Defining Futile and Potentially Inappropriate Interventions: A Policy Statement From the Society of Critical Care Medicine Ethics Committee

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Objectives: The Society of Critical Care Medicine and four other major critical care organizations have endorsed a seven-step process to resolve disagreements about potentially inappropriate treatments. The multiorganization statement (entitled: An official ATS/AACN/ACCP/ESICM/SCCM Policy Statement: Responding to Requests for Potentially Inappropriate Treatments in Intensive Care Units) provides examples of potentially inappropriate treatments; however, no clear definition is provided. This statement was developed to provide a clear definition of inappropriate interventions in the ICU environment.

Design: A subcommittee of the Society of Critical Care Medicine Ethics Committee performed a systematic review of empirical research published in peer-reviewed journals as well as professional organization position statements to generate recommendations. Recommendations approved by consensus of the full Society of Critical Care Medicine Ethics Committees and the Society of Critical Care Medicine Council were included in the statement.

Measurements and Main Results: ICU interventions should generally be considered inappropriate when there is no reasonable expectation that the patient will improve sufficiently to survive outside the acute care setting, or when there is no reasonable expectation that the patient's neurologic function will improve sufficiently to allow the patient to perceive the benefits of treatment. This definition should not be considered exhaustive; there will be cases in which life-prolonging interventions may reasonably be considered inappropriate even when the patient would survive outside the acute care setting with sufficient cognitive ability to perceive the benefits of treatment. When patients or surrogate decision makers demand interventions that the clinician believes are potentially inappropriate, the seven-step process presented in the multiorganization statement should be followed. Clinicians should recognize the limits of prognostication when evaluating potential neurologic outcome and terminal cases. At times, it may be appropriate to provide time-limited ICU interventions to patients if doing so furthers the patient's reasonable goals of care. If the patient is experiencing pain or suffering, treatment to relieve pain and suffering is always appropriate.

Conclusions : The Society of Critical Care Medicine supports the seven-step process presented in the multiorganization statement. This statement provides added guidance to clinicians in the ICU environment. (*Crit Care Med* 2016; 44:1769–1774)

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In June 2015, the Society of Critical Care Medicine (SCCM), American Thoracic Society (ATS), American Association of Critical Care Nurses (AACN), American College of Chest Physicians, and European Society of Intensive Care Medicine (ESICM) published the ATS/AACN/ACCP/ESICM/SCCM Policy Statement on Responding to Requests for Potentially Inappropriate Treatments in Intensive Care Units (multiorganization statement) (1). The multiorganization statement defines futile interventions as those that simply cannot accomplish the intended physiologic goal. It defines proscribed treatments as those that are prohibited by applicable laws, judicial precedent, or widely accepted public policies (e.g., organ allocation strategies). It defines legally discretionary treatments as those for which there are specific laws, judicial precedent, or policies that give physicians permission to refuse to administer them. The multiorganization statement states that clinicians should not provide futile or proscribed interventions, and may choose to not provide legally discretionary treatments, and in such case clinicians should carefully explain the rationale for the refusal and may consider an ethics consultation if disagreements persist. In some cases, patients or families believe that clinicians are providing treatment that is inappropriate; however, such cases are not the subject of the multiorganization statement or the current statement.

The multiorganization statement defines "potentially inappropriate" treatments as those that have at least some chance of accomplishing the effect sought by the patient, but clinicians believe that competing ethical considerations justify not providing them. The statement also provides details regarding communication strategies and other methods to minimize conflict so that patients, surrogate decision-makers, and clinicians can reach mutually agreeable decisions about appropriate goals of care. The statement recommends that requests for potentially inappropriate treatment that remain intractable despite intensive communication and negotiation should be managed by a seven-step process: 1) Enlist expert consultation to continue negotiation during the dispute-resolution process; 2) Give notice of the process to surrogates; 3) Obtain a second medical opinion; 4) Perform review by an interdisciplinary hospital committee; 5) Offer surrogates the opportunity to transfer the patient to an alternate institution; 6) Inform surrogates of the opportunity to pursue extramural appeal; and finally 7) Implement the decision of the resolution process. The statement further specifies, "when time pressures make it infeasible to complete all steps of the conflict-resolution process and clinicians have a high degree of certainty that the requested treatment is outside accepted practice, they should refuse to provide the requested treatment and endeavor to achieve as much procedural oversight as the clinical situation allows" (1), that is, they should complete as much of the seven-step process as is practicable.

