



# **MindGent Healthcare Services**

Addressing the Issues of Nursing  
Shortages and Patient Safety through  
Bio-Medical Device Integration (BMDI)

## Abstract

Medical facilities are constantly striving to increase the quality of patient care. Yet a shortage in qualified nursing staff, a key component in quality patient care, will continue for the foreseeable future. This has prompted the need to be able to perform more work, with greater accuracy, using fewer resources. In order to address this seemingly paradoxical situation a new breed of technology has emerged in the healthcare industry. Advances in Bio-Medical Device Integration (BMDI) have been able to relieve the nursing staff from some routine but critical tasks thus freeing them to focus on increasing the level of patient care. Amazingly this technology can be shown to pay for itself in a very short time.

### **Electronic Health Record Systems**

There is little disagreement as to the efficacy of modern electronic health record (EHR) systems in the healthcare industry today. The RAND Corporation has released a two year study showing that use of an electronic health record can increase patient safety and help reduce the cost of health care. RAND estimates that an annual cost savings of \$162 billion could be realized in addition to a two thirds reduction in the 8 million adverse drug interactions each year.<sup>1</sup> However, basing clinical decisions on data in an EHR presents a danger – for correct decisions to be made the data must be timely, complete and above all, accurate.

Most of the data entered into an EHR system is typically done by a facility's nursing staff. This requires that the information from patient monitors be read and entered into the EHR system. At a time when the need for qualified nurses is increasing faster than nurses are graduating, the nurses are finding that they are spending increasingly more time recording patient data and transcribing it into an EHR system at the cost of direct patient interaction.

### **The Manual Patient Care Process**

The frequency of collection for patient data depends upon the physicians' orders and established protocols, for example, every fifteen minutes, or every two hours once stabilized. Manual collection of this data requires staffing levels capable of accommodating the time required for the clinic staff to move between patients, record the requested data, access the appropriate electronic record and transcribe the data into the EHR system. The time required to record patient data in this manual process not only reduces the time available for direct patient interaction by the caregiver involved but also introduces the opportunity for transcription errors. In addition, the availability of data for the physicians will be dependent upon the staff having entered the latest values in a timely manner.

### **Bio-Medical Device Integration**

Modern medical devices used in patient care today have been designed to facilitate the automated recording of patient data. These devices can automatically capture information about the patient and make it available through an electronic connection.

Modern EHR systems have the ability to automatically accept data through a

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<sup>1</sup> The Diffusion and Value of Healthcare Information Technology / Anthony G. Bauer, RAND Corporation, September 14<sup>th</sup>, 2005

component called an interface. These interfaces accept properly formatted messages and update a corresponding patient's medical record. Unfortunately the quantity and diversity of clinical devices has made it impractical for most EHR system vendors to provide a direct connection between their EHR systems and all medical devices available. In order to facilitate the transfer of data from a medical device into an EHR system, specialized bio-medical device integration systems are utilized to read the data from the clinical equipment and forward it on to the EHR system.

Due to the fundamental nature of vital signs, devices that take these measurements are typically among the first to be targeted for automated integration. Integration, however, is not limited to devices measuring vital signs. Other types of devices that can be integrated include (but are not limited to) general patient monitoring systems, ventilators, infusion pumps, blood gas monitors and pulse oximeters. Each of these devices provides information on a patient's condition that would normally be entered manually into the EHR system. The benefits of integrating these devices can be both tangible, in the form of a calculable ROI, and intangible.

### **Operational Cost Savings**

The tangible cost savings for BMDI can be expressed in terms of time savings due to increased efficiency at the patient's bedside. By not having to read, record and transcribe information into an EHR system a considerable amount of time can be saved. A conservative estimate ranges between one and two minutes for each device connected to the

automated system. When considered across an entire facility, the opportunity cost savings can quickly exceed the cost of the initial investment.

Two examples are shown in **Table 1**. The first example is a fifty bed facility; the second is a 150 bed facility. Typically 28% of available beds are designated for critical care. This translates into fourteen critical care beds for the small facility and forty-two beds for the larger one. On average a non-critical care bed will contain two devices from which readings will be taken, and a critical care bed will have four. The fifty bed facility would require a total of 128 devices and the 150 bed facility would require 384 devices.

