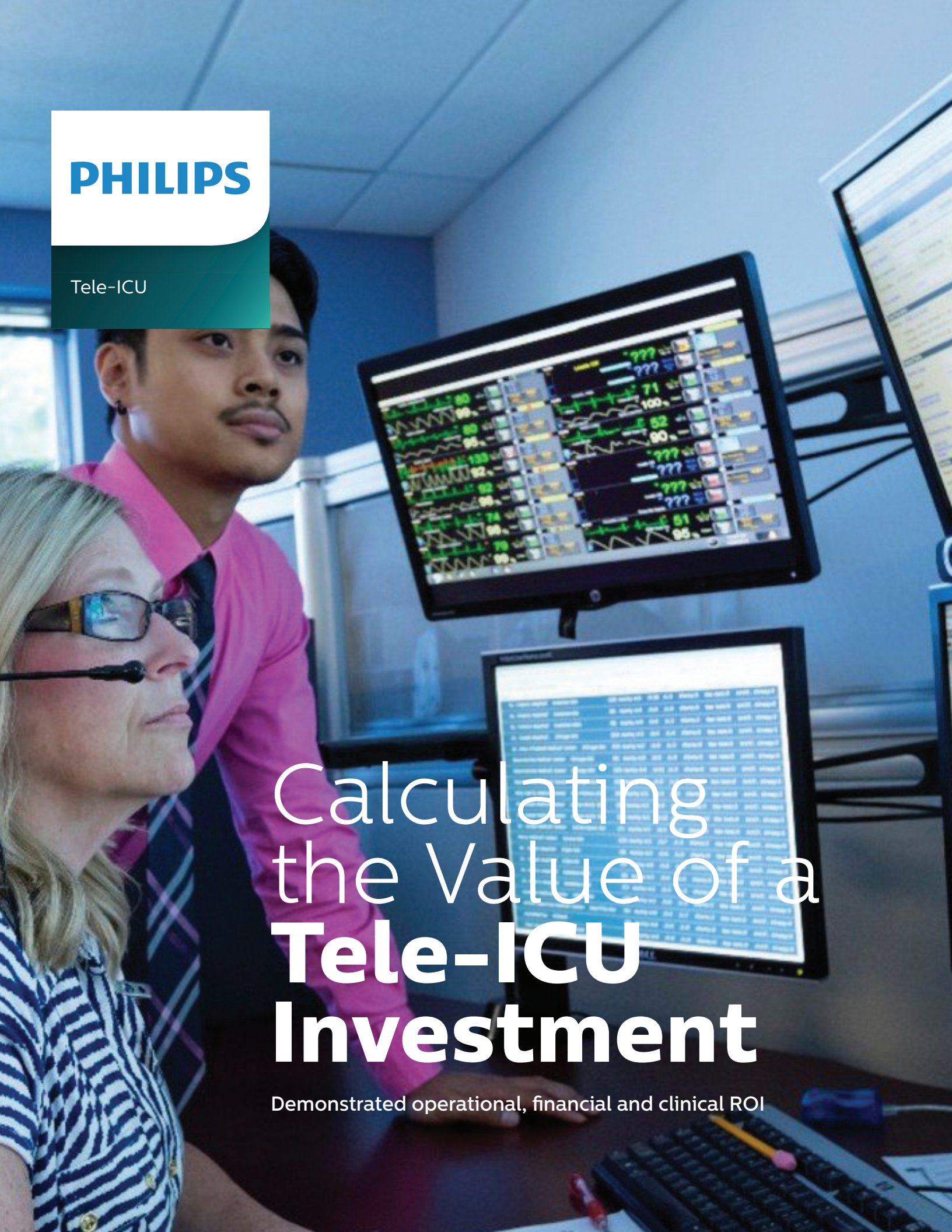

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Tele-ICU

Calculating the Value of a **Tele-ICU Investment**

Demonstrated operational, financial and clinical ROI

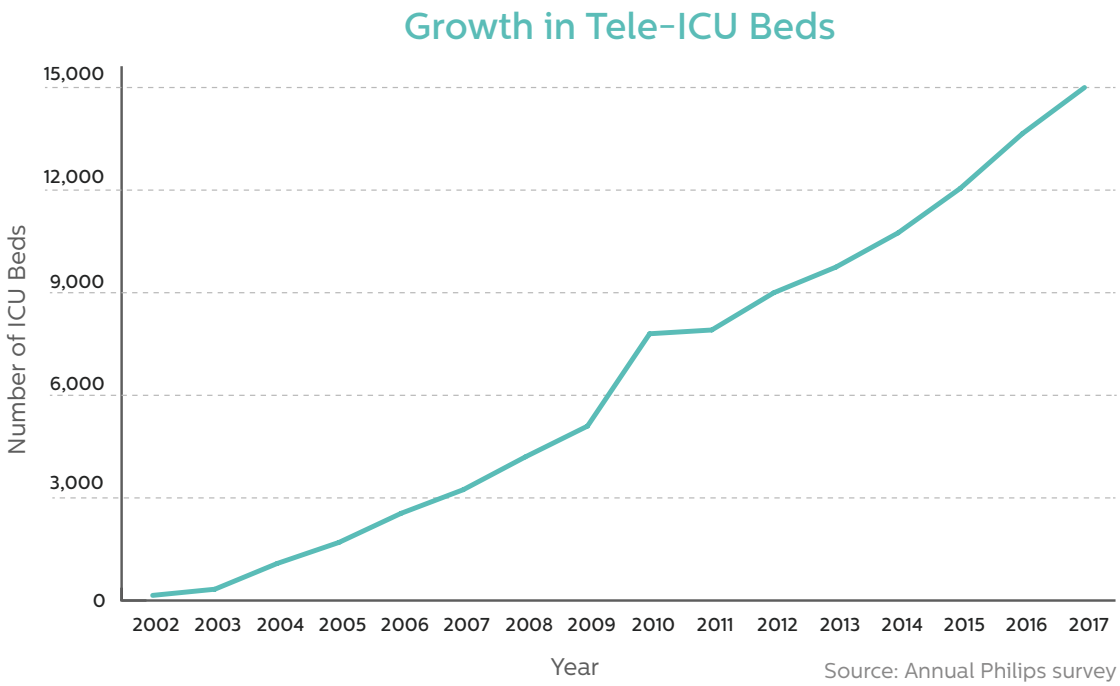
Introduction

The purpose of this report is to review the key operational, financial and clinical benefits of tele-ICU. In the last 17 years, peer-reviewed, published studies have demonstrated that high-intensity, centralized tele-ICU can significantly benefit hospitals and enterprise health systems by generating a substantial return-on-investment (ROI) while improving clinical outcomes and staff and patient satisfaction.[1-37] Venditti et al estimated that adopting tele-ICU standards in community hospitals throughout the US could decrease annual ICU deaths by as much as 13,400 and save $5.4B.[1]

