LEVERAGING MEDICAL DEVICE DATA IN ANALYTICS
THE POWER + POTENTIAL OF A MEDICAL DEVICE INFORMATION SYSTEM
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EXECUTIVE SUMMARY

With the ubiquity of digital data throughout the hospital environment, analytics are playing an increasingly important role in almost every aspect of healthcare. Applying medical device data, the source of the most immediate patient clinical information, as well as device operational information, to a host of analytic applications can make an important difference in both patient care, and the efficiency and operation of a hospital's medical device infrastructure. However, until recently, making these benefits a reality by transmitting device data in an appropriate format to the downstream systems has been a significant stumbling block.

But today a new breed of IT technology, the medical device information system (MDIS), is rapidly changing that. For forward-thinking hospitals around the world, an MDIS is not only capturing device information digitally but also normalizing it, providing patient context and transmitting it to downstream applications that use it in a wide range of innovative ways.

Today, among the key uses of medical device analytics are:

- Early recognition and intervention of patient decline
- Vital signs practice and documentation compliance
- Optimizing medical device utilization

- Mitigating nurse turnover rates
- Reducing nuisance device alarms
- Monitoring medical device information system health

This paper examines the importance of analytics in modern healthcare, the value of medical device data to analytics and specific applications where it is already helping make a difference in the quality and efficiency of care.

THE AGE OF HEALTHCARE ANALYTICS HAS ARRIVED

As digital data has become pervasive throughout the healthcare delivery system, it has streamlined the ability to perform sophisticated information analyses to achieve improvements in numerous healthcare areas, from clinical to operational. Welcome to the age of healthcare analytics!

Healthcare analytics typically involves statistical and quantitative analysis of data to examine or track an area in depth, as well as facilitate explanatory and predictive modeling to suggest ways of solving problems and achieving goals. Analytics typically involve running historical and current data through sophisticated algorithms developed to meet a particular goal. The resulting analysis may provide clinicians with greater clinical confidence through treatment, decision support based on data from similar patients, or it may identify entire populations at risk for certain medical conditions that may be addressed through preventive tactics and education. Analytics applications can also help boost a hospital's administrative, operational and staffing efficiency, as well as management and maintenance of equipment. And analytics can help with ongoing hospital

financial planning, justification of key purchases and insurance claim processing, while driving down costs.

With sufficient data, benchmarks can be set for optimal performance based on a medical facility's specific profile. In fact, most industry experts cite analytics as a crucial step in elevating the overall efficiency of hospitals.

But what will analytics mean in the future? As analytic applications and medical technology, especially medical devices, grow more robust, they are expected to play an increasingly important role in patient management. For example, a clinical data analytics system may flag a patient at risk for a cardiac event or sepsis based on a pattern of medical device readings. These analytics can interface with various alarm programs that will notify appropriate medical personnel about the need for evaluation, which can lead to intervention. They also will tie into decision support systems that suggest evidence-based treatments formulated from a patient population with similar conditions who have been successfully treated in the past.

In the not too distant future, medical devices used remotely — in the home, nursing home or other settings anywhere beyond the hospital — also will interface with systems that send out similar alerts.

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ANALYTIC DATA TYPES

Healthcare like any industry applies analytics to gain hindsight, insight or foresight into a given problem or situation. Typically, this is achieved by taking advantage of four types of data:

→ **Descriptive,** which chronicles an event. For example, a patient had a seizure.

→ **Diagnostic,** which focuses on why the event occurred. For example, the seizure was due to a drop in blood pressure.

→ **Predictive,** which looks at what typically occurs next for these patients. For example, patients who have a seizure due to a head injury will often continue to experience seizures without intervention.

→ **Prescriptive,** which examines what has worked to address the problem in the past. For example, most patients who experience this type of seizure with this type of head injury are best treated with a specific anticonvulsant.

DEVICE DATA ANALYTICS + THE EVOLUTION OF THE MEDICAL DEVICE INFORMATION SYSTEM

As medical device integration has begun to evolve into robust medical device information systems (MDIS), only recently has data been appropriately captured to support analysis, helping hospitals to make the most of this valuable resource. This is because traditional device integration solutions functioned as a pipeline to simply transmit data to an electronic health record (EHR) or other downstream program for storage and use by that system only. By contrast, an MDIS is a true system with many moving parts serving many purposes.

Before transmission to an endpoint system, an MDIS aggregates and normalizes device data in a separate archive where it can be accessed when it is needed by a wide range of analytics and other programs. With the ability to analyze up-to-the-minute information, these systems offer the benefit of addressing potential problems before they occur. However, analytics applications cannot utilize medical device data unless it is, in fact, normalized and stored with patient context in its own system as is the case with an MDIS.

