Published in final edited form as:

Intensive Care Med. 2017 July ; 43(7): 1039–1040. doi:10.1007/s00134-016-4640-9.

Intensive Care Medicine in 2050: Cost-Effectiveness Analysis

Michael R. Pinsky, MD^{*}, Andreas Valentin, MD^{**}, and Gordon Rubenfeld, MD^{***}

^{*}Department of Critical Care Medicine, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

^{**}Department of Internal Medicine, Kardinal Schwarzenberg Hospital, Schwarzach, Austria

^{***}Institute for Health Policy, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada

Over the last centuries Intensive Care Medicine (ICM) has written a story of success that could not have been foreseen at its birth in the 1950s. Despite an increasing age and severity of illness in intensive care patients a 35% relative decrease in mortality for Intensive Care Unit admissions from 1988 to 2012 has been observed (1). It can be expected that such advances will continue, but at which price? Health care is expensive and acute ICM is very expensive, although far from being the most expensive medical discipline (think e.g. of oncology). In this context patient-centered expectations are challenged by society-driven limitations leading to a discussion about values, costs and effectiveness. Continued and even more open societal discussions balancing ethics and economics must occur. For example, pure survival will not be the ultimate goal of intensive care when considering both ethical and economic perspectives.

Realistically, no society can afford to treat all its population with all possible therapies regardless of their utility merely because such therapies can be given. As populations evolve a moral healthcare imperative emerges, the rational rationing of critical care resources. Such decision making is done at the individual patient care level but more importantly at the national organizational level, because such decisions at these levels limit the therapeutic options available to the local healthcare system and individual clinicians. A reasonable mechanism to assess utility of treatments and to maximize the greatest benefit to individual patients by society and policy makers is to perform a cost-effectiveness analysis among effective interventions to maximize population health. As we previously noted (2), the most appropriate measure of cost should be at the societal level and not the healthcare system level, so that the impact of treatments or limitations are measured in terms of the overall costs to society in terms of long-term healthcare costs and impact of disease of family and society as a whole. Saving patients from death only to have them remain dependent of prolonged supportive care services may not be in society or the patient's best interests. For example, decompressive craniotomy for neurotrauma saves lives but markedly increases the number of survivors in persistent vegetative states (3). Clearly, the health-related quality of life following recovery from critical illness is a personal perspective, and one patient and

Address correspondence to: Michael R. Pinsky, MD, 606 Scaife Hall, 3550 Terrace Street, Pittsburgh, PA 15261, USA, pinsky@pitt.edu.

Conflicts of interest: none declared

their family's perception of an acceptable quality of life may be quite intolerable to another. But such perception heterogeneity needs to be accepted and part of any limitation of care discussion.

We have made great strides in quantifying the short-term costs of acute healthcare treatments (2). However, pitfalls remain. Not everything that shortens ICU or hospital length of stay saves overall costs because many costs are front-loaded into the first days of hospitalization and because ICU and hospital days are often traded for equally expensive alternate sites (5, 6). Still, these analyses poorly model long-term healthcare costs (7) and ignore completely the massive financial and social impact of survivorship on the informal caregivers (i.e. family)(8). These holistic cost analyses need to be better defined in the future if we are to apply reasonable cost numbers to the impact of ICM.

Therapeutic effectiveness is also a moving target. A societal measure of treatment benefit can be quantified as quality-adjusted live years (QALYs)(9). QALYs merges survivorship duration with it associated resultant quality of life. Thus, in the example above, decompressive craniotomy resulted in fewer QALYs than usual care because those that survived usual care were more functional. As we evolve into a more open society with immediate information available, we are both at risk of being swayed by emotion and crisis to rescue those at risk no matter the cost, while also being offered a more complete picture of the impact of such emotive decisions. No matter how compelling the cost-effectiveness data, clinicians will have trouble not using rescue strategies to "save" an identifiable life in imminent danger. Finally, it is society that should define its own values for healthcare effectiveness and these should be discussed opening and iteratively as new therapies and evolving realities (e.g. global warming, epidemics, natural disasters) define.