Users are finding that tele-ICU not only serves a critical role in the effective regional management of ICUs, but positively impacts the healthcare system as a whole. Having a centralized remote patient monitoring center provides the ability to consolidate and standardize care, reduce transfers while maximizing bed utilization, and support onsite staff. This reduces costs while enhancing revenues, patient flow, and capacity management across the system. A summary of some of the more significant benefits as documented in the literature has been included in this brief for further reference.

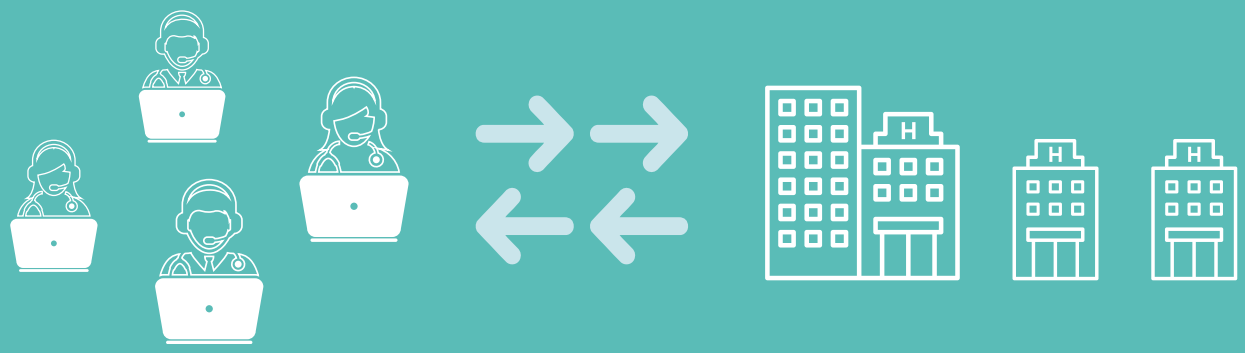
Today's ICUs are under tremendous pressure to achieve better outcomes at lower cost, while dealing with a serious shortage of intensivists and ICU nurses. As of 2015, nearly half of US hospitals did not meet Leapfrog's quality standards of 24/7 intensivist coverage.[2] Yet the growth of value-based care is making it imperative to deliver both quality and cost effectiveness in the ICU.

