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Title: Using Embedded Analytics through Information Technology to “NIP” MDROs in the Bud

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NPSG: Reduce the risk of Healthcare associated infections; NPSG 07.03.01: Preventing Multidrug-Resistant Organism Infections

NPP goal: ensure patients received well-coordinated care across all providers, setting and levels of care

Type of health IT utilized: Embedded analytics from electronic medical record nursing documentation

Summary Story: Healthcare-associated infections (HAIs) are a preventable threat to human life. According to APIC’s white paper published in 2007, “**Dispelling the Myths: The True Cost of Healthcare-Associated Infections,**” HAIs accounted for an estimated 100,000 deaths at a cost of \$5-6 billion annually. HAIs will make the difference between financial success and doom of hospitals. With increasing public reporting, patients will seek those institutions with the lowest infection rates.

Riverside Regional Medical Center (RRMC) had no effective and reliable measurement tool to locate or track the impact that isolation measures had upon HAIs within the organization. Without reliable baseline data and accurate reporting, measurement of successful results from practice change would be impossible.

Solution: RRMC developed a personalized data-mining tool which utilized retrieval of embedded analytics from selected fields in the nursing documentation. This was a creative and unique data-mining tool, as most commercially marketed tools draw off of lab or census generated events. The tool’s name was dubbed “**NIP-IT**”, for Nosocomial Infection Prevention through Information Technology.

Process:

1. Revised Isolation Assessment documentation to include specific types of conditions and precautions to include presumptive isolation .
2. Enhanced Nursing admission data base to target specific isolation triggering conditions.
3. Enhancement of alert by trigger of biohazard symbol appearing next to patient name when isolation order entered into electronic record. The biohazard symbol would also indicate the type of isolation when user “hovered” the cursor over the symbol.
4. Utilization of the nursing admission questions to order a “Presumptive isolation based off of admission assessment” biohazard symbol when patient answered “yes” to any of the admission questions as a prompt to reduce time to isolation and reduction in potential horizontal transmission of infection.

Results: Total Facility HAI rate reduction from 2009 to 2010 : 17% incidence reduction for MRSA, VRE and Cdiff infections; MRSA HAI reduction of 42% from 2008 to 2010
Direct correlation of decrease in HAIs with increase in presumptive isolation and reduction in time to isolation.

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Background knowledge: Healthcare-associated infections (HAIs) are a preventable threat to human life. According to APIC’s white paper published in 2007, “**Dispelling the Myths: The True Cost of Healthcare-Associated Infections,**” HAIs accounted for an estimated 100,000 deaths at a cost of \$5-6 billion annually. HAIs will make the difference between financial success and doom of hospitals. With increasing public reporting, patients will seek those institutions with the lowest infection rates.

Riverside Regional Medical Center is a level 2 Trauma facility in Newport News, Virginia and is licensed for 510 beds. There is an average daily census of 225 which includes adults and newborns. On average, there are 273 operating beds. There are 1,482 full and part time employees and 340 physicians in the Riverside Medical Group.

Local problem: Riverside Regional Medical Center (RRMC) had no effective and reliable measurement tool to locate or track the impact that isolation measures had upon HAIs within the organization. Without reliable baseline data and accurate reporting, measurement of successful results from practice change would be impossible.

Intended improvement: Our goal was to have a reliable way to collect MDRO potential and actual infection data and to use this data to track the impact of reduction measures such as presumptive isolation. The NPSG 07.03.01 is the goal which addresses implementation of practices aimed at the prevention of health care-associated infections due to MDROs in acute care hospitals. With a basic mindset of “Find Them. Track Them. Prevent Them!”, we recognized that we had to gather data directly from the care providers in a way that would not create more work and provide the most accurate and meaningful information. We also recognized that waiting for lab results to provide the trigger for isolation might increase the potential of inadvertent spreading of contamination as well as provide an opportunity to misdiagnose a condition as being an HAI when in fact it was a community associated infection (CAI). As reimbursement for conditions becomes increasingly dependent upon whether a condition was present on admission (POA), it was important to selectively test the most appropriate patients to validate whether or not an infection was acquired at the facility or was POA.

