Trends in Patient Data and Alarm Management

A Spyglass Consulting Group Health Care Study

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Introduction

Purpose

Spyglass Consulting Group conducted a primary research study to identify challenges and opportunities for hospitals who are developing strategies and/or considering investments in **Patient Data and Alarm Management** solutions. These solutions are targeted at physicians, nurses, allied professionals, and support staff who are responsible for monitoring, managing and coordinating patient care within high-acuity environments leveraging telemetry within the hospital including critical care, telemetry and step-down units.

Target audience

This Spyglass research study was targeted at clinical informatics and business decision makers within hospitals and healthcare systems involved in clinical spon-sorship, technical evaluation, strategy, solution planning, and business decision making.

Methodology. In May 2019, Spyglass surveyed thirty (30) clinical informatics and hospital IT thought leaders at leading hospitals across North America, Europe and Asia-Pacific who are technically knowledgeable about how information technology can be utilized within critical care environments to address communications, colla-boration, and care coordination inefficiencies.

During these telephonic interviews, Spyglass

■ Analyzed the limitations of existing Patient Data and Alarm Management solutions and processes,

■ Explored the value proposition and requirements for next generation solutions, and

■ Identified specific care quality benefits to support high value clinical workflow processes through automating data access and alarm delivery within a critical care environment.

The Spyglass research study was designed to gain an understanding of Patient Data and Alarm Management Solutions from the viewpoint of healthcare provider organizations and was not intended to be an evaluation of existing vendor solutions or strategies.

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Market opportunity

Hospitals around the world are migrating toward patient-centered care. Physicians, nurses, allied professionals and support staff are under increased pressure to monitor, manage and coordinate patient care more effectively with a wider array of team members within the hospital and across the care continuum.

Hospitals surveyed report several underlying market factors influencing investments in people, processes and technologies within critical care environments that include:

Hospital patients are sicker

Increasing healthcare costs are increasingly driven by a global aging population and the prevalence of chronic disease. By 2020, chronic diseases will account for almost three-quarters of all deaths worldwide, and of that, 71% of deaths due to ischemic heart disease (IHD), 75% of deaths due to stroke, and 70% of deaths due to diabetes will occur in developing countries. The number of people in the developing world with diabetes will increase by more than 2.5-fold, from 84 million in 1995 to 228 million in 2025. On a global basis, 60% of the burden of chronic diseases will occur in developing countries.[1]

Hospital-based patient care is becoming increasingly complex

Critical care environments are focused on the sickest and most fragile patients, who would not survive without the support of specialized technologies and equipment. Clinicians have to learn how to use these technologies along with keeping abreast of advancements in clinical knowledge, treatments, diagnostics and care management which are pushing their cognitive capabilities.[2]

Hospitals are facing significant labor shortages

A recent report by healthcare advisory firm Mercer, reported that US-based healthcare provider organizations will need to hire upwards of 2.3 million new healthcare workers by 2025 to adequately address the healthcare needs of a growing aging baby boomer population. Existing workers are rapidly retiring and there are insufficient numbers of new graduates available to replenish the workforce. Inadequate staffing levels, especially within critical care environments, are negatively impacting patient care quality and outcomes.[3]

Volume of patient health data is exploding

Hospitals and healthcare systems are trying to manage an explosion in the volume of patient health data. Intelligent middleware is required to collect and aggregate patient data stored within separate siloes across the care continuum to develop a unified patient picture. This includes clinical data within the EHR, claims data, socio-economic data, and patient acquired data generated by medical sensors, wearables, ingestibles and implantables.

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Problem

Hospitals surveyed expressed concerns that physicians, nurses, allied professionals, and support staff working in critical care environments are faced with a multi-faceted and complex combination of people, process, and technology challenges that include:

Nurses are experiencing alert/alarm fatigue
Caused by an increased number of medical devices at the patient's bedside, more than 90% of medical device alarms are considered clinically insignificant and non-actionable. Some nurses now deal with alarm distraction by ignoring the alarms and/or turning off the device acoustics which could result in medical error or a sentinel event.

