Activating a Virtual Hospital with Intelligent Clinical Surveillance Solutions

New Solutions Allow Providers to Reduce Unwanted Variations in Care to Help Improve Workflow Efficiency

Powering clients to a future shaped by growth

FROST & SULLIVAN

Contents

INTRODUCTION

Hospitals face enormous operational challenges as they deal with continuously increasing demands to improve patient care. This hurdle is compounded by the fact that there is no comprehensive digital or tactile view into the specifics of patient care at individual and institutional levels. The amount of data produced in the healthcare sector is massive and growing every year. Hospitals spend a significant amount of their attention capturing data and documenting it, but most lack the capability to synthesize the available data from all their clinical systems and devices to address patient care in practical ways. To meet the challenges of the future, clinicians and hospital administrators should consider adopting clinical surveillance solutions to help ensure best practices in patient care are implemented in ways that serve patient needs. These solutions are designed to supplement existing medical documentation systems by encompassing data from all available sources to provide a population view of all patients across the enterprise to monitor improvements to compliance with best-practice protocols.

Frost & Sullivan is a global consulting firm with decades of experience tracking trends in medical technology innovation. Given the massive amounts of healthcare data being generated, overworked clinicians and the demand for improving patient outcomes, hospitals are using clinical surveillance solutions today to address their clinical workflow challenges. This emerging field that combines advances in clinical medicine, data science, and technology can be effective at addressing many entrenched hospital workflow challenges that are rooted in a lack of data and resource limitations. The current cognitive load placed on clinicians today to understand and use all of the data available to them is unsustainable. Hospitals using clinical surveillance tools could help clinical teams address gaps in compliance with care and workflow protocols. Selecting the right technology, the right implementation processes, and the right vendor partner for deploying these solutions will be critical to their success.

For this white paper, "clinical surveillance" is defined as a technology-driven process of ongoing and systematic collection, analysis, and interpretation of healthcare data essential to the planning, implementation, and evaluation of the standard of care prescribed for each patient. Clinical surveillance continuously synthesizes a comprehensive body of information about a population of patients for a period of time and then proactively guides clinicians' attention to the most critical patients. In contrast, a retrospective review of individual patient data captured in a documentation system or medical device data log may identify opportunities for intervention, but these insights may not be applied to patients in real time. Clinical surveillance allows providers to observe patients using hospital-selected early warning scores (EWS) or screening protocols and drive compliance to clinical care bundles. By making use of this data-driven approach to proactive risk management, physicians can potentially anticipate clinical challenges before they present themselves and improve patient outcomes.

Since clinical surveillance solutions are relatively new to the market, providers may confuse them with documentation and archiving systems (EMR, LIMS, PACS) or retrospective clinical decision support (CDS) tools, which lack a real-time, longitudinal perspective. While clinical surveillance systems may be used in conjunction with operational systems, which are more focused on managing staffing, patient capacity and asset management, they can still offer providers a unique benefit not delivered by any other IT tool. Clinical surveillance tools are focused on providing insights and guidance to clinical teams to remove unwanted variation in care delivery to help improve patient care.

In summary, clinical surveillance is:

1. Customized to the needs of individual enterprises using best-practice protocols already in place at the facility.

2. Proactively oriented to improve visibility to patients the hospital defines as at-risk.

3. Supported by a comprehensive data set across the enterprise providing a single view of all patient data the hospital deems relevant.

4. Focused on driving population-level insights that support systemic changes in clinical care and workflow.

5. Integrated with other hospital systems and technologies.

6. Designed to ease the data overload on clinicians and generate deep data insights that would be challenging to generate easily and consistently.

GE MURAL VIRTUAL CARE SOLUTION:
A STATE-OF-THE-ART CLINICAL SURVEILLANCE OFFERING

In this white paper, Frost & Sullivan will describe a state-of-the-art clinical surveillance solution launched in the US market in 2019. GE's Mural Solution allows clinicians to visualize patients across a unit, hospital, or health system, and provides a consolidated view of a patient's status through an integrated visualization of data from multiple clinical systems, devices, and applications supporting the patient.