The multiorganization statement provides examples of potentially inappropriate treatments; however, a clear definition is not provided. The SCCM Ethics Committee believes that patients, families, and clinicians will benefit from a more consistent understanding of what generally constitutes inappropriate treatment, particularly in cases that involve time pressures that make it infeasible to complete all seven steps. Such a common understanding should decrease unwanted variability in patient care, although some variability will certainly persist. The SCCM Ethics Committee determined that a policy statement addressing this specific issue, based on empirical data and consensus opinion, is necessary. This statement was developed to broadly cover all ICUs, including, but not limited to, medical, surgical, trauma, neurologic, burn, cardiac, pediatric, pediatric cardiac, and neonatal ICUs. Because ICUs are highly variable, the committee focused on universal concepts in ICU care.

METHODS

A priori categories of potentially inappropriate interventions were developed. Categories included situations in which respondents would consider either cardiopulmonary resuscitation (CPR) or ICU interventions (often reported as mechanical ventilation) as inappropriate or futile, and similar situations in which respondents would not personally want CPR or ICU interventions (for complete details, see Appendix 1, Supplemental Digital Content 1, http://links.lww.com/CCM/B979).

Systematic review of publications in PubMed presenting data on futility or inappropriate interventions/treatments was performed. Inclusion criteria were English language reports of empirical research. Exclusion criteria were research performed in Asia or the Middle East (because these populations tend to have different standards of futility, including concepts of death by neurologic criteria) and research performed in third-world countries (because in these regions, decisions regarding appropriate and inappropriate interventions are often heavily influenced by limited resources). Abstracts for all reports were reviewed for primary screening, and full papers for all reports of empirical data were reviewed by two members of the writing committee. Recommendations were discussed by the full SCCM Ethics Committee throughout the writing process, and only those recommendations for which there was consensus were included.

DEFINING POTENTIALLY INAPPROPRIATE INTERVENTIONS

When asked to define potentially inappropriate interventions, physicians, nurses, and other healthcare staff appear to agree that life-prolonging interventions (or in some cases, interventions that merely prolong the dying process) are inappropriate when the patient will not survive outside the acute care setting or when the patient has irreversible severe neurologic injury (2–5). (nota bene: we use the term "potentially inappropriate" interventions for reasons articulated in the multiorganization statement. Empirical research assessing how physicians, nurses, patients, and family members define such interventions has

generally used the term "futile interventions." As such, the data presented here regarding how individuals define potentially inappropriate interventions are based on research regarding how individuals define futile interventions and/or futility.) Three studies reported that when physicians were asked what they themselves would want, over 95% stated that they would not want CPR or mechanical ventilation if they had severe neurologic injury (persistent vegetative state [PVS], permanent coma) (6–8). In one study, approximately 90% of physicians stated that they would not want CPR or mechanical ventilation if they were unable to recognize people or to speak understandably (9). When asked about preferences in the case of advanced dementia, one study reported that 98% of physicians would not want CPR; another reported that 95% would not want mechanical ventilation and 76% would not want CPR (7, 8). One study reported that 87% of physicians would not want mechanical ventilation if they would not recover to survive outside the ICU (7).

These findings are consistent with the position statements of medical professional organizations. In 1991, the ATS asserted that an intervention is futile if it is highly unlikely to result in "meaningful survival" for that patient, and stated that such interventions could be withheld or withdrawn without consent of the patient or surrogate decision-maker (10). In 1995, the Canadian Medical Association advocated that healthcare facilities develop policies to ensure a multidisciplinary approach to conflict resolution in cases of futile and nonbeneficial interventions. The statement asserted that interventions are nonbeneficial if there is no reasonable hope of recovery or if the person is permanently unable to experience any benefit (11). In 1997, the SCCM advocated a process-based approach for interventions that are not medically advisable and provided examples such as a patient in PVS (12). In 1999, the American Medical Association advocated a process-based approach to conflicts over futile interventions noting that such an approach should be enacted in cases when interventions merely prolong the dying process or when the patient is in PVS (13). In 2011, the California Medical Association issued a white paper and model policy that defined nonbeneficial interventions as those that "in a physician's professional judgment, produces effects that cannot reasonably be expected to be experienced by the patient as beneficial or to accomplish that patient's expressed and recognized medical goals, or has no realistic chance of returning the patient to a level of health that permits survival outside of the acute care setting" (14).