Natural experiments in applying cost-effectiveness approaches to global healthcare exist. Notably, Oregon created a list of 100 diseases of treatments that were deemed to be the most cost-effective in terms of the maximum number of people treated for a given acute care cost. The treatment of these diseases was to be offered free of charge to all citizens in the state (10). Although this may seem like a wonderful idea, the devil was in the details. Several treatments that easily saved lives as minimal risk to the patient, like emergency surgery for ectopic pregnancy, did not make the list. How then does one define a "humanistic" effectiveness? We are at risk of dehumanizing national and global rationing of critical care resources if we allow administrators, even with the best of intentions, to perform these calculations without open societal input into this process.

Cost-effectiveness analysis when applied to the rational rationing of acute care resources needs to be an on-going process with clear metrics to define its efficacy. For years, ICM has struggled with surrogate outcomes that might be compelling to change clinical practice to substitute for the all-encompassing 28, 60, or 90 day all-cause mortality. Valid economic analyses that identify strategies that are safe and save total costs is likely to be such a variable. We envision our society in 2050 to have tool kits of methods of data collection, analysis and dissemination that will allow a societal-based value system to continually analyze new therapies, the evolving population demographics, safe cost-minimization strategies, the resultant healthcare supportive services and the willingness of society to cover

those costs. Reasonable rationing of acute care resources will not result in a fixed approach but in a constantly evolving one whose values will be based on core humanitarian beliefs for the overall good of society while not ignoring those at greatest risk of harm (Fig. 1).

References

1. Zimmerman JE, Kramer AA, Knaus WA. Changes in hospital mortality for United States intensive care unit admissions from 1988 to 2012. *Crit Care*. 2013; 17:R81. [PubMed: 23622086]
2. Angus DC, Rubenfeld, Roberts MS, Curtis JR, Connors AE Jr, Cook DJ, Lave JR, Pinsky MR. Understanding costs and cost-effectiveness in the ICU: Report from the 2nd ATS workshop on Outcomes Research. *Am J Respir Crit Care Med*. 2002; 165:540–550. [PubMed: 11850349]
3. Hutchinson PJ, Peter J, Koliass AG, Timofeev IS, Corteen EA, Czosnyka M, Timothy J, et al. for the RESCUEicp Trial Collaborators Trial of Decompressive Craniectomy for Traumatic Intracranial Hypertension. *N Engl J Med*. 2016; 375:1119–1130. [PubMed: 27602507]
4. Bates DW, Spell N, Cullen DJ, Burdick E, Laird N, Petersen LA, Small SD, Sweitzer BJ, Leape LL. The costs of adverse drug events in hospitalized patients. *JAMA*. 1997; 277:307–311. [PubMed: 9002493]
5. Reinhardt UE. Perspective: Spending more through cost control: Our obsessive quest to gut the hospital. *Health Aff*. 1996; 15:145.
6. Kahn JM, Rubenfeld GD, Rohrbach J, Fuchs BD. Cost savings attributable to reductions in intensive care unit length of stay for mechanically ventilated patients. *Med Care*. 2008; 46:1226–1233. [PubMed: 19300312]
7. Luce JM, Rubenfeld GD. Can health care costs be reduced by limiting intensive care at the end of life? *Am J Respir Crit Care Med*. 2002; 165:750–754. [PubMed: 11897638]
8. Van Pelt DC, Milbrandt EB, Qin L, Weissfeld LA, Rotondi AJ, Schulz R, Chelluri L, Angus DC, Pinsky MR. Informal caregiver burden among survivors of critical illness. *Am J Respir Crit Care Med*. 2007; 175:167–173. [PubMed: 17068327]
9. Loomes G, McKenzie L. The use of QALYs in health care decision making. *Soc Sci Med*. 1989; 28:229–308.
10. Hadorn DC. Setting health care priorities in Oregon. *JAMA*. 1991; 265:2218–2225. [PubMed: 1901610]

Cost-Effectiveness in the ICU

Holistic Approach to a Difficult Balance