A HIMSS Analytics White Paper

Medical Devices Landscape

Current and Future Adoption, Integration with EMRs, and Connectivity

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Executive Summary

While use of key medical devices such as defibrillators, physiologic monitors, electrocardiographs and vital signs monitors is widespread among 825 U.S. hospitals providing data on medical device utilization, only one-third of hospitals are presently interfacing the medical devices at their organization with the electronic medical record (EMR). By percentage, intelligent medical device hubs and physiologic monitors are most likely to be identified as types of medical devices that are interfaced to an EMR.

At most hospitals, the sole method of connectivity between EMRs and medical devices was through the use of a Wired local area network (LAN) connection. And, while a number of organizations are using wireless connectivity in conjunction with wired LAN connectivity, only 8 percent of respondents reported that their hospital relies solely on wireless connections.

The potential growth in key devices areas, such as interactive infusion pumps, fetal monitors and infant incubators, along with the limited number of hospitals that are presently interfacing devices and EMRs, suggest that there is tremendous potential for healthcare organizations to connect their existing devices to their EMRs.

Respondents that interface devices to the EMR at their organization report that the ability to automatically chart data from the device directly to the EMR is a primary reason for creating the interface. The automatic transfer of this type of data has a number of potential benefits to healthcare organizations, including a reduction of medical errors, improved workflow for clinicians, and additional data analytics opportunities, all of which will lead to improved quality of care.

Background

On July 15, 2010, the Centers for Medicare and Medicaid Services (CMS) published the final rules on the Electronic Health Record Incentive Program, only six months after it published a Notice of Proposed Rulemaking. According to the Federal Register, "The HITECH Act statutorily requires the use of health information technology in improving the quality of care, reducing medical errors, reducing health disparities, increasing prevention and improving the continuity of care among health settings."[1] In order to meet the goals of this statement, CMS identified a core set of 14 meaningful use objectives in which eligible hospitals (EH), including Critical Access

1 http://www.himss.org/content/files/MU_Final_Rule.pdf Accessed September 12, 2010

Hospitals (CAH). It also identified 15 core meaningful use objectives in which eligible professionals (EP) need to focus to qualify for incentive funds provided through the new CMS Medicare and Medicaid incentive program. Additionally, EHs and EPs must also focus on five of 10 menu set objectives to quality for incentive funds. The Federal Register continues, "These core set of measures are also foundational and aligned with each other. For example, electronic copies of health information given to a patient will be useless if it does not contain basic information such as a problem list, medication list or allergy list."[2]

Recording and charting changes in vital signs has been identified as one of the core areas that will be measured to qualify for meaningful use incentives. This area provides a good example of the way in which the integration of the data from a medical device into an electronic medical record (EMR) can improve the quality of patient care delivered.

Documentation of accurate vital signs during hospitalization provides clinicians with key data on blood pressure, pulse, temperature and other metrics that are critical for monitoring a patient's condition. Requiring clinicians to either document vital signs on a patient chart or enter them directly into a computer system using a computer or mobile device such as a tablet PC has the potential to not only result in errors in entry, but can also delay the entry of the information into the EMR.[3] This is particularly critical in an area like the Intensive Care Unit (ICU) where vital signs need to be constantly monitored.

Transfer of vital signs information from the device to the EMR should result in a near zero error rate.

While many hospitals aren't conducting formal return on investment (ROI) studies, transfer of vital signs information from the device to the EMR should result in a near-zero error rate, as well as produce other efficiencies. At St. John's Medical Center in Wyoming, for instance, the integration information from vital signs monitors into the EMR has yielded a 60 percent time savings as a result of importing, not entering vital signs data.[4]

Integration of EMRs and vital signs monitors or other devices can take place in numerous ways, including a hard-wiring (such as a USB connection), wireless

2 http://www.himss.org/content/files/MU_Final_Rule.pdf Accessed September 12, 2010

3 "Comparison of the Quality and Timeliness of Vital Signs Data Using Three Different Data-Entry Devices". Wagner, Schaffner, Foulois, Swanson Kazley, Parker, Walo. CIN: Computers, Informatics, Nursing. July/August 2010. Volume 28, Number 4 205-212.