Tele-ICU can help hospitals address intensivist shortages while improving care. Covering only 598 critical care beds in 2003,[3] today such programs cover an estimated 15,000 adult ICU beds across the country (see Exhibit 1). Of all national adult ICU admissions, tele-ICU systems now monitor one in eight patients.[4]



Source: Annual Philips survey

Remote Critical Patient Monitoring



Higher Standardized Quality	**Lower Mortality Rates**	**More Efficient Throughput**	**Shorter Length-of-Stay**
Higher Contribution Margins	**Lower Operational Costs**	**More Clinical Collaboration**	**Less Clinician Burnout**

Having a centralized clinical command center provides the ability to consolidate and standardize care, reduce transfers while maximizing bed utilization, and support onsite staff. This reduces costs while enhancing revenues, patient flow and capacity management across the system.

Newer pricing models address capital costs

Implementing a centralized tele-ICU has been associated with a relatively high initial cost; the fact that many hospitals' cost accounting systems can't calculate the ROI of their ICUs, which are typically cost centers, has compounded the challenge. However, more flexible pricing models are addressing this issue.

A facility's upfront capital investment for tele-ICU varies depending on the type of tele-ICU model, number of ICU beds and the facility's existing physical plant and electronic infrastructure. The cost of creating the remote patient monitoring center typically ranges from $2 to $5 million; each additional ICU that is covered by telemedicine will cost about $250,000 and each ICU bed will cost about $50,000 to $100,000.[5]

The traditional pricing model for tele-ICU entailed an initial licensing fee plus annual maintenance fees. Newer pricing options are providing greater flexibility for covering upfront investment costs, including:

- Term models, in which license and maintenance fees are spread across the contract duration
- Software as a Service (SaaS) subscription models
- Risk-based models, which tie outcomes to payment
- Per-admission and add-on models, which allow health systems with existing tele-ICU programs to easily extend their program to other facilities

These pricing options are eliminating financial barriers to the adoption of tele-ICU, allowing additional health systems to adopt a technology that has become the standard of care, with over 18% of adult ICU beds in the US under contract.[4]

Tele-ICU's upfront investment can be recouped in months

While the investment in tele-ICU is significant, most facilities can expect to see a rapid ROI due to lower morbidity rates and improved case mix index (CMI), throughput, and length of stay (LOS). Tele-ICU also improves documentation and therefore billing accuracy for CMI, which drives increased revenues. Hine reported that both the average monthly pro-fee billing charge and the annualized billing rose 30% or more.[6]

Yoo conducted several analyses of the economic efficiency of bedside and remote teams working via a single electronic tele-ICU. His 2016 simulation analysis projected cost savings in 37% of ICUs and concluded that the technology is highly likely to be cost-effective compared to other health interventions.[7]

Yoo's 2018 study provided additional evidence of the ROI of tele-ICU, especially for the highest-risk ICU patients, as defined by the ICU severity-of-illness scoring system, APACHE-IV. The analysis found that tele-ICU's economic efficiency for high-risk patients held true across most hospital types, and was highest for hospitals that had high mortality rates and per-patient costs.[8]

In 2016, Lilly et al published a study showing that an initial $7.2M outlay for electronic infrastructure, bedside monitors, and physical plant upgrades, plus new AV equipment, was recouped in less than three months due to a $31M increase in the annual direct contribution margin.[9]

"...implementation of an ICU telemedicine program that standardized key processes of care and significantly reduced LOS was associated with a sustained and substantially larger direct contribution margin. The net financial benefits ...offset the initial capital costs of the program in less than 3 months." [10]

– excerpt from 2016 Lilly study, *Chest*

That study found that implementing tele-ICU along with a logistics center increased annual revenues by 46% and the direct contribution margin per case by almost 300%. The annual direct contribution margin increased from $7.9M prior to implementing tele-ICU to $60.5M, due to a 38% increase in case volume, 25% higher revenue and reduced LOS.[11]

Tele-ICU improves regional operations, capacity, and throughput

Tele-ICU's ability to reduce LOS allows hospitals to improve capacity and throughput by admitting more patients without increasing the number of critical care beds or the associated staffing costs.