Fewer studies have assessed patient and family perceptions of inappropriate interventions. In one study, 90% of patients agreed that physicians need not offer mechanical ventilation if the physician judges it to be futile (15). Another study demonstrated wide agreement among patients that merely keeping organs alive is not appropriate (16). In another study, when patients with chronic obstructive pulmonary disease were given a scenario where they themselves were in permanent coma, 91% stated that they would not want CPR and 94% would not want to be on a ventilator; when given a scenario where they had advanced dementia, 82% would not want CPR and 85% would not want to be on a ventilator (8). In the same study, when homeless individuals were given a scenario where they were in permanent coma, 67% would not want CPR and 58% would not want to be on a ventilator; when given a scenario where they had advanced dementia, 77% would not want CPR and 68% would not want to be on a ventilator (8). Two studies suggest that Caucasians are generally more inclined to refuse life-prolonging interventions than their non-Caucasian counterparts; however, even among minority groups, the majority appear to generally agree with the statements above (6, 8). These data suggest that a majority of patients and family members may be in general agreement with healthcare professionals regarding what constitutes potentially inappropriate treatment.

Based on these data and consensus opinion of the SCCM Ethics Committee, the primary goal of ICU care is to provide treatment to patients for whom there is a reasonable expectation of survival outside the acute care setting with sufficient cognitive ability to perceive the benefits of treatment. "ICU interventions should generally be considered inappropriate when there is no reasonable expectation that the patient will improve sufficiently to survive outside the acute care setting, or when there is no reasonable expectation that the patient's neurologic function will improve sufficiently to allow the patient to perceive the benefits of treatment." This definition should not be considered exhaustive; there will be cases in which life-prolonging interventions may reasonably be considered inappropriate even when the above criteria are not met. As evidenced by the data presented above, it is expected that some patients and families will object to decisions to limit or withdraw life-prolonging interventions. When the patient or surrogate decision maker(s) does not agree with the clinician's decision, the clinician should follow the seven-step process outlined above before limiting or withdrawing life-prolonging interventions (1). As noted in the multiorganization statement, retrospective review, reporting, and tracking of such cases and outcomes are important to ensure fairness and equitability, and to follow for any unintended consequences (1). When time pressures make it infeasible to complete all seven steps and there is no reasonable expectation that the patient will improve sufficiently to survive outside the acute care setting with sufficient neurologic function to perceive the benefits of treatment, clinicians should refuse to provide the requested treatment and should complete as much of the seven-step process as the clinical situation allows (1). Such a decision is consistent with professional standards and good medical practice.

Some providers and institutions may believe that they should never overrule a patient or surrogate decision maker who is requesting life-prolonging interventions. These providers and institutions may support providing ICU care to a patient even when the above definition is met (17). Nothing in this statement should be construed as restricting the ability of such providers and institutions to provide such care. The purpose of this statement is to provide guidance that may be used by providers and institutions in cases in which they believe specific interventions are potentially inappropriate,

particularly in time-limited situations. The guidance provided in this statement should be considered neither exhaustive nor obligatory.

At times, it may be appropriate to provide time-limited ICU interventions to a patient when the above definition is met if doing so furthers the patient's reasonable goals of care (17). For example, a patient with end-stage cancer who will not survive outside the acute care setting may have a strong desire to be kept alive long enough to say "goodbye" to her daughter who is travelling to the hospital from far away. In such a case, although the default decision would be that ICU interventions are not appropriate, providers may agree that providing ICU interventions for a period of time to allow the patient to see her daughter is appropriate. Such decisions should be made on a case-by-case basis.