Nurses and physicians are frustrated with manual and delayed documentation processes...
...and tools for collecting, validating, and recording patient vital signs within the EHR. A critical care patient connected to 3 or 4 medical devices could generate upwards of 2,000 distinct data points per day. Manual data entry is a time-consuming, error-prone, and often incomplete process that can result in delayed documentation and potential transcription errors.

Nurses are facing information overload
Responsible for monitoring multiple patients whom are each connected to multiple medical devices, nurses must manually collect, aggregate and analyze large volumes of raw patient data to determine a patient's condition and status. This difficult, time consuming, and labor-intensive process can directly impact care quality.

Care teams are experiencing communications and collaboration inefficiencies
Many caregivers are forced to use antiquated communications tools provided by hospital IT including overhead paging system, pagers, and proprietary VOIP handsets. Communications lack adequate clinical context and often result in endless cycles of telephone tag. Treatment delays and sentinel events are often caused by a breakdown in communications.

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Investments

Strategy

47 percent of hospitals surveyed have developed and 43 percent are in the process of developing a Patient Data and Alarm Management vision and strategy within their critical care environments.


Emerging 43%
Yes 47%
No 10%
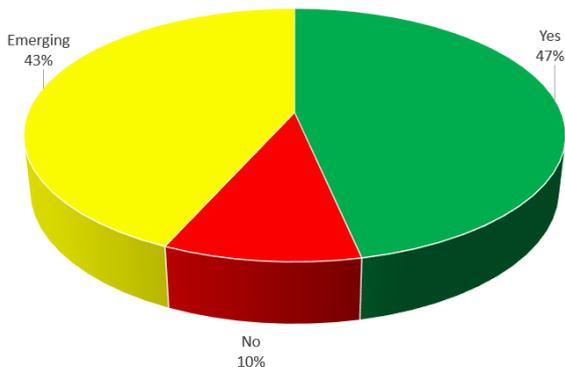
Investment plans

70 percent of hospitals surveyed have made initial investments in Patient Data and Alarm Management solutions, and nearly 90 percent plan to make new or incremental investments over the next 12 to 18 months.

Evaluating investments 20%
No 10%
Early stage investments 70%
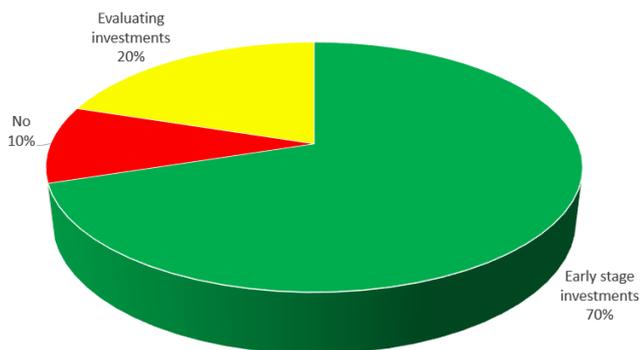
Priorities

60 percent of hospitals surveyed report that Patient Data and Alarm Management solutions are a HIGH investment priority and 23 percent believe they are a MEDIUM investment priority.

Low 17%
High 60%
Medium 23%

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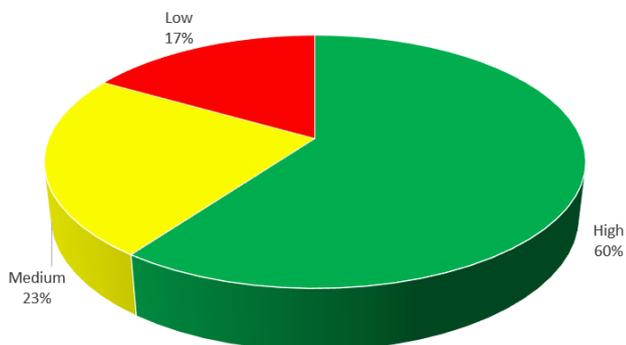
Solution

*Hospitals surveyed identified the value proposition for a **Patient Data and Alarm Management** solution and specific capabilities required by the care team to enhance the monitoring, management, and coordination of patient care within a critical care environment.*

Patient Data and Alarm Management solutions must support the ability to:

- **Integrate.** Medical device integration can *integrate* and collect near real-time data from medical devices and retrospective data from the EHR and other hospital legacy systems.