If eighteen readings are taken from each device per day the total time savings across the fifty bed hospital (devices \* readings per device \* minutes per reading \* 356 days / 60 minutes per hour) is 14,016 hours. This is the equivalent of 6.7 full time employees. The corresponding savings for the 150 bed facility is 42,408 hours, or 20 full time employees.

The conversion of time savings into cost savings requires knowledge of the salary of the caregiver that is involved in the manual patient care process.

The staff that would normally be involved in collection of the patient data can vary between facilities. For these examples a salary of \$40,000 – midway between that of a certified nursing assistant (CNA) and a registered nurse (RN) – will be used.

50 Bed Facility		150 Bed Facility	
Critical Care Beds (28%)	14	Critical Care Beds (28%)	42
Non-Critical Care Beds	36	Non-Critical Care Beds	108
Total devices in use	128	Total devices in use	384
Readings per device	18	Readings per device	18
Minutes per reading	1	Minutes per reading	1
Total hours saved	14,016	Total hours saved	42,048
Caregiver's Annual Salary	\$40,000	Caregiver's Annual Salary	\$40,000
Caregiver Cost w/ Benefits	\$48,000	Caregiver Cost w/ Benefits	\$48,000
Fully Loaded Hourly Rate	\$23.08	Fully Loaded Hourly Rate	\$23.08
Total Annual Savings	\$323,446	Total Annual Savings	\$970,338

**Table 1: Savings Calculations**

For a caregiver with an average annual salary of \$40,000, the fully loaded cost (at 20% benefits) would be \$48,000. For a full time caregiver with no overtime (2080 hours worked per year) the fully loaded hourly rate is \$23.08. Based on this hourly cost, the savings of 14,016 hours per year for the fifty bed hospital translates into an opportunity cost savings of \$323,446. The cost savings associated with the 42,048 hours per year for the 150 facility is \$970,338.

### **Patient Safety/Evidence Based Practice**

Many intangible benefits come in the form of increased completeness of data readings, a reduction in transcription errors, greater availability of information and the ability to increase sampling frequency. While it may be difficult to place an exact monetary ROI on each of these intangibles, little argument can be made that they directly affect the quality of patient care in a positive way.

As technology increases, the number of medical devices that are used to collect information on a patient's status is also increasing. Most of these devices will monitor multiple readings. Automating the collection of data insures that **all** desired information is collected. This eliminates the possibility of accidentally

omitting critical data during the documentation process.

When documenting patient information manually, data is typically recorded on paper during a patient assessment. Upon returning to the nursing station, the data will then be transcribed into the patient's electronic record by manually keying the data into the health information system. Each step in the transcription process is a possible point of failure. While great care is taken to insure the correctness of the information, there is still a risk that an error will be made during one of the two recording steps. By automating this process, the errors that are possible in a manual process can be completely avoided.

The frequency with which patient data is recorded is determined by physician orders. When manual processes are used to record information, increasing the frequency of data sampling also increases the work load of the clinic staff. Implementation of an automated data collection process allows physicians to request higher data sampling frequencies without impacting the need for additional patient care resources. Recording patient data at a higher frequency could allow for catching changes in a patient status sooner.

In an environment where information is recorded automatically into the patient's electronic medical record, there is no need for a physician to wait on patient care staff to complete their rounds and transcribe the data. The physicians will always know that they have the latest and most accurate information available. This is especially useful for physicians reviewing patient status remotely.

