

A photograph of a modern telemedicine control room. The room is filled with rows of computer workstations, each equipped with multiple monitors displaying various medical data and patient vital signs. The monitors are arranged in a curved pattern along the desks. The room has a clean, clinical aesthetic with white walls and light-colored wooden floors. In the foreground, a desk is partially visible with a computer keyboard and mouse. A blue banner with the "PHILIPS" logo and the words "Tele-ICU" is overlaid on the left side of the image.

PHILIPS

Tele-ICU

© RobFaulkner.com

Tele-ICU Literature Reference Guide & Bibliography

The focus on healthcare quality and cost is creating an opportunity to differentiate physicians as leaders in the charge for patient safety and improved healthcare delivery. Tele-ICU is generating tangible results by focusing on a different way of managing critical care. Recognizing the growing emphasis on clinical transformation, leaders are rising to the challenge to drive change – through evidence-based standards of care and looking at hard outcomes. This bibliography is a summary of published studies and articles that highlight improvements in care delivery, cost reduction, and education obtained by Tele-ICU Programs around the country.

Associates. Evaluation of Hospital-Setting HCIA Awards. Prepared for CMS; Baltimore, MD: 2016.

Agency for Healthcare Research and Quality. HCUP Facts and Figures: Statistics on Hospital-Based Care in the United States, 2008.

American Association of Critical Care Nurses. (2013). *Nursing Practice Guidelines for Tele-Intensive Care*. (1st ed.). Aliso Viejo, CA: AACN.

Barden, C., & Davis, T. M. (2012). The tele-ICU: A new frontier in critical care nursing practice. *AACN Advanced Critical Care*, 23(3), 287–288. doi:10.1097/NCI.0b013e31825dff80

Barrett, M. L., et al. (2014). Utilization of Intensive Care Services, 2011. HCUP Statistical Brief #185. Agency for Healthcare Research and Quality, Rockville, MD. Retrieved from

Burnham, E. L., Moss, M., & Geraci, M. W. (2010). The case for 24/7 in-house intensivist coverage. *American Journal of Respiratory and Critical Care Medicine*, 181(11), 1159–60. doi:10.1164/rccm.201004-0651ED

Coletti, C., & Zubrow, M. (2010). Resident perception of a tele-intensive care unit implementation. *Telemedicine and e-Health*, 16(8), 894–897. doi: 10.1089/tmj.2010.0040

Effect of a Telemedicine Facilitated Program on ICU Length of Stay (LOS) and Financial Performance. Norman, et al. *Crit Care Med*. 2009 Vol. 37, No.12 (suppl):32.

Effect of Telemedicine on Mortality and Length of Stay in a University ICU. Kohl et al. *Crit Care Med*. 2007;35(12):A22.

Everett, W. (2009). Tele-ICU: Much-needed evidence. *Health Affairs*, 28(6), 1858. doi:10.1377/hlthaff.28.6.1858