- **Orchestrate.** Data management, alarm management and predictive analytics tools can help *orchestrate* the introduction of patient data and alarms to support individual and team-based care processes. Alarm management and predictive analytics leverage event- and data-driven insights for more informed clinical decision making at point-of-care.

- **Enable.** Distributed dashboards in strategic locations on the unit and mobilization tools carried by the care team members *enable* care team members to monitor a patient's current status and receive critical medical device alerts, alarms and notifications regardless of their physical proximity within the hospital.

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Integrate: Medical device and clinical systems integration

Medical device and clinical systems integration can integrate and collect near real-time data and alarms from medical devices, creating an automated and standardized patient data stream to the EHR and the alarm management system.

Hospitals surveyed report that the highest priorities for clinical workflow improvement include:

- Improving nursing staff efficiency and productivity
- Reducing the risk of transcription errors
- Enhancing patient safety and reducing risk of sentinel events
- Spending additional time with patients at the bedside

Problem

Hospitals are required to regularly record patient vital sign parameters to address payer, legal, and clinical documentation requirements. Unfortunately, many organizations are still leveraging manual paper-based processes to collect, validate and document the vital signs data within the EHR which is a time-consuming, error-prone process that can lead to transcription and medical errors. Hospitals are also required to monitor and respond to audible and visual medical device alarms to ensure patient safety.

Survey results

All hospitals surveyed report that medical device integration provides HIGH value to integrate and collect and validate real-time vital signs data, alarms, and events from medical devices such as physiological monitors, ventilators, IV pumps and dialysis machines to record into the EHR and make them available to be viewed on patient care dashboards and mobile devices.

Key capabilities include:

- Automating the collection, validation and storage of approved clinical data

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Integration priorities

Hospitals surveyed report that top medical device and clinical system integration priorities for a critical care environment include:

Medical devices

- Physiological monitors (97%)
- Ventilators (83%)
- Dialysis machines (60%)
- IV Pumps (53%)

Hospital clinical systems

- EHR (90%)
- Nurse Call (73%)
- Real-time location services (37%)

Which medical devices and clinical information systems are top integration priorities (N = 30)
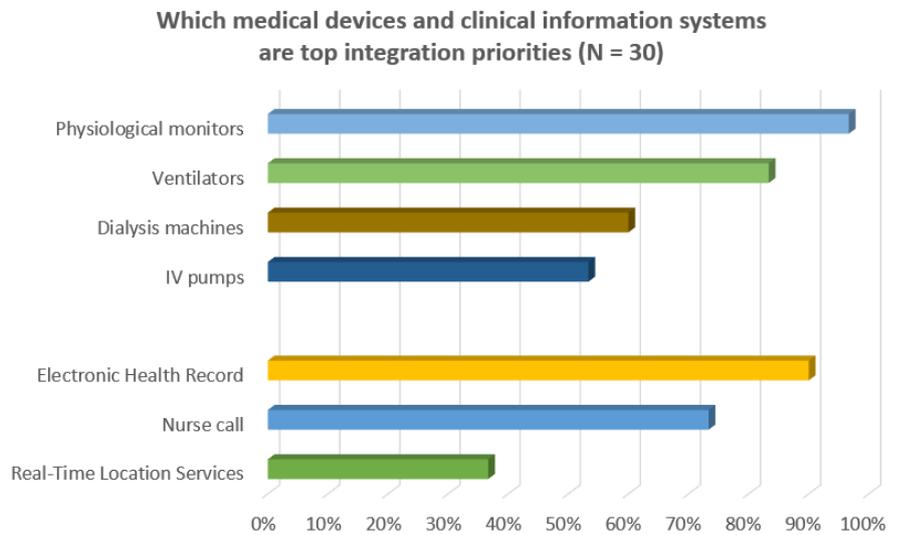
Orchestrate: Data management, alarm management, and predictive analytics

Data management, alarm management and predictive analytics can help orchestrate the introduction of patient data and alarms to support individual and team-based care processes. Alarm management and predictive analytics leverage event- and data-driven insights for more informed clinical decision making at the point-of-care.