In some ICUs, it may be appropriate to admit patients for specific palliative interventions or for end-of-life care that provides comfort through the dying process. Such admissions, however, may not be appropriate in other ICUs. When the patient is experiencing pain or suffering, palliative interventions (i.e., treatments to ameliorate pain and suffering) are always appropriate. Although providing life-prolonging interventions may be deemed inappropriate in some cases, patients have a right to high-quality holistic care to relieve pain or suffering if they are experiencing such symptoms.

CONSIDERATIONS IN PROGNOSTICATION

When determining whether ICU interventions are appropriate in a specific case, clinicians must establish the prognosis in regard to survival outside the acute care setting and recovery of cognitive ability sufficient to perceive the benefits of treatment. Such prognostication, however, can be difficult. Objective scoring systems have been developed, and have demonstrated high reliability in specific disease and injury states (18–27). Data suggest that for some specific categories of patients, clinicians can accurately predict those who will not survive outside the acute care setting and/or will not regain meaningful cognitive ability (28–44). Such data must be reevaluated periodically in light of ever-improving diagnostic and prognostic ability and as advances in medical and surgical treatments improve outcomes (45–49).

Although prognostication is highly accurate and reliable in some specific disease and injury states, our ability to accurately predict survival and neurologic outcome for many patients remains suboptimal, and healthcare professionals are often overly pessimistic (50–53). Although providers with more experience are generally more accurate in their prognostic predictions (54, 55), neither available scoring systems nor providers are highly accurate for many patients (50, 56, 57). There are some data to suggest, however, that over the course of the patient's ICU stay, prognostication does improve (58, 59). In the case of infants and children, clinicians must consider the potential for cognitive development over time, and should assess the likelihood that the child might develop sufficient cognitive ability to perceive the benefits of treatment in the future.

Data further suggest that patients' and families' confidence in providers' abilities to prognosticate is suboptimal. One study assessed family members' belief that doctors' predictions of survival are accurate and their willingness to withdraw life-prolonging interventions based on such predictions. The investigators found that 40% of family members did not believe that doctors can accurately predict 0% survival, and most did not trust the doctor's statement of 0% survival. In this study, 32% of family members stated that they would continue life-prolonging interventions even if the doctor stated that there was less than 1% chance of survival, and 18% stated that they would continue life-prolonging interventions even if the doctor stated that there was a 0% chance of survival (60). As suggested in the multidisciplinary statement, specific strategies are essential to build trust and optimize communication. Such strategies include active listening during family meetings, provision of emotional support and trust-building techniques, presentation in clear language that is free from medical jargon, and actively eliciting and attending to the patient's values and preferences (see the multiorganization statement for complete recommendations) (1).

Such data suggest that providers should be cautious in survival and neurologic prognostication. To improve prognostic certainty, providers should consider the patient's course over time as well as the opinions of other experts in critical care medicine, neurocritical care, and/or other specialties.

RECOMMENDATIONS

1. Appropriate goals of ICU care include:
   a. Treatment that provides a reasonable expectation for survival outside the acute care setting with sufficient cognitive ability to perceive the benefits of treatment.
   b. Palliative care that provides comfort to patients through the dying process may be an appropriate goal of care in some ICUs.
2. ICU interventions should generally be considered inappropriate when there is no reasonable expectation that the patient will improve sufficiently to survive outside the acute care setting, or when there is no reasonable expectation that the patient's neurologic function will improve sufficiently to allow the patient to perceive the benefits of treatment.
3. The above definition should not be considered exhaustive. There will be cases in which life-prolonging interventions may reasonably be considered inappropriate even when the above definition is not met.
4. Decisions regarding whether specific interventions are inappropriate should be made on a case-by-case basis (1).
5. The term "futile" should be used only in the rare circumstance that an intervention simply cannot accomplish the intended physiologic goal. Clinicians should not provide futile interventions and should carefully explain the rationale for the refusal (1).