Recognizing that our acute care facility is not a single silo of prevention was an additional driver for this project. The National Priorities Partnership which addresses Care Coordination applies to a second area for intended improvement for our project. As one part of a much larger healthcare system, RRMC is only one part of a continuum of health resources within its own system. It is not unusual to have a patient with an acute care need who may then require rehabilitation or then proceed to require skilled nursing or placement in a long term care facility. With the estimation that by 2020, 157 million Americans will be grappling with at least one chronic condition, no longer should RRMC consider that a patient is “discharged” or “transferred,” but instead should view the episode and those following as more of a “transition of care” which can easily become a cyclical event. As such, a clear language of the presence of an actual MDRO was essential.

The creation of Nosocomial Infection Prevention through Information Technology (NIP-IT) began in June 2008 based off an idea for the need to more accurately capture device days for central lines. The champions for the project were Susan Moeslein, RN, MSA, CIC, Riverside Regional Medical Center Nurse Manager for Infection Prevention, and Dr. Charles Frazier, Vice

President for Clinical Innovations, Riverside Health System. Sue provided the day to day validation of information. Although they were the lead champions, there were several other key individuals who provided technical support:

- Connie Hebert, RN Nursing Informatics Specialist
- Bridgett Burgess, RN Nursing Informatics Specialist
- Susan Hayden, RN Walter Reed Hospital Infection Prevention/Employee Health Coordinator
- Dr. Patrick Haggerty, Riverside Regional Medical Center Epidemiologist
- Steve Menzies, Workflow Engine Analyst
- Mary Gillen, RN Nursing Informatics Coordinator

It has truly been a collaborative effort which has continued to evolve today.

Planning the intervention:

This project was validated electronically by comparing the reality of what was occurring at the bedside to what was being documented. This would fall under the category of an observational study. At the start of the data validation for NIP-IT, a side-by-side comparison was performed for the presence of central lines. We chose to begin with central lines because we had an IV team which had a paper tracking form for patients with central lines. However, when RRMC adopted an electronic medical record, some of the notification to the IV team regarding a patient with a central line was lost. The IV team had the potential of missing a line if they were not contacted directly by the nursing staff. The validation evaluated what was documented in the electronic record and captured via NIP-IT versus actual practice (considered missed opportunities) and what the IV team was documenting. NIP-IT consistently demonstrated validity and was quickly adopted as a reference tool for accuracy by the IV team, especially for patients who moved throughout the facility. Because of the immediate significance of data, a longer study was not felt to be necessary. We then expanded the validation to include the evaluation of isolation practices and reasons for isolation. The validation procedure included a daily printout of documented isolation and then daily rounding to verify that the patients who were documented actually were in isolation. NIP-IT was 100% predictive of both actual and potential isolations; the only patients who were not documented were either those admitted the same day or for a failure of the nurse to document the presence of isolation. NIP-IT continues to have intermittent validation through weekly rounding and verification of isolation practices as well as a review of the types and accuracy of the biohazard symbols when lab results are reviewed.

Steps in the revision for documenting isolation:

1. Revision of Isolation Assessment documentation to include specific types of conditions and precautions to include presumptive isolation – implemented 10/23/08. A specific place was created for the documentation of isolation precautions to include: Contact: MRSA, VRE, C diff, and ESBL. This was part of the daily nursing assessment if the patient was on isolation and included documentation of initial and reinforcement of patient education.
2. Enhancement to Nursing admission data base to target specific isolation triggering conditions (see screen shot). Implemented 4/29/09.

1. Have you ever been told by a Health Care Provider that you had a staph infection, MRSA, or VRE in last year?

- Yes
 No

2. Have you had diarrhea or frequent stools (more than 4 a day) w/in last 2 days?

- Yes
 No

2a. If YES to 2, Is this normal for you?

- Yes
 No

2b. If NO to 2a, Have you been on antibiotics within the last week?

- Yes
 No

3. Do you have a draining wound, spider bite, or boils?

- Yes
 No

4. Have you ever had a surgical wound infection after surgery?

- Yes
 No

3. Enhancement of alert by trigger of biohazard symbol appearing next to patient name when isolation order entered into electronic record. The biohazard symbol would also indicate the type of isolation when user “hovered” the cursor over the symbol. Implemented 6/30/09.

4. Utilization of the nursing admission questions to order a “Presumptive isolation based off of admission assessment” biohazard symbol when patient answered “yes” to any of the admission questions as a prompt to reduce time to isolation and reduction in potential horizontal transmission of infection. Implemented 1/20/2010.