Hospitals surveyed report that the highest priorities for clinical workflow improvement include:

- Reduce interruptions for the care provider
- Improve response to actionable alarms
- Access to patient data for informed clinical decisions
- Increase care provider efficiency

Data management

Problem
Nurses working in critical care environments are suffering from data overload. Retrospective EHR data provides a comprehensive view of the patient's condition and status, however, much of the EHR data lacks situational relevance and is not presented in a format that can be quickly absorbed and understood without additional research and analysis. Real-time patient data is only available on the original medical devices that are connected to the patient at the point of care.

Survey results
93 percent of hospitals surveyed report that an automated system to collect medical device data provides HIGH value to organize and display near real-time clinical data, alarms and events generated by medical devices, such as patient monitors, ventilators, infusion pumps, and blood filtration. Aggregating and presenting patient medical device data enables improvements in clinical workflows and care decisions leading to improved patient outcomes.

Key capabilities include:

- Aggregating the patient's detailed clinical data, vital signs parameters, and events
- Providing a single source of clinical information to provide greater situational context for clinical decision making
- Creating an audit log containing data and alarms history along with end-user actions for quality reporting and continuous process improvement

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Alarm management

Problem

Nurses working in critical care environments are experiencing alarm fatigue. They are overwhelmed by the sheer volume of device alarms, events, and notifications which often lack appropriate clinical context and are not actionable. This makes it difficult for the nurse to prioritize patients' needs, coordinate care with team members, and respond appropriately to critical events. A typical critical care nurse may be responsible for three high acuity patients each of which is connected to six different medical devices.

Survey results

90 percent of hospitals surveyed believe that an alarm management solution provides HIGH value to support individual and team-based workflows. An alarm management solution with a rules-based engine and pre-defined filtering algorithms can route and redirect actionable patient data, alarms, and events to appropriate care team members based on hospital-defined protocols to improve and expedite clinical decision making at point of care.

Key capabilities include:

- Filtering and distributing actionable alarm notifications and supporting patient data to appropriate care team members
- Redirecting alarm notifications to designated care team members in the escalation path
- Creating an audit log containing data and alarms history along with end-user actions for quality reporting and continuous process improvement

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Predictive analytics

Problem

Nurses working in critical care environments are also experiencing cognitive overload. They are often reliant upon their clinical expertise, the patient's physical symptoms, and their abilities to manually access, aggregate, and analyze raw data from medical devices and the EHR. This poses a challenge to identify if a patient's condition has deteriorated or become life threatening, which requires the care team to adjust the level of care and clinical resources required by the patient.

Survey results

60 percent of hospitals surveyed believe that predictive analytics provide HIGH value to support event- and data-driven insights within high acuity medical departments. Predictive analytics can analyze relevant near real-time medical device data AND retrospective EHR data to support clinical decisions for high acuity patients who are considered at-risk of deteriorating or life-threatening conditions thus enabling early interventions by the care team which can significantly improve care quality and outcomes. Hospitals are evaluating currently available algorithms for clinical efficacy and accuracy.

Key capabilities include:

■ Trending near real-time medical device data along with retrospective EHR data

■ Applying algorithms to identify patients at risk of deteriorating and/or life-threatening conditions

Analytics priorities

Hospitals surveyed report that the highest priorities for predictive analytics include:

■ Sepsis detection (90%)

■ Hospital acquired infection (53%)

■ Sentinel cardiac events (43%)

■ Respiratory depression (40%)

■ Fall risk (37%)

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Customer story: Humber River Hospital

Humber River Hospital has 656-licensed beds and is one of Canada's largest regional acute care hospitals, serving a catchment area of more than 850,000 people in the northwest greater Toronto area. Humber provides both in-patient and out-patient care, including cancer, cardiac and critical care, emergency services, dialysis, bariatric surgical services, women's and children services, diabetes and mental health programs.

Humber River has the distinction of being one of the first fully digital hospitals in North America and collaborated with Ascom to deliver a health system-wide solution to transform clinical communications and collaboration solution to promote high quality, safe and efficient patient-centered care.[4]

Purpose built smartphones

Humber River deployed 600 Ascom Myco™ purpose-built smartphones to improve person-to-person communication and person-to-system communication. Staff members use the Myco to talk to each other, and the platform also ensures certain alerts and alarms go to the right clinicians. Avaya SIP PBX integration enables clinicians using the Ascom Myco to communicate with colleagues within and outside of the hospital's walls. An integrated bar code scanner enables mobile documentation during the medication administration process.