4 Medical Device Integration: CIOs must bridge the digital divide between devices and electronic medical records. Healthcare Informatics, February 2009. David Raths. http://www.healthcare-informatics.com/ME2/dirmod.asp?sid=&nm=&type=Publishing&mod=Publications%3A%3AArticle&mid=8F3A7027421841978F18BE895F87F791&tier=4&id=FBACE42BBB304C4F82020BE422FD8EBF Accessed November 11, 2010

Only one-third of hospitals reported that an interface was present at their organization between devices and their EMRs.

technology or Bluetooth technology.[5] Medical devices that have this integration capability are referred to as "intelligent medical devices." Because the data in the HIMSS Analytics study on which this paper is written is based on the interface of data from the medical device to the EMR environment at the healthcare organization at which the device is located, the term EMR is used throughout the remainder of the paper, even though it is understood that the broader implications of the meaningful use criteria are related to the broader EHR environment.

Only one-third of the hospitals in this sample reported that an interface was present between devices at their organization and their EMR. A 2009 HIMSS Analytics white paper suggests that intelligent medical devices are emerging as a critical component of the EMR environment, as the ability to automatically capture and manage patient data from these devices becomes a function of improving both patient safety and clinical outcomes.[6]

In fact, recent research on the capability of hospitals from HIMSS suggests that 56 percent of respondents that answered the question, "Does your EHR capture flow sheet data and changes in vital signs including: height, weight, blood pressure, calculate and display Body Mass Index (BMI), and plot and display growth charts for children 2-20 years old including BMI?" reported that their organization had the capability to do so.[7]

This importance, and thus the number of hospitals developing interfaces between their EMRs and medical devices, will likely increase in 2015, when hospitals have the opportunity to meet Stage 3 Meaningful Use requirements as medical device interoperability is one of the goals outlined to achieve and improve performance and support care processes and on key health system outcomes. Thus, it would be expected that not only will more hospitals develop interfaces between their EMRs and medical devices, but also that those that already have this type of interface in place will increase both the number and breadth of devices that are integrated.

Study Methodology and Demographics

This report is based on data collected from 825 U.S. hospitals. The data for this report were collected between June 2009 and June 2010 and primarily captured using a web-based survey tool supported by telephone follow up.

5 http://www.himss.org/content/files/ConnectMedDeviceEMRFlyer4.pdf "Connecting a Diagnostic Medical Device with Your EMR". Accessed October 19, 2010

6 http://www.himssanalytics.org/docs/HA_MedDevices.pdf Accessed September 12, 2010

7 From HIMSS Meaningful Use Data

The respondents to this survey are primarily located in either the West South Central[8] or South Atlantic[9] regions. Each region comprises about 18 percent of the survey respondents. The smallest number of respondents comes from New England.[10] More than three-quarters of the hospitals in the sample (79 percent) are classified as urban.[11]

Approximately half of the hospitals are part of an integrated delivery system (54 percent); the remaining hospitals represent a single-hospital delivery system. By type of organization, slightly more than two-thirds of the hospitals in this sample are classified as general medical/surgical or general medical. Another 19 percent are critical access hospitals and 6 percent are academic facilities. The remaining 7 percent of the hospitals include a wide variety of organizations that offer more specialized services, including pediatrics/women's health or long-term acute care services.

By bed size, one-third of the hospitals in the sample (35 percent) have less than 75 licensed beds. Another third (37 percent) have 75 to 249 beds. The final 29 percent of the sample has 250 or more beds. The average number of beds per hospital in the sample is 187.54; the median number of beds is 131.50. For the purposes of this research, those hospitals with under 75 beds will be identified as "small hospitals"; those with 75 to 249 beds will be identified as "medium hospitals"; and those with 250 or more beds will be identified as "large hospitals."