- A 2014 CHEST study of 120,000 patients in 56 ICUs found that tele-ICU programs reduced the adjusted hospital LOS by 1.1 days (from 5.6 to 4.5 days) for patients staying longer than seven days.[12] Overall hospital LOS was 20% shorter and ICU LOS was 15% shorter compared to a control group without tele-ICU.[13]
- A 2014 literature review also documented shorter LOS and lower mortality rates for ICUs with telemedicine.[14] A 2012 study that was part of that literature review found that the comparative adjusted ICU length of stay and mortality for an AMC's surgical ICU that implemented telemedicine decreased significantly, while a medical ICU in the same hospital that did not adopt telemedicine experienced no improvements.[15]

- A 2010 report that examined tele-ICU's impact on an AMC and two community hospitals found that all three hospitals fully recovered their costs within one year, allowed the community hospitals to treat more patients, and saved insurers money.[16]

Newer studies also show that tele-ICU can also help health systems improve their regional operations, allowing more patients to be treated in their community hospital ICUs rather than being transferred to higher-cost tertiary centers. Further, those patients who can benefit from the tertiary/quaternary center can be transferred at the optimal time.

- Community hospital ICUs, which typically operate at a lower occupancy rate than academic medical centers (AMCs),[17] benefit by retaining more patients in their facilities, increasing CMI revenue capture, building their image, and enhancing sustainability.
- AMCs, which typically operate at higher capacity,[18] can treat sicker patients and increase their CMI. These centers can avoid filling their tertiary ICU beds with low-margin patients while also reducing the outflow of patients to other health systems due to over-capacity.
- Patients and families benefit from treatment in a lower-cost setting, as well as from reduced travel times, travel-related expenses, and missed work.

Tele-ICU delivers annual cost savings and cost avoidance

A 2014 literature review reports that after initial start-up costs, tele-ICU decreases annual costs[19] due to the ability to cost-effectively staff the unit 24/7 with intensivists, significantly reduce intensivist and ICU nursing turnover, increase the patient-to-intensivist ratio, improve best practices compliance, and reduce malpractice costs. As previously stated, tele-ICU may also preclude the need to build out new ICU beds (at $2M per bed plus attendant staffing costs).

- **Decrease in clinician burnout**
  Given the shortage of intensivists throughout most of the country, many ICUs cannot meet the Leapfrog standard that calls for staffing their units 24/7 with intensivists. Tele-ICU allows facilities to cost-effectively staff multiple units through a centralized command center. It also reduces stress and burn-out for intensivists and ICU nurses, which is the highest among all specialties.[20] That in turn can reduce staff turnover.[21] [22]
- **Increased safety and Leapfrog and regulatory compliance**
  Khunlertki found that tele-ICU could improve evidence-based medicine compliance, management, and safety, as well as helping to decrease the risk of patient falls and extubations.[23] Providing a consistent standard of care around the clock, including weekends, nights and holidays, allows hospitals to meet Leapfrog standards and improve quality scores.

- **Improved staff teamwork, satisfaction, and recruitment**
  Kleinpell reported that tele-ICUs improve collaboration, job performance and communication, and allowed bedside nurses to have more time for patient care.[24] Chu-Weininger also reported that tele-ICU was associated with improved teamwork and safety among ICU nurses.[25]
- **Higher patient-to-intensivist ratios**
  With tele-ICU, one intensivist may be able to manage up to 130-150 patients, compared to some 50-75 patients per intensivist without tele-ICU.[26]
- **Lower costs due to implementation of best practices**
  Consistent implementation of best practices that prevent complications such as acute lung injury or deep vein thrombosis can reduce costs. Tele-ICU can allow clinicians and executives to receive automated reports that can drive best practices.
- **Reduced malpractice expenses**
  In a large, 450-bed, high-intensity tele-ICU system covering five states, the frequency of malpractice claims and incurred costs were significantly lower at tele-ICU sites compared to ICUs without tele-ICU.[27]

The introduction of standardized processes for managing the admission of critically ill patients allowed for a reduction in the number of calls for referring physicians, the ability to admit patients with medical admission diagnoses to surgical ICUs and vice versa, and the ability to more efficiently discharge patients who were no longer critically ill. These practices impacted care processes that directly affected LOS and ICU volume. [28]