HIT Dimensions utilized:

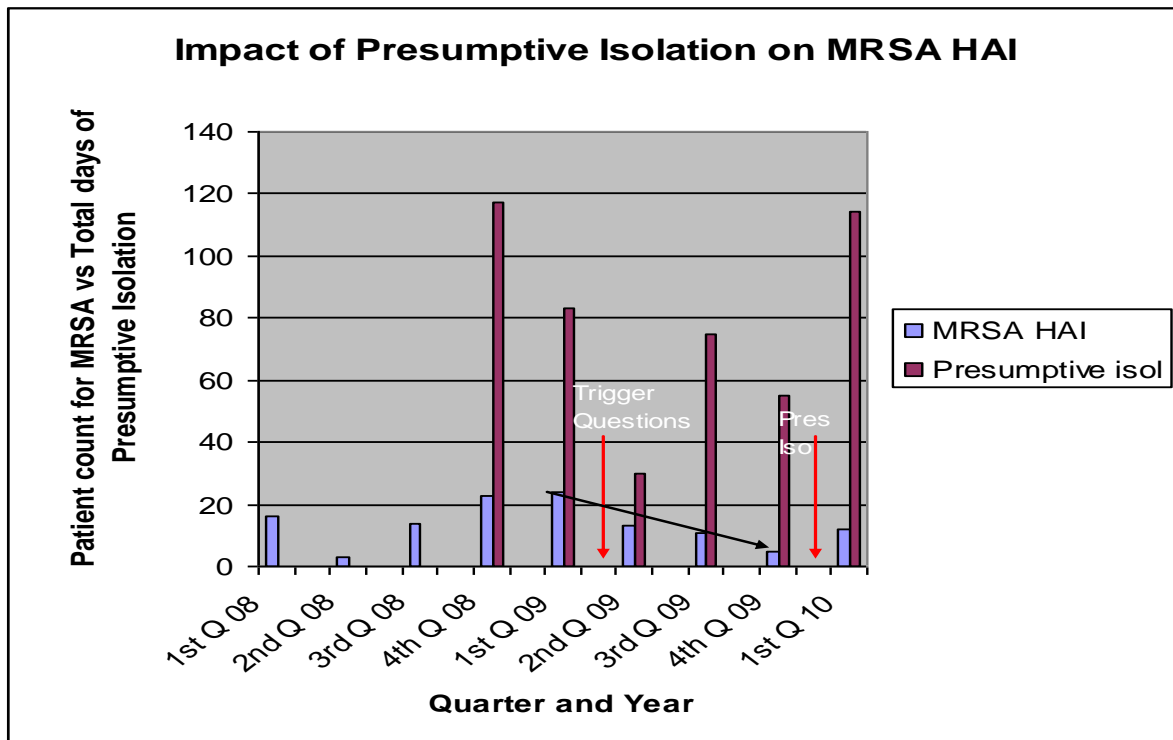
The IT department has been an integral participant along with the Infection Prevention department. The initial attempts at creating an accurate and validated listing of isolation precaution patients required daily rounding by the Infection Prevention manager to validate the accuracy of the report. What began initially as an assessment parameter for isolation became an automated assignment with the ordering of isolation precautions which improved documentation compliance considerably. Data collection from NIP-IT is re-generated daily but is also archived monthly so that reports can be generated as feedback for compliance to the nursing units. As such, it necessitates that the documentation is accurate on a daily basis rather than relying upon data that may be outdated and so is a reflection of actual patient status.

The data warehouse provides significant opportunities for data retrieval. There is a continual, often weekly verification of information as well as a monthly archive of data with an evaluation of trends or variances in reporting accuracy with revisions made as necessary. As an example, in November of 2009, the decision was made to augment the nursing assessment for foley catheters to include the selection of CDC evidenced-based reasons for insertion. The workflow rule to place the urinary catheter assessment came from the physician order to insert the catheter. It became quickly evident, through the use of NIP-IT, that we had a difference in practice with patients who were admitted from the Emergency Department and directly from Surgery who had their foleys placed in these departments. They did not have the same documentation system as the nursing units and so the order for the foley did not cross and we had an immediate discrepancy of device days. The solution to this is ongoing but could not have been brought to light without NIP-IT.