6. As detailed in the ATS/AACN/ACCP/ESICM/SCCM Policy Statement on Responding to Requests for Potentially Inappropriate Treatments in Intensive Care Units (1), a process-based approach should be used whenever an intervention is considered potentially inappropriate yet the patient or surrogate decision maker(s) requests the intervention.
7. When time pressures make it infeasible to complete all seven steps and the above definition is met, clinicians should refuse to provide the requested treatment and endeavor to complete as much of the seven-step process as the clinical situation allows (1). Such a decision is consistent with professional standards and good medical practice.
8. At times, it may be appropriate to provide time-limited ICU interventions to a patient even when the above definition is met if doing so furthers the patient's reasonable goals of care.
9. If the patient is experiencing pain or suffering, treatment to relieve pain and suffering is always appropriate.

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REFERENCES

1. Bosslet GT, Pope TM, Rubenfeld GD, et al; American Thoracic Society ad hoc Committee on Futile and Potentially Inappropriate Treatment; American Thoracic Society; American Association for Critical Care Nurses; American College of Chest Physicians; European Society for Intensive Care Medicine; Society of Critical Care: An Official ATS/AACN/ACCP/ESICM/SCCM Policy Statement: Responding to requests for potentially inappropriate treatments in intensive care units. *Am J Respir Crit Care Med* 2015; 191:1318–1330
2. Sibbald R, Downar J, Hawryluck L: Perceptions of "futile care" among caregivers in intensive care units. *CMAJ* 2007; 177:1201–1208
3. Jacobs LM, Burns KJ, Jacobs BB: Nurse and physician preferences for end-of-life care for trauma patients. *J Trauma* 2010; 69: 1567–1573
4. Jox RJ, Schaider A, Marckmann G, et al: Medical futility at the end of life: The perspectives of intensive care and palliative care clinicians. *J Med Ethics* 2012; 38:540–545
5. Huynh TN, Kleerup EC, Wiley JF, et al: The frequency and cost of treatment perceived to be futile in critical care. *JAMA Intern Med* 2013; 173:1887–1894
6. Mebane EW, Oman RF, Kroonen LT, et al: The influence of physician race, age, and gender on physician attitudes toward advance care directives and preferences for end-of-life decision-making. *J Am Geriatr Soc* 1999; 47:579–591
7. Marik PE, Varon J, Lisbon A, et al: Physicians' own preferences to the limitation and withdrawal of life-sustaining therapy. *Resuscitation* 1999; 42:197–201
8. Norris WM, Nielsen EL, Engelberg RA, et al: Treatment preferences for resuscitation and critical care among homeless persons. *Chest* 2005; 127:2180–2187
9. Gallo JJ, Straton JB, Klag MJ, et al: Life-sustaining treatments: What do physicians want and do they express their wishes to others? *J Am Geriatr Soc* 2003; 51:961–969
10. American Thoracic Society: Withholding and withdrawing life-sustaining therapy. *Ann Intern Med* 1991; 115:478–485
11. Joint statement on resuscitative interventions (update 1995): CMA policy summary. *CMAJ* 1995; 153:1652A–1652F