HIMSS Analytics™ devised the EMR Adoption Model (EMRAM℠)[12] to track EMR progress at hospitals and health systems. The EMRAM scores hospitals in the HIMSS Analytics Database on their progress in completing the eight stages to creating a paperless patient record environment. Half of the hospitals represented in this study scored within Stage 3 of the EMRAM.[13] One-quarter are below Stage 3 and 7 percent are Stage 6 or Stage 7 hospitals.[14]

One-third of the hospitals in this sample have identified themselves as trauma facilities. By definition, this means the hospital is equipped to provide comprehensive

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8 West South Central Region – Arkansas, Louisiana, Oklahoma, Texas

9 South Atlantic Region – Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia and Washington, DC

10 New England – Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

11 In this study, a hospital is designated urban if they have a mailing address located in a designated Core Based Statistical Area (CBSA), which is the official term for a functional region based around an urban center of at least 10,000 people. Source -- http://www.census.gov/population/www/metroareas/metroarea.html Accessed September 27, 2010

12 More information on the EMRAM model can be found at http://www.himssanalytics.org/hc_providers/emr_adoption.asp

13 http://www.himssanalytics.org/hc_providers/emr_adoption.asp - Accessed October 21, 2010

14 A current list of Stage 6 and Stage 7 hospitals can be found at http://www.himssanalytics.org/hc_providers/emr_adoption.asp -- accessed October 21, 2010.

emergency medical services to patients suffering traumatic injuries. Nine percent of the hospitals in this sample indicated they are Magnet hospitals.[15]

Medical Devices Summary

This research explores utilization of 11 medical devices used in healthcare organizations. We asked questions about medical devices in general; we also asked questions about if and how these devices are being integrated to the EMR environment.

A full list of the devices included in this research is listed below.

- Cardiac output monitors
- Defibrillators
- Fetal monitors
- Electrocardiographs
- Infant incubators
- Infusion pumps
- Intelligent medical device hubs
- Interactive infusion pumps
- Physiologic monitors
- Ventilators
- Vital signs monitors

None of the hospitals in this sample report use all 11 medical devices tracked by this research. Thirteen percent use 10 of the devices and another third use nine of the devices. Nearly one-quarter (23 percent) use eight of the 11 devices. Less than 10 percent of the hospitals in this sample have deployed five or fewer of these devices.

15 The ANCC Magnet Recognition Program® recognizes healthcare organizations that provide the very best in nursing care and professionalism in nursing practice. The program also provides a vehicle for disseminating best practices and strategies among nursing systems. It is the gold standard for nursing excellence. http://www.nursecredentialing.org/FunctionalCategory/AboutANCC.aspx -- Accessed on October 20, 2010

Among the devices for which data are captured in this study, defibrillators are most widely deployed with 99 percent of the hospitals reporting this type of device was in use. Also used by at least 90 percent of hospitals in the sample were physiologic monitors (97 percent), electrocardiographs (97 percent) and vital signs monitors (94 percent). Least frequently deployed are intelligent medical device hubs; only 11 percent of the hospitals in this sample reported using this type of device.

Additional information about the market can be determined when the overall installation of intelligent medical devices is analyzed by examining a number of the demographic variables. More specifically in this area, we explored the number of types of devices in place at an organization, not the overall number of devices present. For instance, organizations that provide trauma services have, on average, a greater number of types of devices (8.48) than do those organizations that do not offer trauma services (7.74) (see Table 1).

Measure	Number	Minimum	Maximum	Average	Median
Trauma	283	2.00	10.00	8.48	9.00
Not Trauma	542	2.00	10.00	7.74	8.00

Table 1

By region, those respondents working in the Pacific[16] region have the highest average number of devices types (8.29) compared to those who work in the West South Central region (7.57) (see Table 2).

Measure†	Number	Minimum	Maximum	Average	Median
East North Central	118	4.00	10.00	8.51	9.00
East South Central	73	3.00	10.00	7.74	8.00
Mid Atlantic	78	2.00	10.00	8.32	9.00
Mountain	65	3.00	10.00	8.01	8.00
Pacific	62	5.00	10.00	8.29	9.00
South Atlantic	145	5.00	10.00	8.07	9.00
West North Central	104	3.00	10.00	7.62	8.00
West South Central	148	3.00	10.00	7.57	8.00

Table 2

16 Pacific Region – Alaska, California, Hawaii, Oregon, Washington
† Full census breakdowns can be found at http://www.census.gov/geo/www/us_regdiv.pdf

By EMRAM scores, hospitals that are in Stage 3 or higher tend to have an average of eight types of medical devices installed at their organization (see Table 3).