The Mural Virtual Care Solution (Mural) can focus clinicians' attention on the most critical patient cases and may help clinicians reduce the time to intervention by digitizing hospital-defined protocols, care pathways, and early warning scores (EWS) to generate actionable insights that proactively direct clinical teams to deliver responsive and timely care.* The solution is highly flexible and can input data from virtually any HL7 networked IT system or device that a hospital might be using, not just those from GE Healthcare. Mural can be configured to focus on nearly any clinical challenge of interest to the facility by digitizing protocols, care bundles and best practices that its clinicians have deemed meaningful. In its development process, providers told GE Healthcare that it often took them over 15 minutes of scanning disparate IT systems to get a complete assessment of a patient's condition. Users document data in EMRs in a wide variety of locations, making it difficult for clinicians to get simple answers to questions they may have. The Mural Solution's visualization approach and ability to deploy virtually any clinical algorithm the facility imagines allow users to more efficiently use the data they already have in their network. Mural is also designed to integrate with existing EMR systems in a hospital, allowing customers to more easily scale the solution across their enterprise.

HOSPITALS LACK THE TOOLS TO TACKLE COMPLEX SYSTEMS PROBLEMS THAT HAMPER CARE IMPROVEMENT

Hospitals pour significant time and resources into their internal training and quality improvement programs, but these initiatives do not always meet with uniform success.[1, 2, 3, 4] Despite their best intentions, when clinicians are stressed for time or lack the best available data on patients in the hospital, they often struggle to follow all the required steps in their hospital-defined care bundle or protocol.[5, 6, 7] Hospitals want their clinicians to follow established protocols while at the same time using their best judgment, but the experience of most facilities is that protocols are often followed inconsistently or take an inordinate amount of time to achieve wide-scale adoption.

A model that could be more effective is one where human skills, judgment and empathy are supported with data-driven, digital tools to provide an extra layer of support. GE's Mural Solution is *augmenting* a clinician's ability to make clinical decisions, not *artificial* intelligence. Ideally, a care model would rely upon clinical surveillance to free a clinician to leverage the human skills that no machine can replicate—experience, empathy and intuition. Technology is a check against the inherent limitations that all humans must contend with in complex environments such as ICUs. The Mural Solution allows for the prioritization of which patients a clinician should evaluate first. Clinicians concerned that surveillance tools will add an additional burden to their schedule should be comforted that the solutions are designed to allow for the escalation and communication of information in a variety of formats that are far more streamlined and customized than systems in the past. One of the goals of tools like the Mural Solution is to help clinicians deliver more efficient and focused care by separating distractions from relevant clinical information.

> **A model that could be more effective is one where human skills, judgment and empathy are supported with data-driven, digital tools to provide an extra layer of support. GE's Mural Solution is *augmenting* a clinician's ability to make clinical decisions, not *artificial* intelligence.**

A technology-augmented approach can also assist with smoother patient hand-offs between shifts and with referrals. Unlike data documentation systems, surveillance tools should not create inefficiencies in a clinician's schedule or add a data entry burden since the goal of the systems is to optimize the use of the clinicians' limited time. In fact, a hope with these tools is that clinicians will spend less time doing non-value-add activities and more time applying the information gathered about the patient to provide better care guidance and operational efficiencies.

Many hospitals are facing a serious shortage of physicians, nurses and other clinicians to manage their growing patient volumes. Ample evidence exists demonstrating an impact on patient care as provider-to-patient ratios grow.[5, 6] Clinical surveillance tools will join other technologies that enable remote specialists to cover wider geographical areas that may not have access to the specialists insights. The solution can reduce the amount of time clinicians spend searching through multiple systems for patient information, thereby enabling them to focus on patient care. The goal is not

