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Patient Centric Identification and Association

P. Frisch [1], S. Miodownik [2], P. Booth [3], P. Carragee[4], M. Dowling, RN[5]

Abstract— Increased technological complexity of medical devices and systems coupled with increased workloads and reduced staffing, have created difficulties and discontinuities in the management of patient information. These issues have directly impacted and contributed to a rise in equipment-related errors, patient dissatisfaction, a potential for patient injury and resulting overall increased concern for patient safety. In response these concerns a variety of new devices, systems and applications have been developed to share information, provide cross checks along with verified delivery of critical information to the point of care. These applications include biomedical information systems, medication administration, sample collection, and electronic medical records. The deployment of these new integrated and networked devices, systems and applications are dependent on an accurate and consistent patient identification and association methodology which dynamically manages the relationship between patients, staff and equipment. Since the association information is common to many applications and utilizes a variety of technologies, (i.e. active and passive radio frequency identification (RFID), barcodes, etc.) an institutional approach is necessary to mange these processes in a consistent manor utilizing a common set of identification hardware.

Implementation of a "Patient Centric Identification and Association Platform" represents a significant advance in the management of clinical patient information. The implementation of a Biomedical Device Information Network at Memorial Sloan-Kettering Cancer Center (MSKCC) integrates the identification and association of patients with devices and care providers and provides the methodologies to manage alarms, providing the ability to filter low priority or nuisance alarms. This implementation enables critical information to be distributed directly to care providers utilizing dedicated communications devices. Patient Centric Identification and Association is the enabling technology providing precise identification and association establishing an enhanced environment of care, increased patient safety, and a clear proactive response to the regulatory requirements of the Joint Commission (JCAHO) national patient safety initiatives.

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Paul H. Frisch, PhD is an Assistant Attending in the Department of Medical Physics and Chief of Biomedical Physics & Engineering at Memorial Sloan-Kettering Cancer Center, New York, NY. 10021 (phone (212) 639-8758); fax (212) 717-3010); email: frischp@mskcc.org).

Saul Miodownik is the section leader of Clinical Engineering within Biomedical Engineering, Department of Medical Physics at Memorial Sloan-Kettering Cancer Center, New York, NY. 10021

Paul Booth is the section leader of Biomedical Systems within Biomedical Engineering, Department of Medical Physics at Memorial Sloan-Kettering Cancer Center, New York, NY. 10021.

Patrick Carragee is a Director of Information Systems (Infrastructure, Client Services and Research Computing) at Memorial Sloan-Kettering Cancer Center, 633 3rd Ave, New York, NY, 10017 (phone (646) 227-3438); email: carragep@mskcc.org).

Mary Dowling, RN is the Director of Acute Care Services at Memorial Sloan-Kettering Cancer Center, New York, NY. 10021.

I. Introduction

Hospitals have experienced an increase in the acuity levels of patients coupled with an increasing number of critical care and / or monitored beds, increases in emergency room visits and post surgical cases [1,2,3,4]. In addition each generation of new clinical equipment has provided an increased complexity and capability in terms of interconnectivity and the number of clinical alarms and operational parameters available. As a simple example, a physiological monitoring system of a decade ago provided approximately a dozen discrete high-low and arrhythmia alarms. Present physiological monitoring provides 25-40 discrete alarms. Expanding this increase of alarms over the trend of increased patient monitoring and an increasing equipment inventory we are moving quickly in the direction of information overload. The ability of handling this increasing number of critical alarms by a reducing staff results in an increased potential of missing critical information and the introduction of errors directly effecting patient safety. As a result of the increased interconnectivity and data sharing between devices and applications has raised concerns about identification and association processes to ensure that patient specific alarms and data are properly distributed. This trend is so significant and has raised significant concerns within regulatory agencies, such as the Joint Commission (JCAHO), driving the JCAHO to establish national guidelines (National Patient Safety Goals) to address a these patient safety concerns [5]. Since 2004 these patient safety goals have highlighted medication related errors, the need for improved identification processes, improved validation and verification process and enhanced communications capability, both staff to staff and patient to staff.