Measure	Number	Minimum	Maximum	Average	Median
Stage 0	69	2.00	10.00	6.30	6.00
Stage 1	44	5.00	10.00	7.27	7.00
Stage 2	107	5.00	10.00	7.81	8.00
Stage 3	416	3.00	10.00	8.15	9.00
Stage 4	97	4.00	10.00	8.62	9.00
Stage 5	38	3.00	10.00	8.12	8.00
Stage 6	46	4.00	10.00	8.70	9.00
Stage 7	8	8.00	9.00	8.63	9.00

Table 3

Urban and rural hospitals also have differences in the number of types of devices deployed. On average, rural hospitals have an average of 6.81 types of devices deployed, compared to 8.31 for urban hospitals (see Table 4).

Measure	Number	Minimum	Maximum	Average	Median
Rural	176	3.00	10.00	6.81	7.00
Urban	649	2.00	10.00	8.31	9.00

Table 4

Hospitals that are part of an integrated delivery system are more likely to have a greater variety of devices deployed (8.12) than are hospitals that are part of a single hospital system (7.86) (see Table 5).

Measure	Number	Minimum	Maximum	Average	Median
Single	384	2.00	10.00	7.86	8.00
IDS	441	3.00	10.00	8.12	8.00

Table 5

There are also clear differences in the number of device types deployed when the type of services a hospital offers is taken into consideration. Academic facilities (8.88) and general medical/surgical hospitals (8.36) have a greater average number of types of devices than do critical access hospitals (CAH) (6.83) (see Table 6).

Measure	Number	Minimum	Maximum	Average	Median
Academic	52	7.00	10.00	8.88	9.00
CAH	156	3.00	10.00	6.83	7.00
Medical/Surgical	559	2.00	10.00	8.36	9.00
Other	58	3.00	10.00	6.79	7.00

Table 6

By bed size, smaller organizations are more likely to use a smaller complement of devices (7.04) compared to larger hospitals (8.68) (see Table 7).

Measure	Number	Minimum	Maximum	Average	Median
Small	289	3.00	10.00	7.04	7.00
Medium	301	2.00	10.00	8.37	9.00
Large	235	4.00	10.00	8.68	9.00

Table 7

There are also differences when the Magnet status of a hospital is taken into consideration. On average, Magnet hospitals use 8.65 different device types, compared to 7.93 device types for non-Magnet hospitals (see Table 8).

Measure	Number	Minimum	Maximum	Average	Median
Not Magnet	748	2.00	10.00	7.93	8.00
Magnet	77	3.00	10.00	8.65	9.00

Table 8

Device by Device Summary

Cardiac Output Monitors

In this HIMSS Analytics Database study, a cardiac output monitor is defined as a device that shows the electrical and pressure waveforms of the cardiovascular system for measurement and treatment. Parameters specific to respiratory function can also be measured. Because electrical connections are made between the cardiac monitor and the patient, the device is kept at the patient's bedside.

More than half of the hospitals in this sample (58 percent) reported that they have deployed cardiac output monitors. There is an average of 22.23 cardiac

output monitors in place at these hospitals. The median number is 8.00 cardiac output monitors.

Approximately 20 percent of hospitals plan to purchase cardiac output monitors in the future. Only 10 percent of those hospitals that plan to purchase cardiac output monitors in the future will do so in the next year. The majority (84 percent) will wait more than 18 months to make this purchase. Nearly all of the hospitals that indicated a plan to purchase cardiac output monitors (92 percent) will replace monitors that are in place at this time or buy additional units; only 8 percent will purchase cardiac output monitors for the first time.