only to help clinicians deliver better and more efficient care but also for clinicians to find more professional fulfillment because their daily activities better align with their advanced training. For those facilities that are unable to recruit specialists on-premises because of location or budget, clinical surveillance and a telehealth platform can become important tools to deliver specialist consultations to their networked populations. The benefit may be especially true for remote locations that often struggle the most with gathering ICU specialist support.[8] In the future, hospitals may become increasingly integrated with other facilities in their network, relying on shared services to expand access to care, manage population health, share limited resources and achieve commercial scale. By delivering visibility to patient status with full context at a system level, clinical surveillance tools may help healthcare networks track care with increased consistency and efficiency.
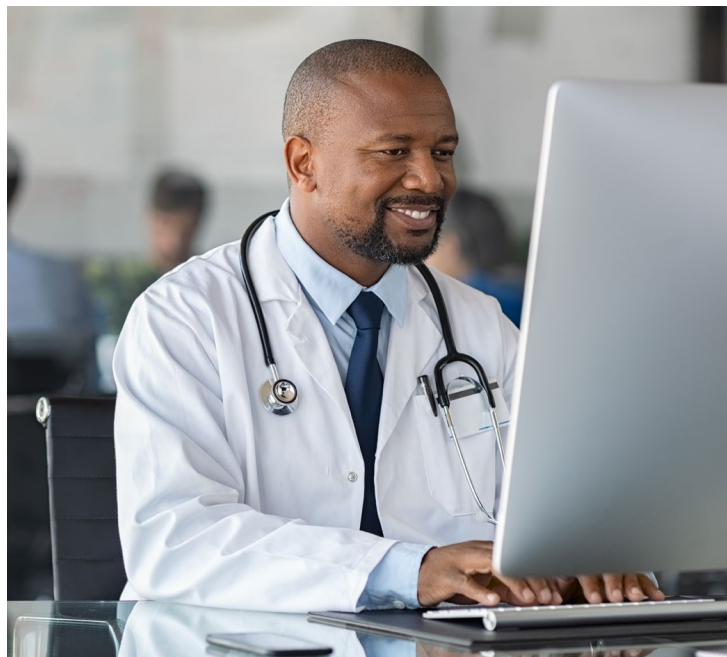
DEVELOPMENT OF THE GE HEALTHCARE MURAL CLINICAL SURVEILLANCE SOLUTION

In its development of the Mural Virtual Care Solution (Mural), GE Healthcare learned first-hand from its customers how leveraging surveillance tools within a new care paradigm can help address some of the challenges in the delivery of care. In conversations with these health systems, the company discovered that many of the applications that clinicians use in virtual care models could not be viewed in a single pane. In addition, customers were struggling to achieve true integration and interoperability across all of their clinical systems and data-generating devices. In essence, there was no truly agnostic platform through which clinicians could analyze all available patient data at once.

As hospital systems grow larger through mergers and acquisitions and strive to remove unwanted variability in care delivery, they often face a common challenge in which the individual facilities within the system support different IT systems and devices. "As a result of that lack of interoperability and integration, the person at the hub has to deal with different versions of EHRs, PACS, etc. In a worst-case scenario, you could have more than a dozen spokes all with different EHR systems and a nurse or intensivist trying to interpret patient information," said Vivek Bhatt, CTO of Clinical Care Solutions at GE Healthcare.

Without an agnostic platform for clinical surveillance, hospital systems found that it was extremely challenging to develop a comprehensive view of all patients in their system or to deploy a "hub-and-spoke" model for virtual care across multiple patient facilities. Finally, customers noted that even when they were able to gain access to relevant patient data, they could not systemically apply their defined protocols to notify them of patient-level risks or drive care improvement. In addition, hospitals lacked the ability to monitor patient-level data to ensure the care protocols they were expecting their staff to implement were actually implemented.

"GE began to realize, in the development of the Mural Solution, that physicians and nurses alike wanted a continuous clinical surveillance system that provides vigilance and effective care scenarios that can be customized for care areas, not just at the hospital level," said Greg Sitkiewicz, General Manager of GE Healthcare Patient Monitoring in the United States.

COGNITIVE LOAD HAS A REAL IMPACT ON CLINICIANS, WHICH COULD BE ADDRESSED WITH SURVEILLANCE TOOLS

Translating evidence-based protocols, best practices and patient clinical information into patient care pathways can be challenging because it requires the effective and consistent reduction of variations in care, which could lead to poor data outcomes. These types of challenges are ideally suited for clinical surveillance solutions to address. When a hospital fails to deliver clinical care consistent with the standards and protocols they have chosen to put in place, it may result in a longer patient length-of-stay (LOS) because of inefficiencies that result or even patient complications that emerge. In this same scenario, hospitals may be at risk of using more resources, thereby adding to the cost of care as well.