Intelligent middleware

Humber River deployed Ascom's Unite software to integrate Ascom's Telligence patient response system for patient requests, GE physiological monitors for alarms and parameters, and the Meditech EMR for critical lab results. Smart alert filtering and automatic escalation ensures that only significant alerts are distributed to nurses and other care team members based on hospital-defined protocols which helps reduce alert/alarm fatigue at point of care.

Analytics Command Center

Humber River collaborated with GE Healthcare to conceive, design and build a 4,500 square-foot digital Command Center that uses complex algorithms, predictive analytics and cutting-edge engineering to target improved clinical, operational and patient outcomes. The heart of the 4,500 square-foot Command Centre is a GE Wall of Analytics that processes real-time data from multiple source systems across the hospital including Ascom Unite software. The system applies advanced and predictive analytics and provides a continuous "read out" alerting staff to everything from delayed patient care activity, unbalanced physician and staff work-load and unusual situations that may correlate to increased risk of patient harm.[5,6]

Results

With the deployment of the Ascom, Humber River was able to achieve some impressive results:

- Patient satisfaction improved dramatically, as a result of the reduction in environ-mental noise and the ability to directly interact with care team members directly via the Ascom Myco and bedside terminals

- Critical lab notifications and alerts from cardiac monitors pushed to the Ascom Myco were shown to help reduce cardiac arrest, increasing patient safety

- Optimizing the nursing workflow using the Ascom Myco to reduce the number of steps nurses took each shift from 11.5 km a day to 9.5 km led to higher job satisfaction, lower staff turnover

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Enable: Distributed dashboards and mobilization

Both distributed dashboards, strategically placed throughout the medical unit, and mobile handsets, carried by care team members, enable clinicians to monitor a patient's condition and receive critical medical device alerts, alarms and notifications regardless of their physical proximity to the patient within the hospital.

Hospitals surveyed report that the highest priorities for clinical workflow improvement include:

- Nursing supervisor can get a near real-time status of their entire unit to optimize clinician staffing and improve the quality of care and safety
- Care team has efficient access to their patient's current condition and actionable events
- Physicians can review the trending of patient vitals and alarms to inform care decisions
- Biomedical engineer can verify the device connection and the data acquisition and identify technical alarms to evaluate maintenance needs

Distributed dashboard

Problem

Hospitals are transitioning the physical layout of their patient care environments toward single patient rooms. This makes it more difficult for clinical staff to visually monitor all patient activity.

Survey results

37 percent of hospitals surveyed report that distributed dashboards including desktop and/or wall mounted display units provide HIGH value. Dashboards can display near real-time patient data, alarms, and events from medical devices associated with a specific patient or an entire unit to help care team members quickly identify problems, prioritize patients' needs, and plan critical care responses.

Drill down capabilities provide a comprehensive overview of the device's status, and alarms and/or warnings that may occur on the connected device. Color coded lights show alarm severity level such as blue – low severity, orange – medium severity, and red- high severity.

Key capabilities include:

- Provide a consolidated view of all patients on the unit
- Provide a view of all connected devices and current events for each patient

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Mobile devices and unified communications

Problem

Physicians, nurses and allied professionals are mobile workers, continuously on the go as they traverse the hospital's corridors and therefore are not always in close proximity to their patients when a problem arises. Clinicians are dissatisfied with the antiquated communication options provided by hospital IT that are not well integrated with their workflow. Hospital IT and Clinical leadership struggle with the deployment of smartphone hardware and software options to configure the optimal integrated workflow solution for the clinicians in their hospitals

Survey results

77 percent of hospital surveyed report that smartphones and unified communications tools provide HIGH value to support closed loop communications and the ability to receive real-time notifications of clinically significant alarms, warnings, and events that are relevant and actionable.

Key capabilities include:

■ Unified communications & presence management supporting care team member presence, availability, and multi-modal means of communication

■ Actionable notifications of patient events indicating level of acuity through sound and visual means

■ Access to near real-time patient data and retrospective EHR information provides the necessary patient context that drives good clinical decisions

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Operationalize: Professional services

Professional services, which includes both clinical and technical consultation, can help operationalize the Patient Data and Alarm Management solution to enhance and optimize high-value clinical workflows.