Defibrillators

Respondents to the survey were given the following definition for defibrillators: "A device used to correct a dangerously abnormal heart rhythm, usually ventricular fibrillation, or to restart the heart by depolarizing its electrical conduction system and delivering brief measured electrical shocks to the chest wall or the heart muscle itself (e.g., pacemakers, AED or Automated External Defibrillators)."

Nearly all of the hospitals in this sample (99 percent) have deployed defibrillators. The average number of defibrillators in place at these hospitals is 33.66; the median number of defibrillators is 20.00.

Approximately one-third of the hospitals in this sample (39 percent) reported plans to purchase defibrillators in the future. Nearly all of the hospitals that plan to purchase defibrillators (99 percent) will do so to either expand their number of defibrillators or replace existing units. A vast majority of respondents (87 percent) reported that they will not make a purchase in this area for more than 18 months.

Electrocardiographs

An electrocardiograph (ECG or EKG) is defined as a device used in the detection and diagnosis of heart abnormalities that measures electrical potentials on the body surface and generates a record of the electrical currents associated with the heart muscle activity. Use of electrocardiographs is nearly universal, as 97 percent of the hospitals in this sample reported using this type of device. On average, these hospitals have 11.27 electrocardiographs, with a median of 6.00 devices.

Approximately one-third of hospitals in this study plan to purchase electrocardiographs in the future and nearly all of these hospitals will either replace

existing devices or add to the number of devices in place. Only two hospitals will purchase electrocardiographs for the first time. Only 8 percent of these devices will be purchased in the next year. Most hospitals with planned purchases will wait at least 18 months until they purchase new electrocardiographs (89 percent).

Fetal Monitors

A fetal monitor is an electronic instrument used to record the heartbeat of the fetus and contractions of the mother's uterus. Approximately three-quarters of the hospitals in this sample (72 percent) reported using fetal monitors. On average, these organizations have 14.42 fetal monitors (median 9.00).

Slightly more than one-quarter of the hospitals in this study (28 percent) reported plans to purchase fetal monitors in the future. Most respondents reported that the fetal monitors that will be purchased will either replace existing devices or be in addition to devices that are already in place. Less than 1 percent will purchase devices for the first time. Twelve percent will purchase fetal monitors in the next year; 82 percent will wait more than 18 months before making a purchase.

Infant Incubators

For the purposes of this research, an infant incubator was defined as an enclosed apparatus used for the protection and care of prematurely born infants that are kept in controlled conditions. About two-thirds of the hospitals in this sample (69 percent) reported that infant incubators are deployed at their organization. On average, these hospitals have 13.35 infant incubators in place, with a median of 6.00 incubators.

One-quarter of the hospitals in this sample (26 percent) have plans to purchase infant incubators in the future. Nearly all of these purchases (98 percent) will be at hospitals that already use these devices. The majority of the purchases (91 percent) will take place at least 18 months into the future.

Infusion Pumps

An infusion pump has been defined as an apparatus designed to deliver measured amounts of a drug or intravenous (IV) solution through IV injection over time. Some kinds of infusion pumps can be implanted surgically. Infusion pumps are used at nearly two-thirds of the hospitals (64 percent) represented in this sample.

On average, these hospitals use 210.49 infusion pumps, with a median of 108 infusion pumps.

Nearly one-third of respondents (23 percent) reported that they plan to purchase infusion pumps in the future. Only 6 percent of these purchases will be by organizations that are planning to purchase infusion pumps for the first time. While 20 percent of infusion pumps purchases are anticipated to take place in the next year, 71 percent of the purchases are not expected to take place for at least 18 months.

Intelligent Medical Device Hubs

For the purposes of this research, an intelligent medical device hub was defined as a product similar to an interface engine that is designed to capture and manage data streams from medical devices.

This device also provides a variety of processing functions, including network management, bridging, routing, and switching. **If there is not interfacing going on, then no data is streaming from the medical devices, and this device is, by default, not deployed.**

Use of this type of device is limited at this time – only 11 percent of the hospitals in this sample reported having this type of device deployed. On average, these hospitals use 18.76 hubs (median 1.00).

Future activity in this space will be slow. Only 8 percent of hospitals reported plans to purchase this technology in the future. In addition, three-quarters of purchases will not take place for 18 months or more. Half of these purchases (46 percent) will be made by organizations that already use this technology.