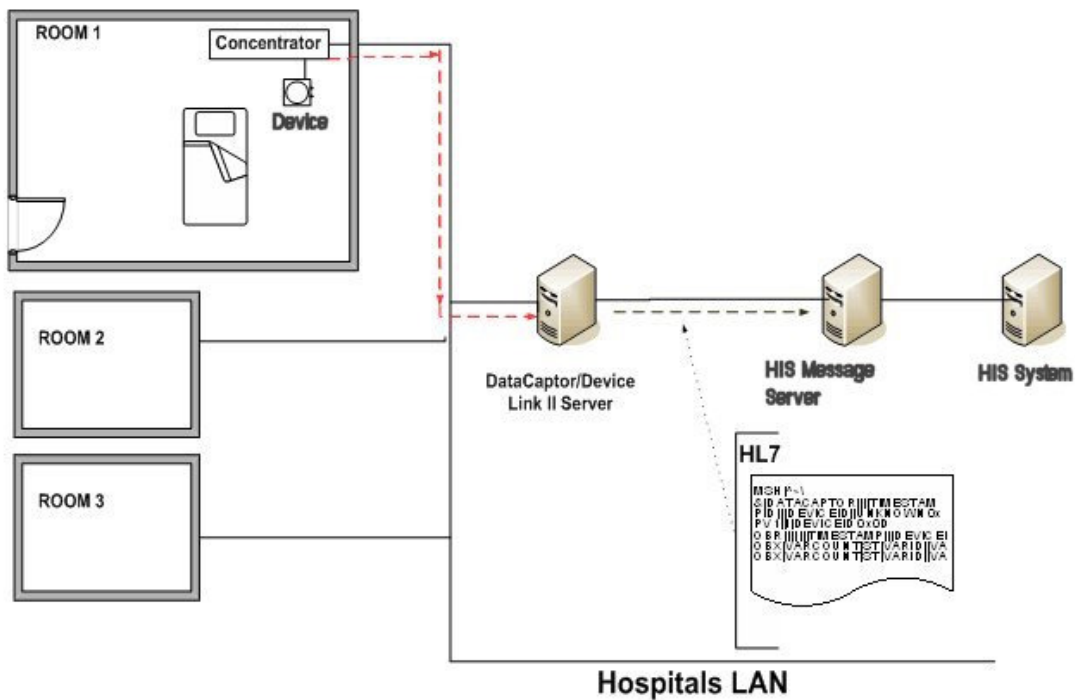
### Nurse Satisfaction

By reducing the time spent on routine tasks, the use of BMDI allows the nursing staff to concentrate on patient care which ultimately improves patient care. This, in turn, can increase overall job satisfaction and help reduce staff attrition. Retaining skilled personnel helps reduce recruiting and training costs associated with high staff turn-over rates.

### Technical overview

The diagram in **Figure 1** shows the basic components of the bio-medical device integration system. Patient data is collected by the bed-side device and transmitted to a device called a concentrator. The concentrator converts the data received from the medical device into a network packet and forwards it to the BMDI server. The data is then converted to the standard HL7 message format and forwarded to the hospital information system via a message sent to the HIS specific interface system.

Many manufacturers make data available from their devices through a serial port. This form of hardware interface is used to directly connect to a computer. However, most facilities will not have a dedicated PC for each medical device in each patient room. Instead, the data is



**Figure 1: Basic BMDI Network**

expected to be collected and forwarded to a central location for processing. In order to process the information remotely, the serial data must be converted and sent across to the data processor as general network traffic.

This is the job of the data concentrator, a small device that is placed in each patient's room. The concentrator receives the data in the manufacturer's proprietary format, encapsulates it in a network packet and transmits it to the interface server. Concentrators are designed to handle multiple bed-side medical devices, typically four or eight. For normal rooms a four port concentrator is adequate. For critical care rooms where more than four devices may need to be interfaced, an eight port concentrator is normally used.

Centralizing the acquisition of data is only the first step in the automated collection process. Each manufacturer has a proprietary message format for the transmitted data. Not only can each device manufacturer have a different message format, but message formats can differ between devices of a given manufacturer. In order to process this information into a patient's medical record system a separate interface server must convert the proprietary message format into a standard message format understood by the EHR, typically HL7. The versatility of the integration server can be directly measured by the number of device specific message formats that it can translate.

As a medical facility upgrades the bio-medical devices, either through replacement or software upgrades, the format of the data message can change.

This requires a coordinated update of the integration server.

As part of the translation process filtering, transformations and mapping can be required. This should be performed on the integration server as the message is converted to a standard format.