It is a well known fact that medical errors occur due to difficulties in handoffs and in the case of the use for NIP-IT for MDROs, the information for isolation needs has been greatly standardized. When a patient is transferred within the health system, the biohazard symbol signifies to the healthcare provider as to what type of isolation precaution due to infective organism is needed. By “hovering” over the biohazard symbol, the specific information is revealed. When the unit census is displayed, the biohazard symbols are an easily viewed barometer of “infection burden” on the unit. Environmental Services can adjust their rounding to meet the extra needs from such things as an increase in the need to empty trash bins which are loaded with isolation gowns. In addition, a daily send of the NIP-IT report of isolation patient locations to Environmental Services has empowered them to realize whether they are cleaning a presumptive isolation versus actual known organism room and what precautions are necessary. The information of prior isolation remains with the patient visit so is able to be retrieved at a future date.

Outcomes:

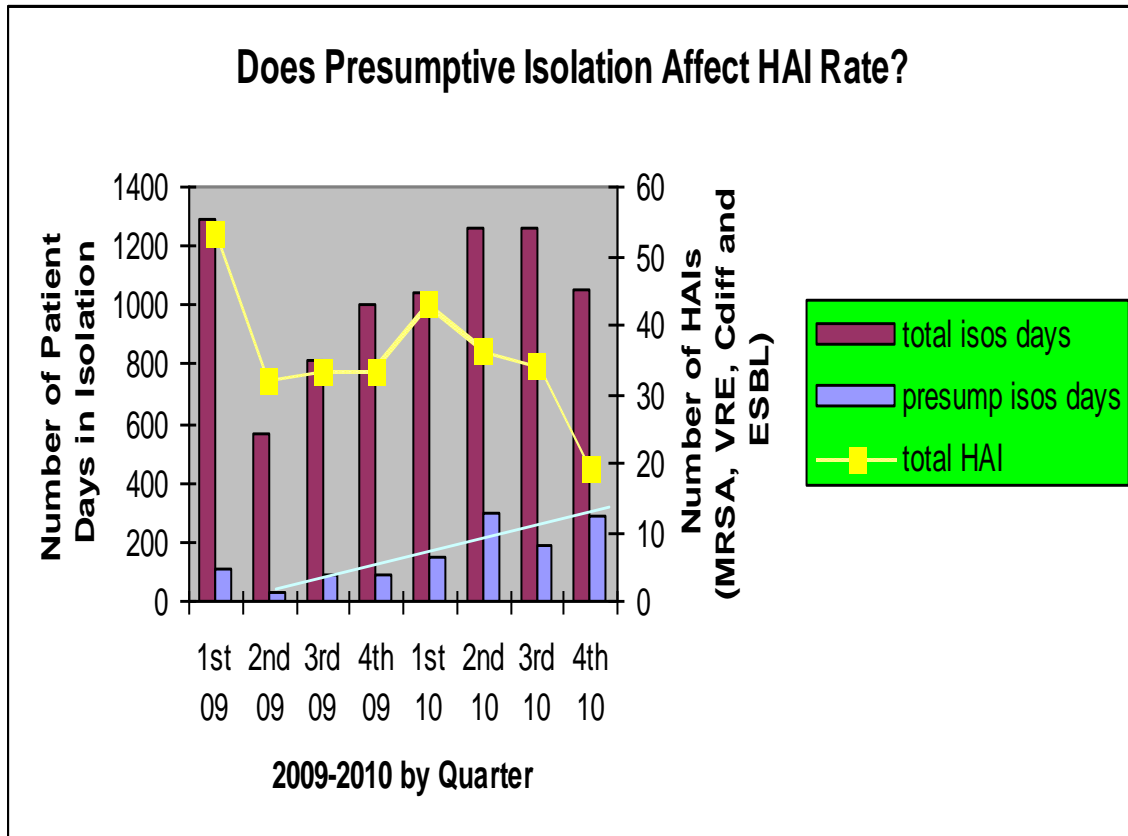
The most significant reductions realized at the beginning of the project were reflected in a reduction in MRSA HAI rate. Some of this may have been due to sending off cultures earlier to more correctly document an infection as present on admission; however, this rate reduction has continued which indicates that we have also reduced transmission within the facility.