These Patient Safety Goals have focused attention on identification and association processes used within hospitals and the need to provide an institutional methodology to dynamically identify the caregiver, ,patient, medical devices, pharmaceuticals and supporting devices, such as phones, pagers, etc., and establishing a matrix to enable the precise dissemination of critical information and alarms to the proper point of care staff and / or documented accurately in the patient medical record.

Association Methodology:

The association methodology illustrated in figure #1, establishes the dynamic relationship between staff, patients and the clinical equipment used to diagnose, monitor, treat, or perform life support on the patient. As illustrated, a unique bar code or RF-ID tag can be used to identify patients, staff, and clinical equipment and which can be used to establish their dynamic association.

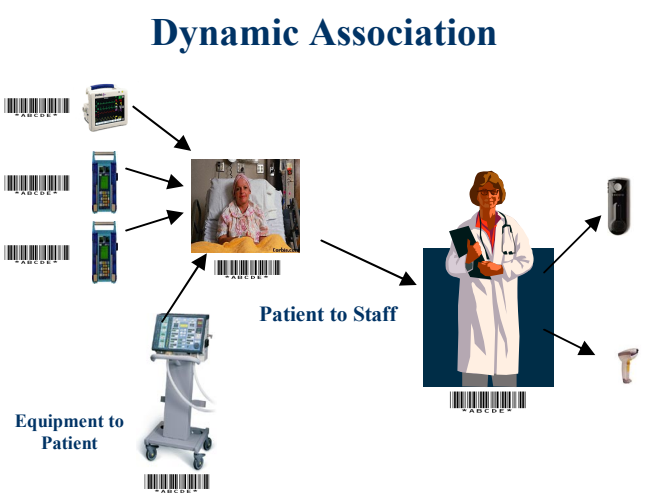

Figure #1 Association Methodologies

The Identification – Association Problem:
Currently clinical applications and medical devices require that the staff redundantly enter patient information and care provider identification data into each systems and application. This information is typically entered at a central location, such as the nursing station, which removes the staff from the patient care environment and away from the identifying features or components, i.e. wrist band, device ID barcode, etc. These processes are redundantly performed on each system and/or application, commonly relying on semi-manual entry, which is prone to error and utilizes valuable staff time that could be dedicated to patient care related issues.

From a workflow perspective the optimization of staff resources and minimizing the potential for errors, implies that this process would ideally occur at the bedside. The staff is typically at the point of care (bedside) delivering patient care and co-located with all the identifying features, i.e. Barcodes, RFID, etc. The process should minimize manual entry relying on a variety of technologies designed to support the identification processes, i.e. active and passive RFID, barcodes, etc. The identification of patients and staff is common to many clinical devices and supporting applications which imply that the approach should to be institution wide, using a common set of technologies and hardware.

The design of any institutional solution would require several key components to be considered and integrated. These components include a robust TCP-IP network, a wireless infrastructure, along with an institutional approach and solution to real time location (RTLS).

Example: Application Dependent on Association:
Biomedical Device Information System:
A typical application dependent on the association process is the biomedical device information system[6] integrating a variety of clinical devices utilized in patient care environment connected either wired or wirelessly to the center's backbone[1]. Each device downloads critical alarms and operational parameters onto the network, resulting in the shared availability of data. The system provides alarm acquisition and central processing from each of the discrete clinical systems. Each system (physiological monitoring, ventilator, infusion pump, etc.) continues to operate normally, processing information and providing this information to their dedicated central monitoring stations, as typically deployed. Within the network architecture all device alarms and data are additionally available to the central alarm processor or server is used to acquire and collate patient-specific alarms from multiple devices. Critical alarms (once filtered) are then directly forwarded to a Vocera (VoIP) phone carried by medical staff. The ability to collate and associate information is critical to the successful distribution of events. In the present deployment of the system the association process occurs through a central application running on at the central nursing workstation. This application links with the Admission, Discharge and Transfer application, identifying patients admitted into the medical center, the Active Directory, identifying medical staff, and the biomedical device database used to identify equipment. Medical staff manually selects the patient, staff and devices to be associated from the tables.