FOUR TYPES OF ANALYTICS
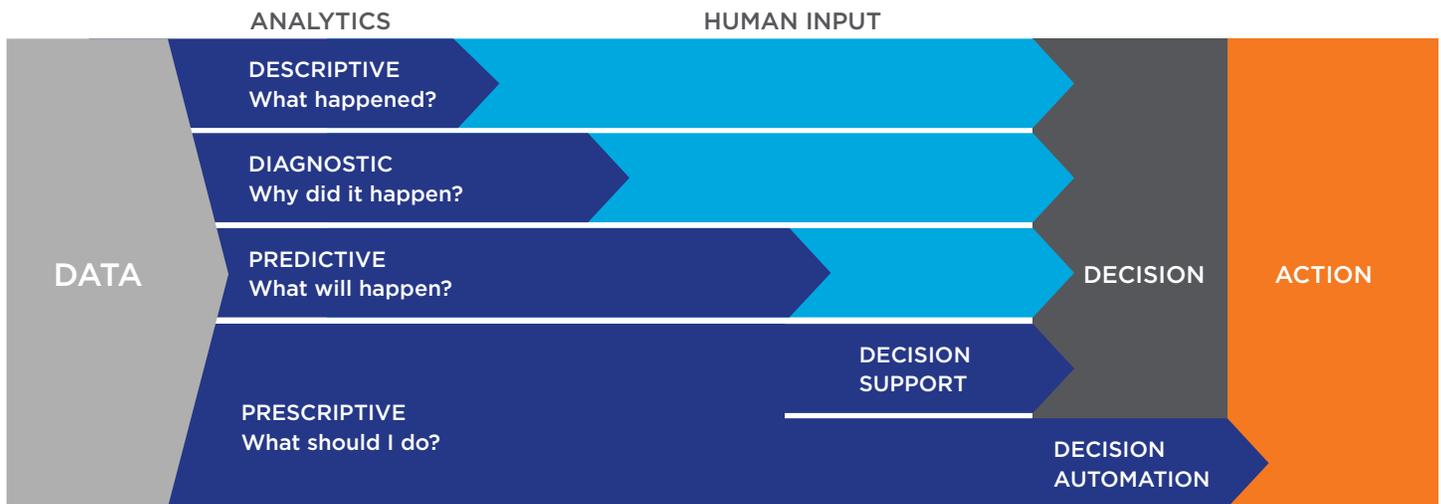
Source: Gartner (October 2015)
Source: Gartner 2016 Planning Guide for Data Management and Analytics; 02 October 2015 G00290775, Analyst(s): Carlie J. Idoine

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THE POTENTIAL TO DO MORE WITH MEDICAL DEVICE DATA

Medical device data is unique in the healthcare system because it provides ongoing, timely information, delivering essential insights into a patient's immediate condition. A device data analytics application can play a crucial role in enhancing patient care and addressing many healthcare workflow, patient care and management, and medical device issues. Information from bedside monitoring devices often drive decision-making that has an immediate and important impact on patient care. And what is often overlooked is the data created by a device about itself. Therefore, ensuring that devices are always fully operational and able to support accurate and complete data capture is crucial and can be just as important as the patient data it is capturing.

For therapeutic bedside devices, such as ventilators and infusion pumps, appropriate settings and proper functioning are also important. An incorrect setting or a malfunctioning device can mean the difference between a good or undesirable patient outcome.

Hospital administrators and nursing staff can leverage medical device analytics data to place patients in the proper care area and to help balance nursing workloads. Making the most of medical device inventory is critical in today's cost-driven healthcare age. This can present hospitals with significant operational and budgetary challenges. The ability to use device operational data to efficiently and proactively monitor the performance and maintenance of these smaller "machines" can extend their life and, obviously, maximize the investment in the machinery.

ANALYTICS: REALIZING THE FULL POWER OF A MEDICAL DEVICE INFORMATION SYSTEM

Today, emerging medical device analytic applications are playing a key role in boosting the value of medical devices and the data they create in many areas, providing a wide range of benefits:

EARLY RECOGNITION + INTERVENTION OF A PATIENT'S DECLINE

Medical device information systems can easily analyze key patient vital signs, along with other observations charted during assessments to calculate a score which may indicate a patient's risk of decline. They can also display all individual early warning scores for immediate nurse review at the point of care, along with a protocol for the bedside caregiver to follow based on the score.

BENEFITS: Having an early warning score as a clinical indicator for patient deterioration can alert clinicians earlier in care to optimize rapid response team calls.

VITAL SIGNS PRACTICE + DOCUMENTATION COMPLIANCE

Vital sign measurements are taken to help assess the overall health of a person and can provide insight into the improvement or decline of a patient's condition. Critical care patients are continuously monitored; while more stable med-surg patients are measured every 4 to 6 hours. It is important that consistent, timely, accurate, and comprehensive measurement and reporting take place so clinicians know when to intervene, adjust, or continue with the plan of care.

BENEFITS: Through medical device analytics, nurse managers are able to see the frequency of vital sign readings on their units by patient acuity. They can gain insight into the completeness and timeliness of vitals, modifiers, and other documentation recorded, and identify outliers and opportunities for staff education. In addition, analytics can provide evidence-based practice protocols to meet quality measures.

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OPTIMIZING MEDICAL DEVICE UTILIZATION

Using special analytics software, hospitals can track the specific location of every device and determine utilization rates by location such as units and floors.