"Applying digital capabilities can give the clinician a flashlight for peering into tons of data, which could reveal potentially life-saving insights," explained Bhatt. "Without visibility, how can a clinician begin to see the whole picture?"

> " **Applying digital capabilities can give the clinician a flashlight for peering into tons of data, which could reveal potentially life-saving insights.**

Achieving Compliance to Patient Safety Goals

Digital tools like the Mural Solution are designed to reinforce those protocols the hospital has already decided to implement. Research studies across multiple medical disciplines have shown that compliance with recommended care protocols may improve outcomes and ultimately saves lives. One retrospective study published in 2014 suggests that with each 10% increase in compliance with 22 commonly recommended clinical practices at trauma centers, there could be an associated 14% reduction in the risk of death.[10] The number of applications for clinical surveillance tools is only limited by the imagination of caregivers as they seek to employ new ways to better care for their patients.

Some hospitals are already applying clinical surveillance to help achieve compliance with the Joint Commission's National Patient Safety Goals (NPSGs).[11]

These goals fall into seven categories:

- Identify Patients Correctly
- Improve Staff Communication
- Use Medicines Safely
- Use Alarms Safely
- Prevent Infection
- Identify Patient Safety Risks
- Prevent Mistakes in Surgery
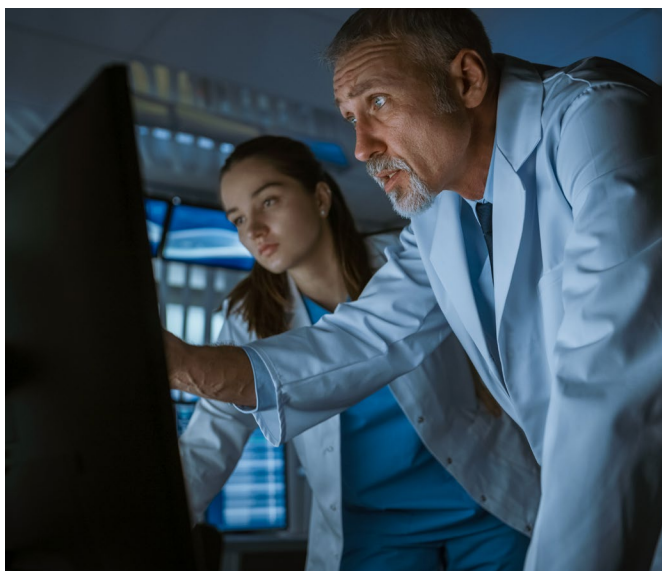
In 2020, the "Prevent Infection" category consists of five standards, all of which are focused on ensuring that staff members follow established guidelines for infection prevention. Clinical surveillance solutions configured to drive compliance with established infection prevention protocols can support these guidelines. The single guideline under "Improve Staff Communication" states that the facility must "get important test results to the right staff person on time." In concept, a clinical surveillance algorithm can be established to measure the amount of time between the collection of test data and when it is conveyed to staff to better expedite care. When viewed at a population level, this data can provide insight to facilities to help them identify the source of delay and put action in place to reduce the amount of time between the completion of tests and the communication of those results to patient care teams.

In addition to supporting programs designed to reduce hospital-acquired infections (HAIs), clinical surveillance can also help manage pressure ulcers or other Never events. For example, the Braden scale is a commonly used predictive tool used across nearly every U.S. hospital.[12] By integrating a Braden scale algorithm into a clinical surveillance tool, hospitals may have a way to ensure more consistent risk classification across their patient population and improve identification of patients at greater risk for developing a pressure ulcer.

Reducing Maternal Mortality

Maternal mortality associated with childbirth is capturing significant attention as a focus area for quality improvement. In July 2020, the Joint Commission is introducing two new standards to address complications in the areas of maternal hemorrhage and severe hypertension/preeclampsia.[13] Clinical surveillance tools may help address the problem of maternal hypertension in a number of ways. For example, the drug Pitocin is commonly administered to initiate labor, but this drug can have an impact on blood loss and maternal hypertension—both significant risk factors for maternal mortality. Clinical surveillance could provide more visibility on the timing and dose administration of Pitocin and could help enable adherence to hospital-defined protocols for the administration of this drug, prompting when to discontinue use as defined by the hospital.