### **The DataCaptor® Solution**

To estimate the ROI possible for the hypothetical medical facilities discussed above the costs of deployment will be based on the Capsule Technologie product DataCaptor®. This selection is used as a reference because Capsule Technologie is one of the world leaders in bio-medical device integration solutions. Their versatile DataCaptor® product is a general purpose integration system that provides connectivity to a wide range of medical devices from major manufacturers, including:

- Alaris Medical Systems
- B. Braun
- Baxter Healthcare
- COBE Cardiovascular, Inc
- Dräger Medical
- GE Medical Systems
- Philips
- Siemens

The DataCaptor® product provides connectivity to over 300 different medical devices from over 40 manufacturers, the most of any bio-medical device integration solution available. In fact, Capsule Technologie's device specific drivers are used by many of the other major integration systems available.

	50 Beds	150 Beds
Software	\$90,368	\$230,784
Hardware	\$105,950	\$307,850
Infrastructure Upgrades	\$30,000	\$90,000
Implementation Services	\$201,600	\$380,700
Total Capital Investment	<u>\$427,918</u>	<u>\$1,009,334</u>
Total Annual Savings	\$323,446	\$970,338
ROI Period (Months)	15.9	12.5

**Table 2: ROI Calculations**

**Return on Investment**

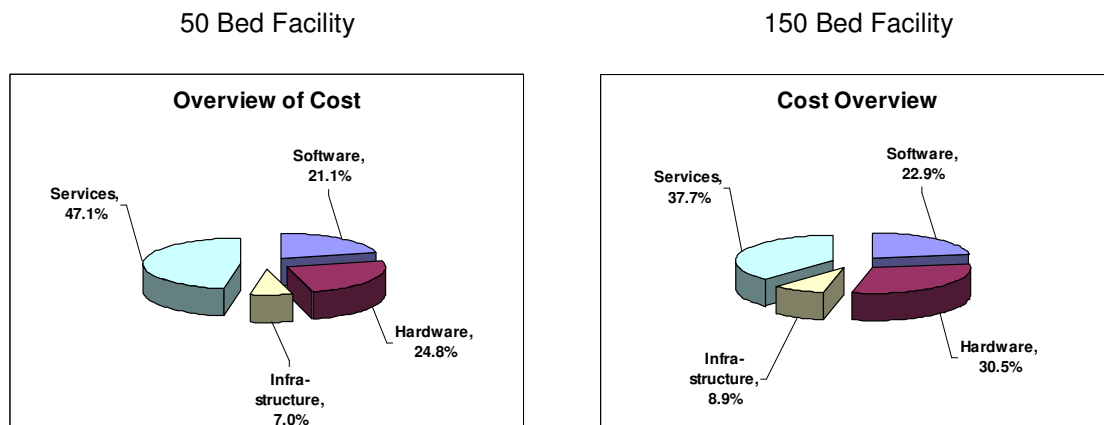
The ROI for implementing BMDI solutions can be calculated based on the cost savings generated by higher efficiencies. Consider the hospital facilities in the examples above. **Table 2** shows the cost and ROI for implementing the DataCaptor® BMDI solution for each of the two facilities. Software costs include all license fees for connecting an average of four devices to each critical care bed and two devices for all other beds. The hardware costs include the cost of the server, concentrators, cables and device identifier modules. Infrastructure upgrades include the cost of modifying an existing facility to have the network connectivity required to support a BMDI installation. Implementation services are based on a four month project for the fifty bed facility and an eight month project for the 150 bed facility.

These projects include planning, testing, deployment and management of the BMDI installation. The project cost for both facilities is shown in **Figure 2**.

Based on the cost savings calculated earlier, the ROI period is only 15.9 months for the fifty bed facility and 12.5 months for the 150 bed facility.

**Summary**

Advances in healthcare technology have now made it possible to simultaneously increase patient safety, reduce costs, and increase efficiency through the use of bio-medical device integration. The cost of implementing a BMDI solution can be typically recouped in twelve to sixteen months.



**Figure 2: Initial investment distribution**