Interactive Infusion Pumps (Smart Pump)

For the purposes of this research, an interactive infusion pump, or smart pump, is a device that uses clinical decision support technology to avoid dosing errors. Smart pumps can be programmed and adjusted from a nurse's portal when they are interfaced with the EMR, thus making them interactive. However, a smart pump does not need to have this capability. Information on this device can often be found in the pharmacy. Half of the hospitals in this sample have interactive infusion pumps deployed in the organization. On average, these hospitals use 280 interactive infusion pumps (median 150.00).

One-quarter of respondents reported that they have plans to purchase smart pumps in the future. The majority of these (83 percent) will replace existing technology. Only 25 percent of the hospitals that reported plans indicated that they will make this purchase in the next year; 70 percent will wait at least 18 months to make this type of purchase.

Physiologic Monitors

In this research, a physiologic monitor was defined as a patient monitoring system that can be configured to continuously measure and display various parameters via electrodes and sensors that have been connected to the patient. Examples include electrical activity of the heart via an EKG, respiration rate for breathing, blood pressure, their body temperature, their cardiac output, and amount of oxygen and carbon dioxide in the blood. It is essential that these devices support multiple functions.

Use of physiologic monitors is widespread among the hospitals in this sample, with 97 percent reporting that this type of device is deployed. On average, these hospitals have 106 physiologic monitors (median 49.50). Forty percent of the hospitals in this sample have plans to purchase physiologic monitors. Most of these purchases, however, won't take place for at least 18 months and nearly all physiologic monitors will be purchased to replace existing technology.

Ventilators

For the purposes of this research, a ventilator was defined as a machine that mechanically assists patients in the exchange of oxygen and carbon dioxide (sometimes referred to as artificial respiration). Approximately 90 percent of the hospitals in this sample reported that their organization has deployed ventilators.

On average, hospitals have an average of 21 ventilators (median 10.00). Slightly more than one-third of respondents (35 percent) reported plans to purchase ventilators in the future. Only 13 percent of these purchases are projected to take place in the next 18 months; nearly all will be to replace existing ventilators.

Vital Signs Monitors

In this research, a vital signs monitor was defined as a device that has the sole purposes of monitoring temperature, blood pressure measurements, and pulse (e.g.

NIBP or Non-Invasive Blood Pressure (NIBP), SPO2). Use of vital signs monitors is nearly universal, with 94 percent of the hospitals in this sample reporting use of this type of device. On average, these hospitals have 63 devices (median 30.00).

Approximately one-third of respondents (36 percent) plan to purchase vital signs monitors in the future. However, nearly all of these purchases will replace existing monitors. In addition, most healthcare organizations will wait at least 18 months before investing in vital signs monitors.

Interface with EMR Environment

As the summary section of each device above alluded to, this research captured information on whether or not an interface between an organization's devices and EMR was in place.

Only one-third of the hospitals in this sample reported that an interface was present between devices at their organization and their EMR. The table below outlines the percent of hospitals that have a deployed device and interface at least one of those devices to the EMR (see Table 9).

Device	Number Deployed	Percent Interfaced with EMR
Defibrillator	815	1.60%
Physiologic Monitors	798	24.30%
Electrocardiograph	796	15.10%
Vital Signs Monitors	779	6.80%
Ventilators	750	9.30%
Fetal Monitor	590	19.00%
Infant Incubator	566	2.70%
Infusion Pump	527	3.40%
Cardiac Output Monitor	474	7.50%
Interactive Infusion Pump	406	6.90%
Intelligent Medical Devices Hub	92	71.70%

Table 9

On average, the hospitals interface an average of 2.59 device types to their EMRs (median 2.00). None of the respondents are interfacing devices in all 11 areas above to the EMR and only five interface 10 of the device types to the EMR at their organizations.

Respondents that are presently interfacing at least one type of device to their EMR were also asked to identify their reason(s) for integrating the medical devices' transactions.