– Excerpt from 2016 Lilly study, *Chest*

Tele-ICU can improve patient care and outcomes

Tele-ICU can help hospitals foster:

- More standardized care and admission and discharge decisions
- Enhanced, ongoing clinical decision support
- Faster response times to abnormal lab values and instability alerts, which may prevent avoidable complications, as described in the following article excerpt.[29]

The eICU program provides "someone who is awake and has at his fingertips all the information needed to make decisions." It becomes part of a rapid-response team, for example, if a patient experiences cardiac arrest—the eICU physician often takes charge of directing the resuscitation efforts, with nurses and later-arriving physicians physically in the ICUs performing hands-on care. Respondents lauded the software that can provide earlier detection of complications by continuously analyzing patients' physiological data. [30]

– Excerpt from Berenson article, *Health Affairs*

The data supporting tele-ICU's ability to impact clinical outcomes is robust:

- A 2012 meta-analysis of 11 observational studies by Wilcox and Adhikari found that telemedicine reduced ICU and hospital mortality and LOS in critically ill patients.[31]
- In a 2013 study reported in CHEST, tele-ICU performance evaluated across 56 ICU units reported that ICU mortality dropped by 26% and overall hospital mortality fell by 16%.[32] The lower mortality was attributed to:
    - Standardized practices that included review by an intensivist within one hour of admission
    - Timely performance data
    - Faster responses to alerts
    - Adherence to ICU best practices
- In a 2011 study reported in JAMA, tele-ICU decreased hospital mortality rates from 13.6% to 11.8%; these results were associated with higher adherence to best practices that reduced deep-vein thrombosis, stress ulcers, cardiovascular events, ventilator-associated pneumonia and preventable complications.[33]
- More patients can be discharged directly to home rather than a skilled nursing facility.[34] Emory University similarly discharged 4.9% more patients to home healthcare and 6.9% fewer patients to nursing facilities following their tele-ICU implementation.[35] The Emory study also showed that Medicare patients had fewer readmissions at 60 days than a control group; this has significant financial implications for health systems that are providing or contemplating accountable care.

Tele-ICU also delivers intangible benefits

Tele-ICU also offers a number of important but less tangible benefits to the health system, patients, and families that may include:

- Reducing the stress and burden on families, patients and caregivers.
- Decreasing the number of calls to referring physicians, which reduces their burden and may improve satisfaction and loyalty.
- Enabling the health system to become a provider of choice and to be included in narrow networks. One study found payers could potentially save $9.8M due to the referral of 986 patients to community hospitals rather than a tertiary facility.[36]
- Expanding a health system's reach and market share because they can offer ICU services in rural/less accessible areas.

Comparison of purpose-built and EHR-based tele-ICU systems

Hospitals that consider using an EHR-based tele-ICU solution should be aware that, while it may offer a lower initial price point, it will require at least the same hardware and staffing costs and offer more limited services than purpose-built tele-ICU solutions. An EHR-based system is likely to entail an opportunity cost in the form of additional staff time and expertise to launch and manage the system. The onus is on the health system to determine its needs, build and staff the program, and develop algorithms.

Facilities considering an EHR-based tele-ICU system purchase should determine whether it can deliver the following:

- Clinical transformation services, including 24/7 customer service with support from an experienced team that remains involved with the customer through the life of the contract.
- Tested, predictive algorithms based on a large ICU relational database and refined over time.
- Evidence of successful implementation in other facilities.
- The ability to participate in a sharing community in which customers can share best practices with other tele-ICU users.
- Intensivist staffing efficiencies, which represent the largest single tele-ICU expense. As noted above, a purpose-built tele-ICU solution can serve more patients per intensivist compared to EHR-based solutions. At an average annual salary of about $306,000 per intensivist,[37] those costs mount quickly and could dwarf any reductions in software costs.

Conclusion

Tele-ICU programs have become the standard of care, offering well-documented clinical, operational and financial benefits that can quickly recoup upfront investments. In fact, there is evidence that health systems may be able to see a financial ROI within several months. Purpose-built tele-ICU systems may entail higher initial capital costs than EHR-based systems, but also provide numerous cost and quality benefits that should be considered in any ROI comparison. Health systems and hospitals also may be able to take advantage of newer pricing options from tele-ICU vendors that accommodate their individual circumstances and can overcome any barriers due to upfront outlays.

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