Continued

- Forni, A., Skehan, N., Hartman, C. A., Yogaratnam, D., Njoroge, M., Schifferdecker, C., & Lilly, C. M. (2010). Evaluation of the impact of a tele-ICU pharmacist on the management of sedation in critically ill mechanically ventilated patients. *The Annals of Pharmacotherapy*, 44(3), 432–438. doi:10.1345/aph.1M576
- Franzini, L., Sail, K. R., Thomas, E. J., & Wueste, L. (2011). Costs and cost-effectiveness of a telemedicine intensive care unit program in 6 intensive care units in a large health care system. *Journal of Critical Care*, 26(3), 329. e1–329.e6. doi:10.1016/j.jcrc.2010.12.004
- Golembeski, S., Willmitch, B., & Kim, S. S. (2012). Perceptions of the care experience in critical care units enhanced by a tele-ICU. *AACN Advanced Critical Care*, 23(3), 323–329. doi:10.1097/NCI.0b013e31825ed8bb
- Goran, S. F. (2010). A second set of eyes: An introduction to Tele-ICU. *Critical Care Nurse*, 30(4), 46–55. doi:10.4037/ccn2010283
- Goran, S. F. (2012a). Measuring tele-ICU impact: Does it optimize quality outcomes for the critically ill patient? *Journal of Nursing Management*, 20(3), 414–428. doi:10.1111/j.1365-2834.2012.01414.x
- Goran, S. F. (2012b). Making the move: from bedside to camera-side. *Critical Care Nurse*, 32(1), e20–29. doi:10.4037/ccn2012191
- Goran, S. F., & Mullen-Fortino, M. (2012). Partnership for a healthy work environment: tele-ICU/ICU collaborative. *AACN Advanced Critical Care*, 23(3), 289–301. doi:10.1097/NCI.0b013e31825c1cc2
- Gorman, M. J. (2011). Tele-ICU Comes of Age. *Health Management Technology*, 8–11.
- Hassan, E., Badawi, O., Weber, R. J., & Cohen, H. (2010). Using technology to prevent adverse drug events in the intensive care unit. *Critical Care Medicine*, 38(6), S97–S105. doi:10.1097/CCM.0b013e3181ddee1b4
- Hawkins, C. L. (2012). Virtual rapid response: The next evolution of tele-ICU. *AACN Advanced Critical Care*, 23(3), 337–340. doi:10.1097/NCI.0b013e31825dff69
- Heart Disease and Stroke Statistics—2011 Update. Roger et al. *Journal of the American Heart Association*, 2011;123:e82–e91
- Heron MP, Hoyert DL, Murphy SL, Xu JQ, Kochanek KD, Tejada-Vera B. Deaths: Final data for 2006, Adobe PDF file [PDF–5.3M] National Vital Statistics Reports 2009;57(14):1–15.
- Hillman KM. Duration of life-threatening antecedents prior to intensive care admission. *Intensive Care Med*. 2002 Nov;28(11):1629–34
- Hillman KM. Rapid response systems. *Indian J Crit Care Med*. 2008 Apr-Jun; 12(2): 77–81
- Hoonakker, P. L. T., Carayon, P., McGuire, K., Khunlertkit, A., Wiegmann, D. A., Alyousef, B., Wood, K. E. (2012). Motivation and job satisfaction of Tele-ICU nurses. *Journal of Critical Care*. Electronically published ahead of print. doi:10.1016/j.jcrc.2012.10.001
- Hospital Mortality, Length of Stay, and Preventable Complications Among Critically Ill Patients Before and After Tele-ICU Reengineering of Critical Care Processes. Lilly et al. *JAMA*; 2011; 305(21):doi:10.1001/jama.2011.697. <http://www.hcup-us.ahrq.gov/reports/statbriefs/sb185-Hospital-Intensive-Care-Units-2011.pdf>.
- Impact of an Intensive Care Unit Telemedicine Program on a Rural Health Care System. Zawada, et al. *Postgraduate Medicine*, 2009; 121(3):160–170.
- Improved Screening and Management of Severe Sepsis (SS): Combining an integrated multidisciplinary Team and Technology. Jenkins et al. *Crit Care Med*. 2009 Vol. 37, No.12 (suppl):738.
- Institute of Medicine of the National Academies. (2012). Best care at lower cost: The path to continuously learning health care in America. Report Brief from the Institute of Medicine, 1–4.
- Jahrdoerfer, M. & Goran, S. (2013). Voices of family members and significant other in the tele-intensive care unit. *Critical Care Nurse*, 33(1), 57–68. doi: <http://dx.doi.org/10.437/ccn2013114>
- Jenkins CL, et al. Positive Deviance: Introducing eICU Technology to the Medical Surgical Patient Population. Banner Health. Nov. 2010.
- John JT. A New, Evidence-based Estimate of Patient Harms Associated with Hospital Care. *Journal of Patient Safety*. 2013; 9(3): 122–8.
- Kahn, J. M. (2011). The use and misuse of ICU telemedicine. *Journal of the American Medical Association*, 305(21), 2227–8. doi:10.1001/jama.2011.716
- Khunlertkit, A., & Carayon, P. (2012). Contributions of tele-intensive care unit (Tele-ICU) technology to quality of care and patient safety. *Journal of Critical Care*, Electronically published ahead of print. doi:10.1016/j.jcrc.2012.10.005
- Lilly CM, et al. A Multi-center Study of ICU Telemedicine Reengineering of Adult Critical Care. *CHEST*. 2014; 145(3): 500–7.
- Lilly CM, et al. TeleICU: Experience to Date, *J Intensive Care Med*. September 13, 2009; 1–7.
- Lilly CM, et al., Hospital mortality, length of stay, and preventable complications among critically ill patients before and after Tele-ICU reengineering of critical care processes. *JAMA*. 2011, 305(21): 2175–83.
- Lilly CM, Motzkus C, Rincon T, et al. ICU Telemedicine Program Financial Outcomes. *Chest*, *CHEST* 2017, <http://dx.doi.org/10.1016/j.chest.2016.11.029>