12. Consensus statement of the Society of Critical Care Medicine's Ethics Committee regarding futile and other possibly inadvisable treatments. *Crit Care Med* 1997; 25:887–891
13. Medical futility in end-of-life care: Report of the Council on Ethical and Judicial Affairs. *JAMA* 1999; 281:937–941
14. Responding to requests for non-beneficial treatment: A white paper prepared by the CMA Council on Ethical Affairs in conjunction with the CMA Center for legal Affairs. California Medical Association, July 2011
15. Curtis JR, Patrick DL, Caldwell ES, et al: The attitudes of patients with advanced AIDS toward use of the medical futility rationale in decisions to forego mechanical ventilation. *Arch Intern Med* 2000; 160:1597–1601
16. Rodriguez KL, Young AJ: Perceptions of patients on the utility or futility of end-of-life treatment. *J Med Ethics* 2006; 32:444–449
17. Schneiderman LJ, Capron AM: How can hospital futility policies contribute to establishing standards of practice? *Camb Q Healthc Ethics* 2000; 9:524–531
18. Knaus WA, Draper EA, Wagner DP, et al: APACHE II: A severity of disease classification system. *Crit Care Med* 1985; 13:818–829
19. Knaus WA, Wagner DP, Draper EA, et al: The APACHE III prognostic system. Risk prediction of hospital mortality for critically ill hospitalized adults. *Chest* 1991; 100:1619–1636
20. Le Gall JR, Lemeshow S, Saulnier F: A new Simplified Acute Physiology Score (SAPS II) based on a European/North American multicenter study. *JAMA* 1993; 270:2957–2963
21. Lemeshow S, Teres D, Klar J, et al: Mortality Probability Models (MPM II) based on an international cohort of intensive care unit patients. *JAMA* 1993; 270:2478–2486
22. Marshall JC, Cook DJ, Christou NV, et al: Multiple organ dysfunction score: A reliable descriptor of a complex clinical outcome. *Crit Care Med* 1995; 23:1638–1652
23. Vincent JL, Moreno R, Takala J, et al: The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure. On behalf of the Working Group on Sepsis-Related Problems of the European Society of Intensive Care Medicine. *Intensive Care Med* 1996; 22:707–710
24. Metnitz PG, Moreno RP, Almeida E, et al; SAPS 3 Investigators: SAPS 3–From evaluation of the patient to evaluation of the intensive care unit. Part 1: Objectives, methods and cohort description. *Intensive Care Med* 2005; 31:1336–1344
25. Moreno RP, Metnitz PG, Almeida E, et al; SAPS 3 Investigators: SAPS 3–From evaluation of the patient to evaluation of the intensive care unit. Part 2: Development of a prognostic model for hospital mortality at ICU admission. *Intensive Care Med* 2005; 31:1345–1355
26. Zimmerman JE, Kramer AA, McNair DS, et al: Acute Physiology and Chronic Health Evaluation (APACHE) IV: Hospital mortality assessment for today's critically ill patients. *Crit Care Med* 2006; 34:1297–1310
27. Ho KM, Knuiman M, Finn J, et al: Estimating long-term survival of critically ill patients: The PREDICT model. *PLoS One* 2008; 3:e3226
28. Bratton SL, Jardine DS, Morray JP: Serial neurologic examinations after near drowning and outcome. *Arch Pediatr Adolesc Med* 1994; 148:167–170
29. Reisfield GM, Wallace SK, Munsell MF, et al: Survival in cancer patients undergoing in-hospital cardiopulmonary resuscitation: A meta-analysis. *Resuscitation* 2006; 71:152–160