Mechanical Ventilator Extubation

While critical care teams are usually effective at resuscitation and supporting mechanical ventilation in patients who need it, they often experience delays in promptly extubating patients in compliance with established ventilation and respiratory bundles.[14] Yet, delays in ventilation cessation can place patients at higher risk for acute respiratory distress syndrome (ARDS) and other serious complications. Hospital staff may find that a ventilated patient passes a spontaneous breathing trial, clearing them for extubation, but staff becomes busy with more critical patients, delaying the removal of their patient's endotracheal tube. Tying this process to a clinical surveillance tool can alert clinicians when their protocol flags a patient as eligible for extubation. A virtual care solution such as Mural can help support the analysis of respiratory function metrics against hospital-defined protocols. This information could help clinicians identify patients who are becoming increasingly susceptible to ARDS.

SELECTING A CLINICAL SURVEILLANCE SOLUTION THAT TRULY MEETS YOUR NEEDS

Hospitals are still in the early phase of deploying clinical surveillance tools, but as they begin to consider their strategy for integrating these valuable assets, they should ensure they are selecting the right technology deployed with the right processes and supported by the right vendor partner.

Clinical surveillance tools should have the ability to reside on top of existing medical record systems already in use in the hospital. The tools should also be technology agnostic and possess the ability to be integrated and interoperable with the IT systems and medical devices from which the relevant clinical data is being pulled. Surveillance tools should be flexible enough to adapt to any clinical scenario in which the facility wishes to apply them. User interface design is also important to allow clinicians to easily find and use the data in which they are most interested. GE Healthcare's experience suggests that users that are involved in the customized design of their interface will be more engaged with the solution. The right clinical surveillance tools allow different care units to have default views specific to their units.

"The Mural Solution may significantly contribute to helping improve delivery of quality care," said Melissa Martin, Mural Engagement Director for GE Healthcare. "It aggregates pertinent patient data, in real time onto one display, from virtually any networked medical device, EHR, or health information system. You can then tailor the system for what problem you are trying to solve, providing data that could, for instance, help hospitals compare their results to population health data. We feel no one else is approaching this space in the same way."

> **The Mural Solution ... aggregates pertinent patient data, in real time onto one display, from virtually any networked medical device, EHR, or health information system. You can then tailor the system for what problem you are trying to solve, providing data that could, for instance, help hospitals compare their results to population health data.**

DEPLOYING CLINICAL SURVEILLANCE TECHNOLOGY REQUIRES ROBUST PROCESSES

Every Mural Solution engagement begins with a detailed series of conversations with clinicians to identify the challenges they experience that are impacting clinical outcomes, operational performance and cost. Once a challenge has been prioritized, the hospital defines the appropriate evidence-based protocols/practice to address the problem. GE Healthcare recognizes that hospitals are looking for solutions that allow them to apply their own policies and procedures developed over decades of experience. While competing applications in the market prescribe a specific way of delivering care, the Mural Solution has the flexibility to deploy these in-house protocols as well as other industry-established protocols. The newly developed solution is then broken down into component steps that build up to an algorithm that supports the protocol chosen by the hospital.

Once the clinical development stage is completed, the three-phased Mural Solution technical implementation begins. When deploying the Mural Solution, GE Healthcare facilitates working sessions during which the customers define the clinical problem to be solved by the clinical surveillance solution and identify processes and data required to help address the problem. GE Healthcare then works with the facility to determine configurations and notification levels based on the data being observed. GE Healthcare tracks the progress of the project against key metrics with the customer.

Since the solutions are designed to modify human behavior, clinical surveillance technology must be implemented with clinician engagement at the forefront. The messaging about clinical surveillance that comes from hospital leadership is also extremely important. Clinicians should be reminded that the tools are not designed as "Big Brother," but as an extra layer of support to help them improve patient care. They should also be reminded that clinical surveillance is not a substitute for bedside clinicians but an asset to help them be better providers. GE Healthcare has found that it is also important for both clinical leadership and bedside caregivers to be actively involved in identifying the use cases for clinical surveillance as well as the appropriate communication and intervention strategies. When clinicians understand WHY surveillance tools are being implemented and how they can help with caring for the institution's patients, most become supportive of the program. Sometimes, this requires having an honest conversation about where clinicians and staff may be falling short with compliance to particular protocols. Achieving this initial buy-in from the appropriate stakeholders is one of the most important steps of the deployment process, which must be customized for every provider. In addition to support from clinicians, a clinical surveillance program should also be supported by a strong IT and clinical informatics team.

