Published in final edited form as:

Crit Care Med. 2015 November ; 43(11): 2517–2518. doi:10.1097/CCM.0000000000001290.

Florence Nightingale and the Conundrum of Counting ICU Beds

David J. Wallace, MD, MPH[1,2] and **Jeremy M. Kahn, MD, MS**[1,3]

[1]Department of Critical Care Medicine, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

[2]Department of Emergency Medicine, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

[3]Department of Health Policy and Management, University of Pittsburgh Graduate School of Public Health, Pittsburgh, PA, USA

Keywords

critical care; intensive care units; hospitals

Florence Nightingale is celebrated for her patient care during the Crimean War and as a pioneer for professional nursing and modern hospital care. It is well known, for example, that she was among the first to organize injured soldiers by illness severity, in effect creating an early model of intensive care. Less well known, however, is that Nightingale also made significant contributions to the field of applied statistics. She observed a connection between sanitary conditions and hospital mortality, leading to major organizational changes within the British military health care system. Understanding the importance data driven hospital reform, Nightingale also developed the *Model Hospital Statistical Form*, a document for medical facilities to record consistent and accurate counts of patients and accommodations (1). This was a major advance for the time, for which she was later recognized through election into the Royal Statistical Society in 1858.

In this issue of *Critical Care Medicine*, Halpern and Pastores describe the efforts to bring Nightingale's innovation into the modern era (2). Drawing off their experience in generating national estimates of ICU bed availability and utilization (3), they perform a thorough methodological review of the different techniques for intensive care cost and bed accounting in the United States. Understanding where and how we get these numbers is of central importance for the intensive care community, since accurate bed counts are indispensible for health services research, disaster planning, and regional care coordination efforts focused on critical care (4).

Contact: Jeremy M. Kahn, MD MS, Associate Professor of Critical Care and Health Policy & Management, University of Pittsburgh, Scaife Hall Room 602-B, 3550 Terrace Street, Pittsburgh, PA 15221, phone: 412.596.4170, kahnjm@upmc.edu.

Disclosures: None

Copyright form disclosures: Dr. Wallace received support for article research from the National Institutes of Health (NIH). His institution received funding from the NIH NHLBI-K08-HL122478. Dr. Kahn disclosed that he does not have any potential conflicts of interest.

Perhaps the most salient points made by the authors regard the limitations of the two major sources of hospital information in the United States: the Centers for Medicare & Medicaid Healthcare Cost Reporting Information System (HCRIS) and the American Hospital Association (AHA) Annual Survey. Both data sources provide useful information, but both have serious flaws.

We favor HCRIS in our research (5) because its contents are tied to hospital payments and are subject to federal audits, creating incentives for accuracy. However, as Halpern and Pastores note, hospitals do not consistently report on the different types of ICU beds (medical, surgical, etc.). This misclassification is not entirely surprising, as the instructions for completing the HCRIS report are not specific regarding what constitutes an ICU bed. HCRIS has also been slow to capture new intensive care models such as neurocritical care. Some hospitals report this information in free text fields, but the lack of uniformity makes these data largely unusable. Additionally, although HCRIS releases several database versions each year, it can take several years for bed counts to stabilize, as hospitals are allowed to submit amended reports at any time. HCRIS cost reports therefore do not truly *finalize*, resulting in potentially different data depending on when the HCRIS website is queried.

The AHA annual survey has different limitations. Unlike HCRIS, the AHA survey is voluntary and some missing data are imputed, making the results potentially less valid. Additionally, as noted by Halpern and Pastores, the AHA survey does not include all acute care hospitals in the United States. Understanding the characteristics of hospitals that are not counted is important when using information on those that are. And although the AHA's inclusion of step-down and transitional intensive care unit beds is in theory of considerable value to the research community (6), the level of detail included in the AHA survey is insufficient for meaningful research on the topic.

Both the HCRIS and AHA databases could be improved. First, what constitutes an intensive care or step-down bed must be more clearly defined. Second, the general categories of intensive care unit must be refined and expanded to reflect modern clinical practice. Third, the number of registered nurses, advanced care nurse practitioners, physician assistants, pharmacists, physical therapists, dietitians and social workers should be included in the hospital summaries—such data would be of considerable use in understanding ICU organization (7). Fourth, intensive care bed supply should be stratified into routine and total capacity, with total capacity including beds that could be used if necessary, but that are not staffed for intensive care purposes around the clock (e.g., a post-surgical recovery room bed), providing a more holistic window into each hospitals' critical care capabilities.

A key second point made by the authors is that neither HCRIS nor the AHA Annual Survey are by any means up to date. Even the most recent versions are several years behind the times, reflecting the time it takes to collect, curate and publish the data. Thus, even at their best these databases describe critical care supply as it was, not as it is. In the technological age this system seems hopelessly antiquated. There is no reason we can't leverage recent advances in data collection, including crowd sourcing and crowd curating, to get national snapshots of critical care capacity in real time. The restaurant review site Yelp! can tell you

the location of restaurant in America right now, but HCRIS and the AHA Survey can only tell you the number of ICU beds in America 3 years ago. This limitation makes the data severely limited for health planning purposes. We can do better.

In the margin of Adolphe Quetelet's *Essaie de Physique Sociale,* Florence Nightingale wrote, "all sciences of observations depend upon statistical methods – without these, are blind empiricism. Make your facts comparable before deducing causes. Incomplete, pell-mell observations arranged so as to support theory; insufficient number of observations; this is what one sees" (8). As we consider ways to improve the quality of critical care by targeting its organization, we must make our facts comparable. As useful as HCRIS and the AHA Annual Survey are for understanding ICU bed counts, they aren't much more advanced than Nightingale's *Model Hospital Statistical Form.* It's incumbent upon us to transcend the methods described by Halpern and Pastores and get truly up-to-date, accurate, and actionable data on ICU supply and utilization. Only then will Nightingale's innovation truly enter the modern era.

Acknowledgments

Funding: None

References

1. Cook, ET. The Life of Florence Nightingale. London: MacMillan and Co; 1914.
2. Halpern NA, Patores SM. Critical care medicine beds, use, occupancy and costs in the United States: a methodological review. Crit Care Med. 2015 in press.
3. Halpern NA, Pastores SM. Critical care medicine in the United States 2000–2005: an analysis of bed numbers, occupancy rates, payer mix, and costs. Crit Care Med. 2010; 38:65–71. [PubMed: 19730257]
4. Nguyen Y-L, Kahn JM, Angus DC. Reorganizing adult critical care delivery: the role of regionalization, telemedicine, and community outreach. Am J Respir Crit Care Med. 2010; 181:1164–1169. [PubMed: 20224067]
5. Wallace DJ, Angus DC, Seymour CW, et al. Critical Care Bed Growth in the United States. A Comparison of Regional and National Trends. Am J Respir Crit Care Med. 2015; 191:410–416. [PubMed: 25522054]
6. Prin M, Wunsch H. The Role of Stepdown Beds in Hospital Care. Am J Respir Crit Care Med. 2014; 190:1210–1216. [PubMed: 25163008]
7. Weled BJ, Adzhigirey LA, Hodgman TM, et al. Critical Care Delivery: The Importance of Process of Care and ICU Structure to Improved Outcomes. Crit Care Med. 2015; 43:1520–1525. [PubMed: 25803647]
8. Gill CJ, Gill GC. Nightingale in Scutari: Her Legacy Reexamined. Clin Infect Dis. 2005; 50:1799–1805. [PubMed: 15909269]