- Lilly, C. M., & Thomas, E. J. (2009). Tele-ICU: Experience to date. *Journal of Intensive Care Medicine*, 25(1), 16–22. doi:10.1177/0885066609349216
- Lilly, C. M., Cody, S., Zhao, H., Landry, K., Baker, S. P., McIlwaine, J., Irwin, R. S. (2011). Hospital mortality, length of stay, and preventable complications among critically ill patients before and after tele-ICU reengineering of critical care processes. *Journal of the American Medical Association*, 305(21), 2175–2183. doi:10.1001/jama.2011.697
- Lucio, J. & Kopec, I. (2010). Virtual ICU case study: St. Mary's Health Center. *Physician Executive Journal*, 36(4), 1-4.
- Martin GS. Sepsis, severe sepsis and septic shock: changes in incidence, pathogens and outcomes. *Expert Rev Anti Infect Ther*. 2012 June; 10(6): 701–6.
- McCambridge, M. M., Tracy, J. A., & Sample, G. A. (2011). Point: Should tele-ICU services be eligible for professional fee billing? Yes. Tele-ICUs and the triple aim. *CHEST*, 140(4), 847–849. doi:10.1378/chest.11-1555
- McGuire, K., Carayon, P., Hoonakker, P., Khunlertkit, A., & Wiegmann, D. (2010). Communication in the tele-ICU. Proceeding of the Human Factors and Ergonomics Society 54th Annual Meeting, 1586–1590.
- Miller, M. (2009). Tele-ICU and clinical quality. *Health Affairs*, 28(6), 1858–1859. doi: 10.1377/hlthaff.28.6.1858
- Miller, M. D. & Fifer, S. (2006). Tele-ICUs interim findings about remote monitoring and management of patients in intensive care units: A FAST initiative technology analysis. *Discussion Draft for the New England Healthcare Institute*, 1–63.
- Minino AM, Xu J, Kochanek KD. Deaths: Preliminary Data for 2008. Hyattsville, MD: National Center for Health Statistics; 2010. National Vital Statistics Reports, Vol 59, No 2.
- Ministry Saint Clare's Hospital. (2005). Case Study: Ministry Saint Clare's Hospital, *Advanced ICU Care*, 1-4.
- Moeckli, J., Reisinger, H. S., Cunningham, C., Bonello, R. S., Clutter, K. L., & Cram, P. (2012). Project Summary Brief: Tele-ICU implementation in VISN 23: Lessons learned for VA's rural hospitals. *Veterans Administration Office of Rural Health*, 0581, 1–5.
- Mullen-Fortino, M., Sites, F. D., Soisson, M., & Galen, J. (2012). Innovative use of tele-ICU in long-term acute care hospitals. *AACN Advanced Critical Care*, 23(3), 330–336. doi:10.1097/NCI.0b013e31825dfeff
- New England Healthcare Institute & Massachusetts Technology Collaborative. (2010). Critical care, critical choices: The case for tele-ICUs in intensive care. 1–6.
- New England Healthcare Institute, Critical Care: Critical Choices: The Case for Tele-ICUs in Intensive Care. December 2010.
- Olff, C. & Clark-Wadkins, C. (2012). Tele-ICU partners enhance evidence-based practice: Ventilator weaning initiative. *AACN Advanced Critical Care*, 23(3), 312–322. doi:10.1097/NCI.0b013e31825dfec5
- "People with Atrial Fibrillation are 5 times more at risk for Stroke", American Heart Association, accessed September 4, 2013. <http://www.heart.org>. 1432, *Stroke*, July 2010.
- Pfrimmer, D. M., & Roslien, J. J. (2011). The Tele-ICU: A New dimension in critical care nursing education and practice. *Journal of Continuing Education in Nursing*, 42(8), 342–343. doi:10.1001/jama.2011.697
- Przybylski KG, et al. A pharmacist-initiated program of intravenous to oral antibiotic conversion. *Pharmacotherapy*. 1997 Mar-Apr; 17(2): 271-6.
- Remote ICU Care Correlates with Reduced Health System Mortality and Length of Stay Outcomes. Howell et al. *Chest*. 2007;132(4):443b-444b.
- Remote supervision of IV-tPA for acute ischemic stroke by telemedicine or telephone before transfer to a regional stroke center is feasible and safe, Pervez et al. *Stroke*. 2010, 41:e18–e24.
- Reynolds, H. N., Rogove, H., Bander, J., McCambridge, M., Cowboy, E., & Niemeier, M. (2011). A working lexicon for the tele-intensive care unit: We need to define tele-intensive care unit to grow and understand it. *Telemedicine and e-Health*, 17(10), 773–83. doi:10.1089/tmj.2011.0045
- Ries, M., (2016) Evaluating Tele-ICU Cost—An Imperfect Science. *Critical Care Medicine*, 44(2), 441-442. doi: 10.1097/CCM.0000000000001506
- Rincon, T. A., Bourke, G., & Seiver, A. (2011). Standardizing sepsis screening and management via a tele-ICU program improves patient care. *Telemedicine and e-Health*, 17(7), 560–564. doi: 10.1089/tmj.2010.0225
- Rothberg M. Improving Nurse-to-Patient Staffing Ratios as a Cost-Effective Safety Intervention. *Medical Care*. August 2005; 43(8): 785–91. http://journals.lww.com/lww-medicalcare/Abstract/2005/08000/Improving_Nurse_to_Patient_Staffing_Ratios_as_a.6.aspx
- Rufo, B. & Berenson, R. (2009). Tele-ICU: Positive return on investment/Tele-ICU: The authors respond. *Health Affairs*, 28(6), 1859–1860.
- Sadaka, F., Palagiri, A., Trottier, S., Deibert, W., Gudmestad, D., Sommer, S. E., & Veremakis, C. (2013). Telemedicine intervention improves ICU outcomes. *Critical Care Research and Practice*, 2013, 1–5. doi:10.1155/2013/456389
- Saver JL. Time is brain — quantified. *Stroke*. 2006;37(1):263–266.