In an optimized environment this information would be collected through a semi-automated processed, using identification technologies, such as barcodes and RFID to dynamically enable this relationship to be established. This identification and association could also apply to pharmaceuticals, sample collection and other instruments within the patient care envelope, to support medication administration and sample collection. This association application enables common identification data to be shared between applications, such as the medication administration, biomedical device systems, electronic medical record, etc., using standard HL7 or equivalent protocols. In order to evaluate the feasibility of such an applications several investigative studies were performed at Memorial Sloan-Kettering Cancer Center (MSKCC).

II: INVESTIGATION OF AUTOMATED ASSOCIATION:

The study focused on evaluating the feasibility, effectiveness and accuracy of an institutional approach to enable an automated patient centric identification process to be performed at the bedside or point of care. The initial study used active RFID technology manufactured by Aeroscout (Aeroscout, Redwood City Ca.). Within their configuration actively transmitting tags transmit an identifier at a preprogrammed rate over the MSKCC 802.11 infrastructure. The tag output is seen at multiple access points (AP) enabling the position to be calculated based on an RSSI triangulation algorithm. The systems also supports secondary choke point devices (exciters) which can be used to increase the location resolution based on the location and geometry of prepositioned RF exciters. One aspect of our

investigation focused on creating and evaluating the RF envelope around each bedside and whether it could consistently and accurately identify devices, and staff within the RF sphere of the bed.

Following laboratory verification testing an exciter was mounted at each bedside as illustrated in figure #2 (2 bed room shown), on an operational 42 bed unit at MSKCC. The unit supported a mix of single and dual bedded rooms. Each exciter was tuned so that the RF envelope encompassed the bed and a small region around the bed (2-3 feet). All clinical devices and staff were additionally identified with active tags.

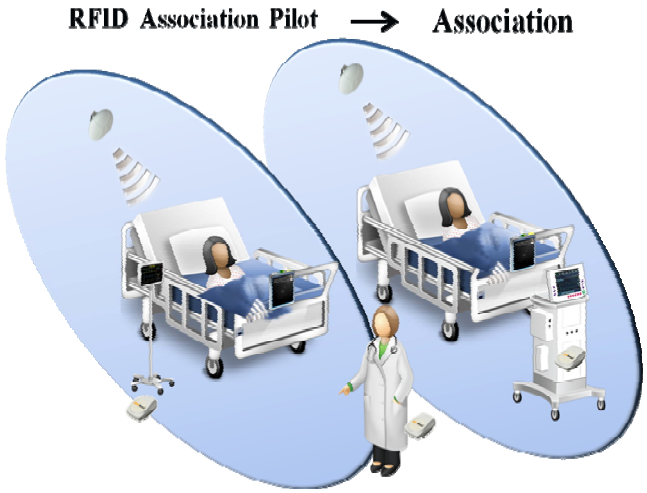

Figure # 2 RFID Association

Over a period of more than six (6) months the identification and location information was collected, tracked and analyzed.

Several basic questions were immediately answered as part of this pilot.

1: Tag positional resolution based on triangulation (without using supporting choke point hardware) was consistently determined to be approximately 15-20 feet of the actual tag position.

2: Tag resolution using over the bed exciter choke points enabled resolutions down to 2-3 feet, enabling an RF envelope to be established around each bed consistently identifying devices and staff within the envelope. The RF exciter output was tuned (power output adjusted) to enable a distinct envelope around each bed, enabling multiple bed configurations to be accommodated. Since the exciters were mounted directly overhead of the bed, bed position relative to the exciter became an issue, and did identify a source of error specifically within multi-bed rooms where there was a risk of inadvertently overlapping the RF envelops potentially introducing errors within the association process.

Evaluation of the patient centric methodology by nursing staff, confirmed the preference to have staff oversight, validation or confirmation of the dynamic or automatic association. This pilot study validated the feasibility and functionally of an automated patient centric identification process, and validated the need for staff interaction to minimize inadvertant errors resulting from envelop overlap and or bed positioning. This study however did confirmed that a standardized institutional approach to perform identification and association using a common set of hardware, which could be applicable across all the clinical applications.

Further review of the many applications and processes which utilize or require identification and association information continues to indicate that this process needs to be an institutional solution which enables sharing this common identifying data set. If standard is not applied each application would dictate dedicated hardware and redundant processes each time an application is used, unnecessarily using staff resources and adding significant incremental cost to the operation. Any institutional solution would need to include legacy devices and applications typically implementing identification processes based on bar-codes and manual entry. Review of upcoming implementations an institutional solution will be required provide an integrated platform, supporting active and passive RFID technologies, barcodes and even in a limited number of cases, manual entry.