RELYING ON AN ESTABLISHED PARTNER TO REALIZE
THE POTENTIAL OF CLINICAL SURVEILLANCE

Clinical surveillance technologies are customized solutions deployed using rigorous processes that integrate the tools into the operations of the hospital using them. A vendor partner supporting the facility throughout the process can help a hospital realize the full benefit of the solution. GE Healthcare describes how the Mural Solution allows close collaboration with hospitals to craft customized solutions designed to solve complex systemic challenges.

Clinical surveillance tools must be able to pull data from all relevant sources, whether IT systems or medical devices. Consequently, those companies, such as GE Healthcare, with experience in both technology fields are in a unique position to support hospitals. GE Healthcare has decades of expertise with medical devices, which is used to support its clinical surveillance deployments. The breadth of that portfolio has given the company huge amounts of data and expertise. This biomedical expertise combined with the company's healthcare IT and clinical experience positions GE Healthcare as an ideal partner to help the facility leverage the data from its disparate systems. Since the Mural Solution pulls source data generated natively from all HL7 networked devices in the institution, not just those manufactured by GE Healthcare, the company supporting such a clinical surveillance system must be intimately familiar with those devices themselves.

"GE Healthcare has a very broad portfolio of expertise with cardiac and vital sign monitors, incubators, anesthesia machines, ventilators, and a broad and diverse line of imaging devices. The breadth of knowledge and understanding gained from the huge types of data from these devices, combined with our digital solutions expertise, has provided GE clinicians, engineers and IT experts a unique and innovative perspective on clinical surveillance to enable us to develop the Mural Solution," said Jeff Hersh, Ph.D., M.D., Chief Medical Officer for GE Healthcare.

As one of the largest medical technology companies in the world, GE Healthcare professionals are attuned to the challenges bedside clinicians face as well as changes in medical practice. Customers deploying the Mural Solution benefit from that level of insight provided by a vendor that is encountering patients like theirs every day. It is not just the software that GE Healthcare possesses but a deep understanding of the patient workflow processes and clinical expertise that allow it to deploy the Mural Solution effectively. The GE Healthcare team combines deep technology expertise with a consultative approach that understands the hospital at an enterprise level.

> **" As one of the largest medical technology companies in the world, GE Healthcare professionals are attuned to the challenges bedside clinicians face as well as changes in medical practice. Customers deploying the Mural Solution benefit from that level of insight provided by a vendor that is encountering patients like theirs every day.**

CONCLUSION

Clinical surveillance holds incredible potential in supporting hospitals in their mission to deliver better outcomes in an ecosystem where there is more data than can be interpreted by human beings. Existing documentation systems can lack contextualization of patient data, while clinical surveillance tools offer one cohesive, interoperable view of the patient information. Providers owe it to their patients (and their staff and physicians) to employ systems that support better care and allow clinicians to practice medicine at the top of their licenses. Clinical surveillance is not "cookbook medicine" or "Big Brother" monitoring, but rather an extra set of eyes and ears to allow clinicians to efficiently deliver care that combines data-driven insights with clinical intuition and expertise. Designed appropriately, clinical surveillance systems do not create more work for front-line clinicians—they allow them to be more effective with the work that they do. Clinical surveillance solutions can be rolled out incrementally within a hospital, focusing first on the critical problems with which a hospital is struggling most. Selecting the right partner to implement a clinical surveillance solution along with the state-of-the-art technology is critical. These vendors must bring with them a deep knowledge of clinical care, information technology, data science and medical device engineering, along with the project management skills necessary to commit to delivering benefits to a client over the long term.