Nearly all respondents (96 percent) indicated that their primary reason was to have the ability to automatically chart the data from the device directly to the EMR. This is nearly triple the next frequently given response, which is to identify and communicate alarm conditions to staff for appropriate clinical response; this response was selected by 33 percent of respondents (see Table 10).

Reason for Integrating Device with EMR	Percent Reporting "Yes"
Automatic Charting to the EMR	96.20%
Clinical Decision Support Purposes	33.10%
Enable Remote Support of Medical Devices	17.50%
Closed Loop Medication Needs	12.70%
Capturing Data for Research Purposes	8.60%

Table 10

Respondents were also asked to identify the means by which medical devices at their organization were interfaced with their EMRs. Approximately half of respondents indicated that their sole method of connectivity was via a wired LAN connection. Another quarter of respondents (28 percent) indicated that they used a combination of wired LAN and wireless connections. Eight percent relied on only wireless connections. The remaining respondents did not identify the type of connectivity that was in place.

Approximately half of respondents indicated that their sole method of connectivity was via a wired LAN.

When the specific type of device is taken into consideration, interactive infusion pumps and electrocardiographs are most likely to use only a wireless connection to integrate with the EMR. Healthcare organizations are least likely to rely on wireless technology as the sole means for integrating fetal monitors to the EMR; only 1 percent of respondents report this to be the case and none of the respondents reported using only a wireless connection for cardiac output monitors, defibrillators and infant incubators.

Following (see Table 11) is a complete listing of the means by which devices are integrated with the electronic medical record.

Device	Number Deployed	Wired and Wireless LAN	Wired LAN Connection	Wireless LAN Connection	Not Specified
Cardiac Output Monitor	29	27.60%	55.20%	0.00%	17.20%
Defibrillator	4	50.00%	50.00%	0.00%	0.00%
Electrocardiograph	120	11.70%	35.00%	28.30%	25.00%
Fetal Monitor	112	8.90%	61.60%	0.90%	28.60%
Infant Incubator	15	33.30%	6.70%	0.00%	60.00%
Infusion Pump	18	22.20%	5.60%	16.70%	55.60%
Intelligent Medical Devices Hub	66	16.70%	62.10%	7.60%	13.60%
Interactive Infusion Pump	28	32.10%	14.30%	28.60%	25.00%
Physiologic Monitors	194	13.90%	66.00%	6.70%	13.40%
Ventilators	70	20.00%	64.30%	2.90%	12.90%
Vital Signs Monitors	53	18.90%	43.40%	15.10%	22.60%

Table 11

New Equipment Purchases

This report has also already suggested that most of the device purchases that will be made will be by healthcare organizations that either plan to replace existing devices or purchase devices to supplement those already in place at their organization. Respondents were asked to identify their reasoning for planning to purchase additional devices in the future.

Nearly two-thirds of respondents indicated that new productivity or safety features are a key driver for making a new equipment purchase. Respondents were least likely to identify the expiration of a contract date as a driver for purchasing new equipment (see Table 12).

Driver for New Equipment Purchase	Percent Reporting "Yes"
New Productivity or Safety Feature	62.70%
Equipment Manufacturer at End of Life	40.02%
Data Integration	38.00%
EMR Installation	32.00%
Adverse Safety Events	26.60%
Expiration of a Contract or Lease	23.50%

Table 12

Conclusion

Among the hospitals in this sample, medical device utilization varies by device type, regardless of whether they are connected to the EMR environment. Electrocardiographs, defibrillators, physiologic monitors, ventilators and vital signs monitors have reached market saturation; this represents a scenario in which at least 90 percent of the market uses the technology.

There is still tremendous opportunity for growth in this market with fetal monitors having the next highest level of market penetration at 72 percent. Intelligent medical device hubs have the lowest market penetration at 11 percent.

It stands to reason that any data transferred directly from a device into the EMR environment would reduce medical errors.

Research has suggested that manually entering medical information, such as vital signs data, into a computerized system at the point of care results in a lower rate of errors than does entering this information into a paper record. It could be expected that transferring this type of data directly from an intelligent medical device into the EMR environment would further reduce the error rate to near zero.