- Savings in RN Staffing Costs Pre and Post eICU Implementation. Goran et al. Data provided by Maine Health, November 2008.
- Shahpori, R., Hebert, M., Kushniruk, A., & Zuege, D. (2011). Telemedicine in the intensive care unit environment--A survey of the attitudes and perspectives of critical care clinicians. *Journal of Critical Care*, 26(3), 328.e9–328.e15. doi:10.1016/j.jcrc.2010.07.013
- Tele-ICU: Experience to Date. Lilly et al. *Journal of Intensive Care Medicine*, September 13, 2009; 1-7.
- “The “Golden Hour” and Acute Brain Ischemia, Presenting Features and Lytic Therapy in >30 000 Patients Arriving within 60 Minutes of Stroke Onset”, *Stroke*, Journal of the American Heart Association, accessed September 4, 2013. <http://stroke.ahajournals.org/content/41/7/1431.full.pdf>.
- Thomas, E. J., Lucke, J. F., Wueste, L., Weavind, L., & Patel, B. (2013). Association of telemedicine for remote monitoring of intensive care patients with mortality, complications, and length of stay. *Journal of the American Medical Association*, 302(24), 2671–2678.
- Thomson Reuters research. <http://www.reuters.com/article/2009/12/04/us-usa-healthcare-costs-idUSTRE5B32PS20091204>
- Venditti, A., Ronk, C., Kopenhaver, T., & Fetterman, S. (2012). Tele-ICU “myth busters”. *AACN Advanced Critical Care*, 23(3), 302–311. doi:10.1097/NCI.0b013e31825dfee2
- Williams, L.-M., Hubbard, K. E., Daye, O., & Barden, C. (2012). Telenursing in the intensive care unit: Transforming nursing practice. *Critical Care Nurse*, 32(6), 62–69. doi:10.4037/ccn2012525
- Wong CA, et al. The cost of serious fall-related injuries at three Midwestern hospitals. *Jt Comm J Qual Patient Saf* 2011 Feb;37(2):81-7.
- Wood KA. Pharmaco-economic Implications of New Therapies in Sepsis. *Pharmaco-economics*, 2004; 22 (14): 895–906.
- Yoo, BK., et al. (2016) Economic Evaluation of Telemedicine for Patients in ICUs. *Critical Care Medicine*, 44(2), 265–274. doi: 10.1097/CCM.0000000000001426.
- Yoo, E. J., & Dudley, R. A. (2009). Evaluating telemedicine in the ICU. *Journal of the American Medical Association*, 302(24), 2705–6. doi:10.1001/jama.2009.1924
- Young, L. B., Chan, P. S., & Cram, P. (2011). Staff acceptance of tele-ICU coverage: a systematic review. *CHEST*, 139(2), 279–88. doi:10.1378/chest.10-1795
- Young, L. B., Chan, P. S., Lu, X., Nallamothu, B. K., Sasson, C., & Cram, P. (2011). Impact of tele-ICU coverage on patient outcomes: A Systematic review and meta-analysis. *Veterans Rural Health Resource Center-Central Region, Issue Brief #6*, 1-6.
- Zawada, E. T., Kapaska, D., Herr, P., Aaronson, M., Bennett, J., Hurley, B., Avera eICU Research Group. (2006). Prognostic outcomes after the initiation of an electronic telemedicine in a rural health system, *SD Med*, 59(9), 391–394.
- Zawada, E.T., Herr, P., Larson, D., Fromm, R., Kapaska, D., & Erickson, D. (2009). Impact of an intensive care unit telemedicine program on a rural health care system. *Postgraduate Medicine*, 121(3), 160–170.

© 2017 Koninklijke Philips N.V. All rights reserved.
Specifications are subject to change without notice.
Trademarks are the property of Koninklijke Philips N.V.
(Royal Philips) or their respective owners.

www.philips.com



For further information, please contact:
Philips eICU Program
www.philips.com/enterprisetelehealth
(205) 527-5033