Survey results

87 percent of hospitals surveyed report that professional services provide HIGH value to plan, deploy, optimize and manage a patient data and alarm management solution to support clinical workflows and enhance care quality. A qualified 3rd party vendor could provide the necessary expertise, knowledge, and skills to help operationalize their solution enterprise-wide.

Key capabilities include:

■ Creating a patient data and alarm management vision and strategy
- Form an interdisciplinary team including nursing, physicians, ancillary staff, IT, biomedical engineering, and finance
- Identify departmental and end user requirements for patient data and alarm management to align with key performance goals and quality metrics

■ Assessing clinical environment and technology infrastructure
- Catalog medical alarm types, priorities and hospital response protocols
- Conduct time-motion studies to identify gaps and inefficiencies within key clinical workflows
- Evaluate the integration requirements with medical devices and clinical systems

■ Developing a deployment plan
- Upgrade WLAN infrastructure to ensure reliable coverage throughout the facility
- Optimize filtering and routing of actionable alarms
- Redesign clinical workflow processes to enhance care quality and outcome
- Monitor end-user feedback to ensure initial success and continuous process improvement

What is the value proposition for specific patient data and alarm management capabilities (N = 30)

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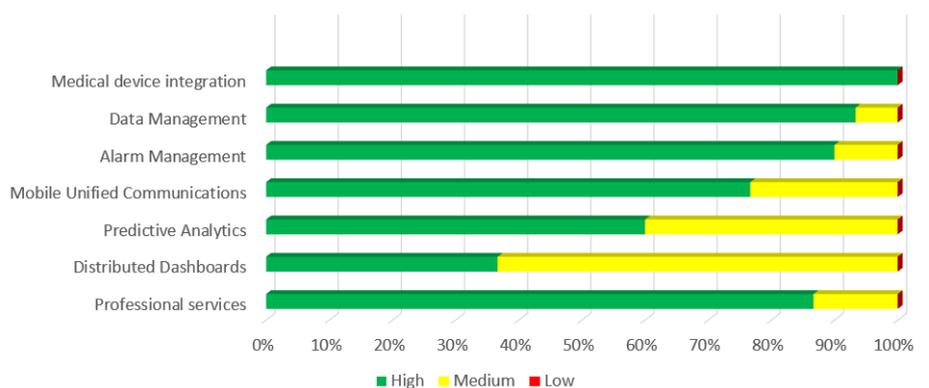
Customer story: Erasmus MC

Erasmus MC
The facts and figures are truly impressive: a 203,000 m² floor area, 586 single-patient rooms, 22 operating rooms. But what really sets the Erasmus MC hospital in Rotterdam apart is its vision for patient safety, patient autonomy and patient-centric care. In fact, every aspect of Erasmus MC – from its soothing color schemes to alarm filtering to smooth clinical workflows – has been designed to nurture recovery in a calm healing environment.

Single platform
But how could Erasmus MC realize this vision, given its 586 single-patient rooms (of which 38 are ICU, 18 are cardiac ICU) each generating messages, alerts and assorted clinical data? The answer lay in the hospital's Medical Integrated Communications and Information System (MICIS), which integrates Erasmus MC's digital information systems into a single platform. Erasmus MC, however, required a strategic partner to help it implement MICIS; a partner with healthcare consultancy, hardware and software solutions, as well as a track record in advanced clinical information management.

Bridge digital information gaps
To devise a customized solution for Erasmus MC, Ascom combined various components of the Ascom Healthcare Platform: consulting, software, smartphones, integration with Electronic Health Records (EHR) and third-party applications, commissioning, training and support. The result was an end-to-end solution, with Ascom Unite and Digistat Connect software integrating siloed healthcare IT systems and fragmented data with the hospital's Electronic Health Record (EHR) system in order to bridge digital information gaps.

Orchestration software
The software also orchestrates clinical information; filtering and prioritizing it, and managing its speedy and uniform delivery to assigned caregivers. Finally, 1,000 Ascom Myco smartphones enable informed actions and decisions. Caregivers receive context-rich alerts, complete with patient names and locations, direct to their Ascom Myco smartphones.