While the previous research demonstrated this capability specifically with regard to vital signs data, it stands to reason that any data transferred directly from a device into the EMR environment would reduce the opportunity for a medical error.

For instance, integration of an infusion pump to the EMR could trigger information about patient allergy to a medication, allowing for real-time intervention of a medication to which a patient is allergic.[17]

In addition to a reduction of patient error, automatic charting to the EMR can also have an impact on staffing. In an industry that is confronted with a nurse staffing shortage[18], integration offers the ability to improve workflow and time savings for nursing and other clinical staff. Technology is identified as a means by which organizations can achieve greater efficiency and improve care among an organization's nursing staff.

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17 Medical Device Integration: CIOs must bridge the digital divide between devices and electronic medical records. Healthcare Informatics, February 2009. David Raths. http://www.healthcare-informatics.com/ME2/dirmod.asp?sid=&nm=&type=Publishing&mod=Publications%3A%3AArticle&mid=8F3A7027421841978F18BE895F87F791&tier=4&id=FBACE42BBB304C4F82020BE422FD8EBF Accessed November 11, 2010

18 American Association of Colleges of Nursing. Nursing Shortage Fact Sheet, Updated September 2010. http://www.aacn.nche.edu/Media/FactSheets/NursingShortage.htm Accessed November 11, 2010

The integration of data directly from a medical device into the EMR offers one area to improve efficiency, freeing nurses to focus on other areas of care.[19]

The integration of data directly from a medical device into the EMR could free nurses to focus on other areas of care.

This research suggests that most of the hospitals that have devices in place are not integrating the data from those devices directly into the EMR at their organization. Among those that are integrating data from devices into their EMR, the primary reason for doing so was to enable the ability to automatically chart the data from the device directly to the EMR, thus reducing the potential for errors in the data entered into the patients' medical record, ultimately improving quality of care.

A tremendous opportunity exists in this market for healthcare organizations to continue to interface data from their medical devices directly into their EMR. One critical factor in achieving integration is determining how to connect an intelligent medical device to the EMR environment, such as using a wired LAN or a wireless connection. The majority of respondents indicated they are presently interfacing their devices with their EMR using a wired LAN connection. But when wireless technology is in place, a wireless connection is often used even though the organization already has wired LAN connections available.

Although this research project did not address the location of intelligent medical devices in relation to wired LAN and wireless access points, this factor may explain why some hospitals are using wireless connections in an environment that also includes wired LAN connections. For example, an intelligent medical device may be used in an area that does not have any wired LAN connection ports, therefore the device must be connected using a wireless connection.

Another example may be the need for an intelligent medical device to remain connected to a patient during transport within the hospital. And, while the data presented here is limited to information collected from hospitals, ambulatory facilities that use devices will likely face many of the same challenges and opportunities.

Intelligent medical devices will continue to emerge as a critical component of the EMR environment as the ability to automatically capture and manage patient data from these devices becomes a function of improving both patient safety and clinical outcomes.

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19 Medical Device Integration: CIOs must bridge the digital divide between devices and electronic medical records. Healthcare Informatics, February 2009. David Raths. http://www.healthcare-informatics.com/ME2/dirmod.asp?sid=&nm=&type=Publishing&mod=Publications%3A%3AArticle&mid=8F3A7027421841978F18BE895F87F791&tier=4&id=FBACE42BBB304C4F82020BE422FD8EBF Accessed November 11, 2010

This also has the potential to impact the bottom lines of EHs and EPs as they strive to achieve meaningful use in order to receive Medicare and Medicaid incentive funds.

The importance of integrating intelligent medical devices with EHRs is expected to increase when we learn about the Stage 2 and Stage 3 meaningful use requirements over the next three to five years.

About HIMSS Analytics

HIMSS Analytics supports improved decision–making for healthcare organizations, and healthcare information technology (IT) companies and consulting firms by delivering high quality data and analytical expertise. The company collects and analyzes healthcare organization data relating to IT processes and environments, products, information systems (IS) department composition and costs, IS department management metrics, healthcare delivery trends and purchasing related decisions.

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