80° X 30' + At least once a shift	HOB 80° X 30' + At least once a shift	HOB 80° X 30' + At least once a shift
	↗	HOB 60° X 30 min At least once a shift	HOB 60° X 30 min At least once a shift	HOB 60° X 30 min At least once a shift	HOB 60° X 30 min At least once a shift	HOB 60° X 30 min At least once a shift
	HOB 30-45° + Lateral decubitus min once a shift	HOB 30-45° + Lateral decubitus min once a shift	HOB 30-45° + Lateral decubitus min once a shift	HOB 30-45° + Lateral decubitus min once a shift	HOB 30-45° + Lateral decubitus min once a shift	HOB 30-45° + Lateral decubitus min once a shift
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Sedation max	RASS -5	-4	-3	-2	-1	0
	SAS 1	1	3	3	3	4
	Consider, if possible	Transcutaneous electrical muscle stimulation (TEMS)				
			Consider, if possible	Passive Cycle ergometer		
					Consider, if possible	Passive Cycle ergometer

Unrestricted visitation and participation of a significant others (i.e., *family* as defined by the patient) can improve the safety of care and enhance patient and family satisfaction. This is especially true in ICU, where patients are usually intubated and cannot independently express their will. Unrestricted visitation from significant others can improve communication, facilitate a better understanding of the patient, advance patient- and family-centered care, and enhance staff satisfaction [36].

Family engagement comprises not only the interesting debate about visitation hours but more importantly how to involve significant others in the care of patients. McAdam et al. identified five roles that families take in the care of patients that were at high risk for dying in the ICU setting. These roles were [37]:

- To be an active presence for the patient, who facilitates communication and offers important personal and clinical information about the patient
- To be a protector and provide a feeling of safety for the patient by watching over them and advocate for him/her
- To act as historian, who provides much needed information about the patient
- To act as facilitator, to maintain relationships with other family members, friends, and coworkers
- To act as a coach providing motivation and inner strength
- To act as a voluntary caregiver aiding to accomplish the actual physical care of the patient and providing intimacy and caring touch

Some advantages of the family's participation were the perception of a greater sense of control and satisfaction with care. The disadvantages were family fatigue, guilt if the loved one does not do well, and additional work for the healthcare providers due to frequent interactions [37].

In 2016, the American Association of Critical-Care Nurses published an alert entitled “Family Visitation in Adult Critical-Care Unit Practice,” stating that children supervised by an adult family member are welcome as visitors in ICU [36]. There are no age restrictions. Although younger children may be unable to remain with the patient for long periods of time, contact with these children can be significant to the patient. They need to be prepared for the hospital environment and the family member’s illness as appropriate. Their behavior should be monitored by a responsible adult and the staff nurse to ensure a safe and restful environment for the patient and a positive and appropriate experience for children.

ICUs are encouraged to draft policies and procedures to create an optimal environment meeting the needs of patients, families, and healthcare workers.

17.8 Conclusion

Multicomponent implementation programs with strategies targeting ICU delirium assessment, prevention, and treatment and integrated within ABCDEF bundle have the potential to improve clinical outcomes [16].

A recent pre-post study showed statistically significant improvements of all patients’ outcomes related to the implementation of every single component of ABCDE bundle in ICU and at the same time an unchanged safety profile if compared with the pre-ABCDE bundle period in terms of accidental extubations, self-extubations, and reintubation rates [38]. There was also a reduction of the percent of ICU time in physical restraints post-ABCDE bundle period, even if not significant (6.9 vs. 12.7%, $p = 0.29$) [38].

However, the most encouraging results are from a recent large prospective cohort study about the implementation of PAD guidelines via ABCDE bundle on 6064 ICU patients [40]. If implemented all the interventions included in the bundle, there was a hospital survival OR of 1.07 (95% CI, 1.04–1.11; $p < 0.001$) for every rise of 10% in total bundle compliance. The patients' hospital survival OR was 1.15 (95% CI, 1.09–1.22; $p < 0.001$) for every rise of 10% in partial bundle compliance [39]. These results show that the efforts of ICU team in implementing this complex set of interventions can be widely paid back with better patients' outcomes.

There is also the need to develop adequate education and training programs to overcome potential resistance to change. At the same time, ABCDE bundle implementation is necessary in establishing a monitoring system about the affection of these interventions on the patients' "hard" outcomes.

The vision of the future about the ABCDEF philosophical approach is well drawn by E. Wes Ely, since he stated that this kind of approach shifts the healthcare workers' attention from the technological aspects of ICUs to a more "human connection" [40]. This holistic vision includes the respect of human dignity and the personal values of patients, during their stay in ICU, with an early use of palliative care to guarantee a respectable process of dying in patients that can't survive to their critically illness [40].

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