World-class team for world-class hospital
The new Erasmus MC in Rotterdam is the result of twenty years preparation and eight years construction work. Throughout its involvement in the project, Ascom held multidisciplinary workshops and reviews with the hospital. Ascom also held IT sessions with key staff from Erasmus MC and project partners – working together to optimize the MICIS's reliability, scalability and security.

Results
Erasmus MC was officially opened in September 2018. Since then:

- The MICIS solution has made a visible and essential contribution to achieving their goals of improved patient comfort, quicker recovery, enhanced efficiency and increased patient satisfaction.
- Advanced alert management is helping to ensure patient safety by sending alerts to specified clinicians, with escalation to colleagues when appropriate.
- Sending filtered alerts and messages to mobile clinicians' Ascom Myco smartphones is also helping to foster a calmer environment; contributing to fewer disturbances to patients, and a lower risk of alarm fatigue for frontline staff.

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Outlook – Emergence of the 'Silent ICU'

Forward thinking provider organizations and standards bodies, especially in Europe, are evaluating next generation alarm management solutions to help support the concept of the 'Silent ICU'. Within the European medical device community, solutions allowing primary alarming to the mobile clinician are in development thus silencing the alarms at the patient bedside.

Problem

A 2016 study involving 1,223 healthcare providers from 24 countries found that noise levels in the Intensive Care Unit (ICU) can go well above recommended levels, disturbing both patients and the medical teams responsible for their care. ICU noise can negatively impact the patients' wellbeing as well as the optimal functioning of the nurse and the medical staff. It can also have a deleterious effect on patient sleep, healing, stress levels, recovery times and overall satisfaction.[7]

Biomedical devices that are attached to ICU patients are generating too many alarms. Upwards of 85 to 90 percent of the alarms are considered clinically irrelevant. Nurses finds that the abundance of alarms are irritating and annoying which results in nurses ignoring low level alarms. Patients find the alarms create a noisy environment which interrupt their sleep are not conducive to the healing process. Hospital risk management is resistant to resetting the biomedical device's threshold hold values due to risk of litigation if an adverse patient condition or never-event occurs.

Survey results

The majority of hospitals surveyed defined their aspiration goals of deploying next generation alarm management solution to help support the concept of the 'Silent ICU' to address noise reduction at the patient bedside and contribute to better patient outcomes. Some key technology themes supporting the 'Silent ICU' include:

- Central Monitoring Unit. Biomedical alarms should be redirected to a centralized monitoring station within the hospital system if qualified medical staff are not present within the patient's room. Technicians at the monitoring station can therefore triage the alarm and dispatch a notification to the nurse or other care team members if any type of intervention is required.

- Smart alarms can decrease the volume of irrelevant alarms by leveraging advanced analytics that consider multiple vital signs parameters when monitoring a patient's condition. These vital signs could include blood pressure, heart rate, respiration rate, and oxygen saturation rate.

- Confirmed Distributed Alarm Systems which allow the hospital to turn off the alarm sound in the room and make the alarm, distributed directly to the caregiver's mobile, a primary notification.

- Advanced clinical decision support tools on a remote central station can display the possible complications in order of likelihood and the underlying risk factors present in the patient's medical history.

- Intelligent notifications can be sent to the ICU nurse's smartphone that provides him or her with the precise clinical context of the alarm and recommended actions to be performed by the nurse and other care team members.

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Conclusions

Hospital IT imperative

Hospitals surveyed are increasingly moving toward patient-centered care focus. Physicians, nurses, allied professionals and support staff are under increased pressure to monitor, manage and coordinate patient care more effectively with a wider array of team members within the hospital and across the care continuum. Underlying market factors influencing investments in people, processes, and technologies within higher acuity medical environments include sicker hospital patients, increased complexity of hospital-based care, and chronic labor shortages.

Problem

Hospitals surveyed expressed concerns that physicians, nurses, allied professionals, and support staff working in critical care environments are faced with a common set of problems which include alert/alarm fatigue, manual and delayed documentation processes, information overload, and communications and collaboration inefficiencies.