ENDNOTES

1. Gawande, A. The Checklist Manifesto: How to Get Things Right. New York (NY): Metropolitan Books; 2009. (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3960713/)

2. ACOG Committee Opinion. Committee on Patient Safety and Quality Improvement. No. 792. Clinical Guidelines and Standardization of Practice to Improve Outcomes. Obstetrics & Gynecology. e122 Vol. 134, No. 4, October 2019. (https://www.acog.org/-/media/Committee-Opinions/Committee-on-Patient-Safety-and-Quality-Improvement/co792.pdf?dmc=1&ts=20190930T0543011625)

3. Berwick, DM. A User's Manual for the IOM's 'Quality Chasm' Report. Health Aff 2002;21:80–90. (https://www.ncbi.nlm.nih.gov/pubmed/12026006)

4. Grol, R. Between evidence-based practice and total quality management: the implementation of cost-effective care. Intl J Qual Health Care 2000;12:297–304.

5. Lee, et. al. Are high nurse workload/staffing ratios associated with decreased survival in critically ill patients? A cohort study. Ann Intensive Care. 2017; 7: 46.

6. Carthon, et. al. Association of Nurse Engagement and Nurse Staffing on Patient Safety. Journal of Nursing Care Quality. 2018. 34(1). 40-46.

7. Grigonis, et. al. Use of a Central Catheter Maintenance Bundle in Long-Term Acute Care Hospitals. American Journal of Critical Care. 2016. 25 (2): 165–172. (https://aacnjournals.org/ajcconline/article-abstract/25/2/165/3113/Use-of-a-Central-Catheter-Maintenance-Bundle-in?redirectedFrom=fulltext)

8. https://www.sccm.org/Communications/Critical-Connections/Archives/2019/The-Multidisciplinary-Critical-Care-Workforce-An

9. Tele-ICU Literature Review-Impact on Clinical and Economic Outcomes

10. Shafi, et. al. Compliance with Recommended Care at Trauma Centers: Association with Patient Outcomes. 2014. Journal of the American College of Surgeons. Aug;219(2):189-98. (https://www.ncbi.nlm.nih.gov/pubmed/25038959)

11. 2020 Hospital National Patient Safety Goals. The Joint Commission. (https://www.jointcommission.org/-/media/tjc/documents/standards/national-patient-safety-goals/2020-hap-npsg-goals-final.pdf)

12. Floyd, N. Effectiveness of Pressure Ulcer Protocols with the Braden Scale for Elderly Patients in the Intensive Care Unit: A Systematic Review. 2018. Walden University Dissertations and Doctoral Studies Collection.

13. Joint Commission press release. August 29, 2019. (https://www.jointcommission.org/en/resources/news-and-multimedia/news/2019/08/new-joint-commission-standards-address-rising-maternal-mortality-in-the-us/)

14. Epstein, S. Extubation failure: an outcome to be avoided. Critical Care. Volume 8, Article number: 310 (2004). (https://link.springer.com/article/10.1186/cc2927)

NEXT STEPS

⊙ **Schedule a meeting with our global team** to experience our thought leadership and to integrate your ideas, opportunities and challenges into the discussion.

⊙ Interested in learning more about the topics covered in this white paper? Call us at 877.GoFrost and reference the paper you're interested in. We'll have an analyst get in touch with you.

⊙ Visit our **Digital Transformation** web page.

⊙ Attend one of our **Growth Innovation & Leadership (GIL)** events to unearth hidden growth opportunities.

Silicon Valley
3211 Scott Blvd, Suite 203
Santa Clara, CA 95054
Tel 650.475.4500
Fax 650.475.1571

San Antonio
7550 West Interstate 10
Suite 400
San Antonio, TX 78229
Tel 210.348.1000
Fax 210.348.1003

London
Floor 3 - Building 5,
Chiswick Business Park
566 Chiswick High Road
London W4 5YF
Tel +44 (0)20 8996 8500
Fax +44 (0)20 8994 1389

✉ myfrost@frost.com   📞 877.GoFrost   🌐 http://www.frost.com

FROST & SULLIVAN

Frost & Sullivan, the Growth Partnership Company, works in collaboration with clients to leverage visionary innovation that addresses the global challenges and related growth opportunities that will make or break today's market participants. For more than 50 years, we have been developing growth strategies for the Global 1000, emerging businesses, the public sector and the investment community. Is your organization prepared for the next profound wave of industry convergence, disruptive technologies, increasing competitive intensity, Mega Trends, breakthrough best practices, changing customer dynamics and emerging economies?

FROST & SULLIVAN