DEVELOPMENT OF AN INSTITUTIONAL PATIENT CENTRIC IDENTIFICATION & ASSOCIATION SYSTEM

A Patient Centric Identification & Association System is diagrammed in figure #3, integrating the use of barcodes and radiofrequency identification (RFID, both active and passive) providing a consistent methodology to support bedside association. An envelope around the bedside or treatment area can be established using variety technologies, including ultrasound, active RF or a passive RFID antenna array. Medical devices and equipment can be dynamically and automatically identified using similar active and / or passive RFID and accurately located as being within the RF envelope of the bed. Staff can also be tracked in the same manner, while the patient and/or pharmaceuticals can use these technologies or legacy barcodes. Once the system has dynamically identified all components at the bedside or RF field around the bed, whether automatically using RFID or manually using barcodes, a confirmation of this association can be made on a staff screen at the bedside or handheld device (figure #4).

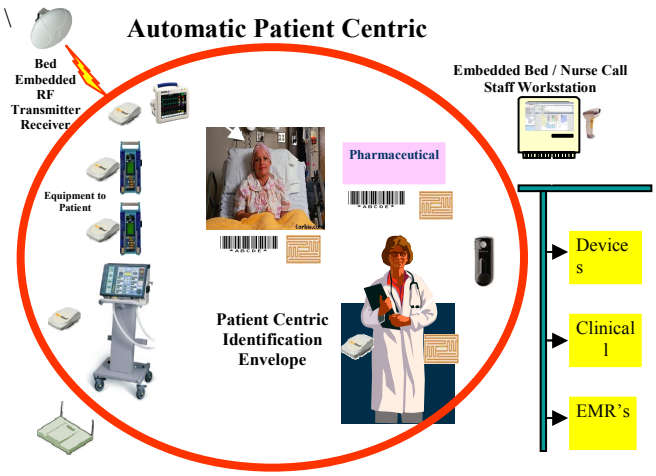

Figure # 3 Patient Centric Association Methodology

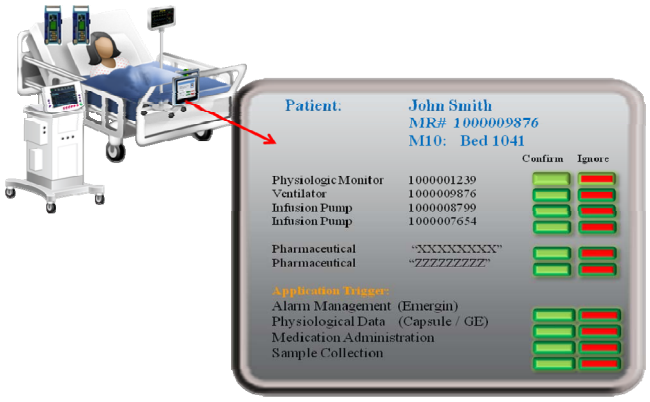

Figure #4 Association Validation

Once the associated devices, staff, etc. are confirmed by staff this data could be available to a variety of applications, via standard interfaces such as HL7. As an example, applied to the biomedical devices information system, staff members at the bedside can confirm all devices used on the monitoring or treatment of the patient, the staff member receiving the critical alarms and the patient. This association can then be downloaded to the specific devices or devices servers. To be compatible with typical patient care operations the association process supports a one-to-many relationship between a staff member, multiple patients, along with multiple devices per patient and a hierarchy for the escalation of critical information.

In order to demonstrate and confirm the potential benefits on staff workflow increased patient safety and overall cost effectiveness a pre-production functional multi-patient (room) pilot configuration is being implemented for testing and evaluation. This configuration will utilize a mix of the actual medical devices deployed within MSKCC; all integrated with active and passive RFID tags and barcodes. The system will integrate a bedside interface (screen) capable of automatically reading passive, active RFID and enable barcodes to provide the association. Once confirmed the system will pass validated association data to the medical devices and then to clinical applications to enable the detailed study of the interface process and overall viability of this type of institutional solution and impact on patient care and safety.

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