Investment Plans

Spyglass discovered that 90 percent of hospitals surveyed plan on making new or incremental investments in Patient Data and Alarm Management solutions over the next 12 to 18 months.

Solution capabilities

Hospitals surveyed identified the value proposition for a Patient Data and Alarm Management solution and the specific capabilities required by the care team to enhance the monitoring, management, and coordination of patient care within a critical care environment. These capabilities include the ability to:

- **Integrate.** Medical device integration can integrate and collect near real-time data from medical devices and retrospective data from the EHR and other hospital legacy systems.
- **Orchestrate.** Data management, alarm management and predictive analytics tools can help orchestrate the introduction of patient data and alarms to support individual and team-based care processes. Alarm management and predictive analytics leverage event- and data-driven insights for more informed clinical decision making at point-of-care.
- **Enable.** Distributed dashboards in strategic locations on the unit and mobilization tools carried by the care team members can enable care team members to monitor a patient's condition and receive critical medical device alerts, alarms and notifications regardless of their physical proximity within the hospital.

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About Spyglass Consulting Group

Spyglass Consulting Group is a market advisory firm focused on disruptive technologies, changing business models, and growth opportunities within the healthcare and life sciences industries.

Gregg Malkary is the Founder and Managing Director of Spyglass. With more than 30 years of strategic planning, marketing, and business development experience, he is a nationally recognized leader in digital and clinical transformation helping its clients create, protect and transform business value to support executive decision making, drive innovation, and enable sustainable competitive advantage.

Spyglass offers its clients market leading portfolio methodologies, tools, and services in the following growth areas:

- Evaluating disruptive technologies
- Transitioning to value-based care and population health management
- Embracing consumerism and digital health
- Improving operational performance through analytics
- Optimizing clinical workflows and EHR systems

Spyglass clients include leading technology companies, management consulting firms, healthcare provider organizations, and the investment community which includes **Cisco, IBM, Microsoft, Intel, Accenture, Hewlett Packard, GE Healthcare, Philips Healthcare, Kaiser Permanente, and Johns Hopkins.**

Prior to founding **Spyglass Consulting Group** in August 2002, Malkary was an Associate Partner at **Outlook Ventures**, a venture capital firm that focuses on early stage investments in enterprise software and communications companies. Previously, Malkary was the Director of Strategic Planning for **Exodus Communications** where he was responsible for identifying, evaluating and executing growth initiatives for Exodus in the managed web-hosting marketplace. Malkary has also held consulting and senior management roles in business development, strategic planning and product marketing for public and private technology companies including **IBM, Hewlett Packard, Accenture, Silicon Graphics, SkyTel Communications and Liberate Technologies.**

Malkary frequently speaks at regional and national conferences focused on mobile computing, wireless technologies and healthcare-related issues. He has been written about and quoted in numerous industry publications including the Wall Street Journal, CIO, Business 2.0, MIT Technology Review, Network World and eWeek.

Malkary is an honors graduate of **Brown University** having earned a MS and BA in Computer Science. He was awarded the prestigious North American Philips Corporation Fellowship for his graduate research work in graphical simulation environments.

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End Notes

[1] World Health Organization, The Global Burden of Chronic Disease, 2019

[2] Committee on the Learning Health Care System in America, "Best Care at Lower Cost: The Path to Continuously Learning Health Care in America," May 10, 2013

[2] Mercer Health Provider Advisory, "Demand for Healthcare Workers Will Outpace Supply by 2025: An Analysis of the US Healthcare Labor Market," 2018

[4] MarketWatch, Humber River Hospital, North America's first fully digital facility, selects workflow-enhancing communication solutions from Ascom, Feb 2016

[5] GE Healthcare Press Release, Humber River Hospital in Toronto Turns to Advanced Analytics to Improve Patient Care, 2016

[6] GE Healthcare Press Release, Humber River Hospital and GE Healthcare Building First Hospital Command Centre for Quality Healthcare in Canada, 2016

[7] Kamdar BB, Knauert MP, Jones SF, et al. Perceptions and Practices Regarding Sleep in the Intensive Care Unit. A Survey of 1,223 Critical Care Providers. Ann Am Thorac Soc. 2016;13(8):1370–1377. doi:10.1513/AnnalsATS.201601-087OC

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