30. Thenayan EA, Savard M, Sharpe MD, et al: Electroencephalogram for prognosis after cardiac arrest. *J Crit Care* 2010; 25:300–304
31. Cronberg T, Rundgren M, Westhall E, et al: Neuron-specific enolase correlates with other prognostic markers after cardiac arrest. *Neurology* 2011; 77:623–630
32. Courtwright A: Who is "too sick to benefit"? *Hastings Cent Rep* 2012; 42:41–47
33. Cronberg T, Horn J, Kuiper MA, et al: A structured approach to neurologic prognostication in clinical cardiac arrest trials. *Scand J Trauma Resusc Emerg Med* 2013; 21:45
34. Goodman D, Kasner SE, Park S: Predicting early awakening from coma after intracerebral hemorrhage. *Front Neurol* 2013; 4:162
35. Mulder M, Gibbs HG, Smith SW, et al: Awakening and withdrawal of life-sustaining treatment in cardiac arrest survivors treated with therapeutic hypothermia. *Crit Care Med* 2014; 42:2493–2499
36. Hunt WE, Hess RM: Surgical risk as related to time of intervention in the repair of intracranial aneurysms. *J Neurosurg* 1968; 28:14–20
37. Teasdale GM, Drake CG, Hunt W, et al: A universal subarachnoid hemorrhage scale: Report of a committee of the World Federation of Neurosurgical Societies. *J Neurol Neurosurg Psychiatry* 1988; 51:1457
38. Skandalakis LJ, Pemberton LB, Gray SW, et al: The duodenum. Part 4: Surgery. *Am Surg* 1989; 55:492–494
39. Hemphill JC 3rd, Bonovich DC, Besmertis L, et al: The ICH score: A simple, reliable grading scale for intracerebral hemorrhage. *Stroke* 2001; 32:891–897
40. Fanshawe M, Venkatesh B, Boots RJ: Outcome of stroke patients admitted to intensive care: Experience from an Australian teaching hospital. *Anaesth Intensive Care* 2002; 30:628–632
41. Perel P, Arango M, Clayton T, et al; MRC CRASH Trial Collaborators: Predicting outcome after traumatic brain injury: Practical prognostic models based on large cohort of international patients. *BMJ* 2008; 336:425–429
42. Rost NS, Smith EE, Chang Y, et al: Prediction of functional outcome in patients with primary intracerebral hemorrhage: The FUNC score. *Stroke* 2008; 39:2304–2309
43. Steyerberg EW, Mushkudiani N, Perel P, et al: Predicting outcome after traumatic brain injury: Development and international validation of prognostic scores based on admission characteristics. *PLoS Med* 2008; 5:e165
44. Smith EE, Shobha N, Dai D, et al: Risk score for in-hospital ischemic stroke mortality derived and validated within the Get With the Guidelines-Stroke Program. *Circulation* 2010; 122:1496–1504
45. Juul N, Morris GF, Marshall SB, et al: Intracranial hypertension and cerebral perfusion pressure: Influence on neurological deterioration and outcome in severe head injury. The Executive Committee of the International Selfotel Trial. *J Neurosurg* 2000; 92:1–6
46. Vespa PM, Boscardin WJ, Hovda DA, et al: Early and persistent impaired percent alpha variability on continuous electroencephalography monitoring as predictive of poor outcome after traumatic brain injury. *J Neurosurg* 2002; 97:84–92
47. Karathanou A, Paterakis K, Pakopoulou M, et al: Biochemical markers analyzed using microdialysis and traumatic brain injury outcomes. *J Neurosurg Sci* 2011; 55:173–177
48. Honeybul S, O'Hanlon S, Ho KM: Decompressive craniectomy for severe head injury: Does an outcome prediction model influence clinical decision-making? *J Neurotrauma* 2011; 28:13–19
49. Stein DM, Hu PF, Chen HH, et al: Computational gene mapping to analyze continuous automated physiologic monitoring data in neurotrauma intensive care. *J Trauma Acute Care Surg* 2012; 73:419–424
50. Sinuff T, Adhikari NK, Cook DJ, et al: Mortality predictions in the intensive care unit: Comparing physicians with scoring systems. *Crit Care Med* 2006; 34:878–885
51. Litton E, Ho KM, Webb SA: Comparison of physician prediction with 2 prognostic scoring systems in predicting 2-year mortality after intensive care admission: A linked-data cohort study. *J Crit Care* 2012; 27:423.e9–423.e15
52. Frick S, Uehlinger DE, Zuercher Zenklusen RM: Medical futility: Predicting outcome of intensive care unit patients by nurses and doctors–a prospective comparative study. *Crit Care Med* 2003; 31:456–461
53. Becker KJ, Baxter AB, Cohen WA, et al: Withdrawal of support in intracerebral hemorrhage may lead to self-fulfilling prophecies. *Neurology* 2001; 56:766–772
54. Barrera R, Nygard S, Sogoloff H, et al: Accuracy of predictions of survival at admission to the intensive care unit. *J Crit Care* 2001; 16:32–35
55. Gusmão Vicente F, Polito Lomar F, Mélot C, et al: Can the experienced ICU physician predict ICU length of stay and outcome better than less experienced colleagues? *Intensive Care Med* 2004; 30:655–659
56. Rodriguez RM, Wang NE, Pearl RG: Prediction of poor outcome of intensive care unit patients admitted from the emergency department. *Crit Care Med* 1997; 25:1801–1806
57. Joynt GM, Gomersall CD, Tan P, et al: Prospective evaluation of patients refused admission to an intensive care unit: Triage, futility and outcome. *Intensive Care Med* 2001; 27:1459–1465
58. Afessa B, Keegan MT, Mohammad Z, et al: Identifying potentially ineffective care in the sickest critically ill patients on the third ICU day. *Chest* 2004; 126:1905–1909
59. Ibsen LM, Koch T: Submersion and asphyxial injury. *Crit Care Med* 2002; 30:S402–S408
60. Zier LS, Burack JH, Micco G, et al: Surrogate decision makers' responses to physicians' predictions of medical futility. *Chest* 2009; 136:110–117