BENEFITS: Equipment can be reallocated to maximize utilization rates if some areas are chronically short on devices, while others have an excess. If utilization rates are high across all locations, hospitals can use this information to help justify purchase of additional devices. Clinical engineering staff also is provided with a high level view of where each piece of equipment is situated should they need it for troubleshooting or maintenance.

REDUCING NUISANCE DEVICE ALARMS

With an analytics application, clinical staff can view on a single dashboard the current thresholds for all device alarms and use the data to manually adjust them patient by patient as required. Using historical alarm data, they can predict how changes in threshold values will impact the number of alarms received.

BENEFITS: Alarm trends and thresholds are analyzed and presented, allowing decisions to be made that may reduce alarm fatigue. Often overwhelmed by the din of non-critical alarms, clinicians can suffer audio fatigue, preventing them from discerning alarms signaling a true emergency. Alarm fatigue has consistently been cited as a Top 10 Health Technology Hazard by well-known healthcare analysts ECRI.

MONITORING MEDICAL DEVICE INFORMATION SYSTEM HEALTH

Data from the medical device information system itself can be analyzed to ensure that all components are maintaining peak performance. This includes monitoring the function of all in- and out-bound interfaces, servers, battery life and device connectivity. Data can be viewed historically and trended to pinpoint any prior system problems that may have affected system output to help diagnose the specifics of an existing problem. System Administrators also can see developing issues that might signal system decline or the need to proactively conduct preventive maintenance.

BENEFITS: Helping to mitigate potential problems before they occur and impact patient care. Proactive alerts to the MDIS system administrator save clinicians from having to communicate the issue; and reduce troubleshooting time.

BEDSIDE NURSE TURNOVER RATES HAVE GROWN WITH SIGNIFICANT COST IMPACTS

16.8%
BEDSIDE NURSE TURNOVER RATE INCREASED OVER 2% IN 2017
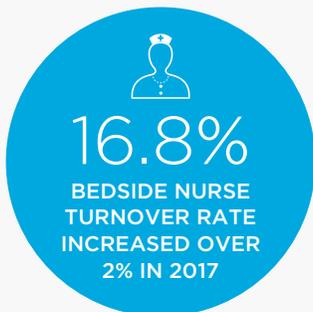
Up from 16.4% in 2014
Up from 11.2% in 2011

EACH 1% INCREASE IN RN TURNOVER COSTS THE AVERAGE HOSPITAL $337,500
(RECRUITING, TRAINING, OVERTIME COVERAGE, ETC.)

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MITIGATING NURSE TURNOVER RATES WITH ANALYTICS

Currently, one fourth of the hospitals report a vacancy of 10% or greater it takes an average of 93 days to fill a nursing vacancy. And when asked, workload is consistently cited as one of the reasons nurses leave their current employer.

Applying analytics to medical device data can help clinical leaders better balance nursing workload to enhance job satisfaction and efficiency. By viewing acuities on each unit based on patient's early warning scores, nurse managers can use the information, along with other factors, to assess and assign team members more effectively. The result is a more balanced workload for each nurse; ensuring that the highest acuity patients are not all assigned to the same clinical team.

In addition, the right analytics application can leverage alarm data to assist in setting alarm limits, creating a better nursing work environment. By viewing retrospective alarm information, limits can be set to significantly reduce the number of nuisance alarms. This allows nurses to focus on the alarms that truly require their intervention, helping to make them more effective and efficient on the job.

BENCHMARKING

As the quantity and quality of data stored in medical device information systems grow, it can be pooled across institutions and analyzed to contribute to meaningful benchmarks for performance on many parameters, such as: alarm management; cost-effective device utilization; optimal nursing load balancing; device failures; and battery life. Statistics from individual hospitals can then be compiled and compared against these benchmarks. Medical facilities can then work towards achieving realistic goals that will improve patient care delivery and hospital efficiency, while cutting costs.

LEADING THE WAY: CAPSULE'S MEDICAL DEVICE INFORMATION SYSTEM

Capsule revolutionized the market with the first medical device information system, in 2014 and has a long history in the field of medical device information management. The company made its name in the domain with robust medical device integration solutions and has long realized the value of manipulating and analyzing device data.

Today, Capsule offers the only true medical device information system — one that archives device information in ways that are conducive to timely analysis by a rapidly expanding number of applications built into the Capsule system. Today, the company is leading the way in capitalizing on the full value of medical device data through the early incorporation of analytics into its device information systems.

Capsule is uniquely positioned to further evolve this technology. The company has been the medical device integration industry leader, developing and evolving powerful integration software and providing a suite of medical device connectivity, monitoring, integration and analytic options. Its MDIS solution has been implemented in a full range of acuity areas in hospitals of all sizes. It also has connected to a broad range of bedside device types from a wide array of vendors. Moreover, Capsule captures all available data from a medical device, including device operational data. With the recent introduction of advanced integration and analytics capabilities, Capsule's MDIS is able to discriminate among all of that data and send specific information to downstream systems (e.g. alarm management, patient surveillance and clinical decision support applications). As a result, Capsule's robust device datasets can reveal innovative new insights in healthcare delivery, paving the way for benchmarking opportunities to provide an edge as analytics expands into the medical device space.

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