At the beginning of the third quarter of 2008, we began the revision of the Isolation assessment documentation to include presumptive isolation which accounts for the large initial spike on the above graph. There was a slight increase in MRSA HAIs initially which is believed to have occurred due to a general heightened awareness of MRSA. We had also joined the Virginia Healthcare Quality Council (VHQC)’s project to reduce MRSA and had formed a special MRSA Reduction Task force around this same time period. Although there has not been a clear and consistent correlation between an increase consistently in presumptive isolation with a concurrent decrease in actual MRSA HAIs, there nonetheless has been a steady decrease in

MRSA HAIs with the only consistent change implemented being the better capturing of actual practice through documentation and NIP-IT.

We have seen a reduction overall in our HAI rates: for MRSA, VRE and C difficile. The total facility case number dropped from 150 cases to 124, representing a 17% reduction in rate. What is most significant about this is that the MRSA cases reduced from 53 to 33 cases and was the first time that the HAI rate had seen any drop below 50 cases from the previous four years. This 38% reduction was reflected in cost savings for both Critical Care and total facility.



The above graph indicates what we have believed from the beginning – that locating the potential for an infection, as well as promptly isolating a known infection, has led to reducing our HAI rate.

An additional measure that this automated system has provided is to improve communication of isolation status and reason for isolation throughout the health system which utilizes the same documentation tool. The biohazard symbol is an alert and the healthcare provider can “hover” over the symbol to view the type of isolation in order to take appropriate precautions.

The use of embedded analytics has also facilitated process improvement projects for both MRSA and C difficile reduction efforts. The Infection Prevention manager sends a daily report for current in-house patients who have had previous or current positive results for C difficile to the pharmacy in addition to sending a daily isolation report to Environmental Services so that the housekeepers can clean using the most efficient products. IT has provided the avenue for “designer” cleaning, matching cleanser to organism!

Barriers Encountered:

When other data mining companies were surveyed about where they obtained their information, nursing documentation was not considered a reliable and consistent format. It has required a significant commitment on the part of the Infection Prevention team to be concurrent with timely feedback to nursing staff for inaccuracies and inconsistencies in documentation. In addition, it has taken time to develop and validate the information.

As with any project, the evolution of NIP-IT has had quite a few “tweaks.” A tremendous strength to the program is the active and open dialogue that continues between the Infection Prevention department, Nursing and Information Technology staff workflow processors and Nursing Informatics. One important factor that we have tried to always keep in mind is to make the information useful, timely and practical without causing extra steps in care provided to the patient. Extra steps create more opportunities for failure and so a goal has always been to streamline and have consistency in the process.

A barrier which presented itself at the start of the project was the manner in which we extracted the embedded analytics. We initially used Boston Workstation, a scripting engine. An issue with the Boston Workstation was that it was not always consistent – it required rebooting. We found that this initial extraction tool created interface issues with the electronic medical record (EMR) and on a few occasions, caused system issues which delayed documentation efficiency. It was a custom project to address the needs of a small group of people utilizing a desktop Microsoft access data base program. We quickly outgrew this as the program became more and more successful.

A second barrier is the standardization of documentation practices. This may sound simple to logical programmers, but when practitioners get involved, this may not always be the case. Nurses are ingrained with the teaching that “if it’s not documented, it’s not done.” However, the comfort level of individuals charting in an electronic media is definitely not universal; those staff who have been used to charting in a paper format may not be as comfortable with an electronic media, nor as familiar with how to check their documentation. A barrier with NIP-IT is that it is a bit like a Phoenix, renewing each day so that if a nurse documented something correctly one day but forgot to chart the same information on the next day, it would not be captured in the following day’s NIP-IT report. An example of this is the capturing of central line dressing changes; at RRMC, there is an IV team member who changes and documents the dressing change date. Initially, we had a charting format that allowed the nurse to “pull forward” copied information, but on a Joint Commission visit, this was not felt to be an optimal safe practice and so we had to change this to daily charting assessments. The particular area to document the dressing date required scrolling down in the charting which created an extra step which would often be neglected. Through validation of lack of documentation compliance, the field is now going to become a mandatory field which will hopefully correct this.

Another barrier that occurred with MDRO isolations was discovered when we realized that there was no “up front” assessment for potential for infection on admission to the facility. The nursing staff was dependent upon the physician to order isolation, and often times this did not occur until lab results came back several days after admission. In the case of a patient admitted with a known draining wound or someone with diarrhea, what might seem an obvious reason to isolate was not being performed due to waiting on results. The creation of the infection prevention

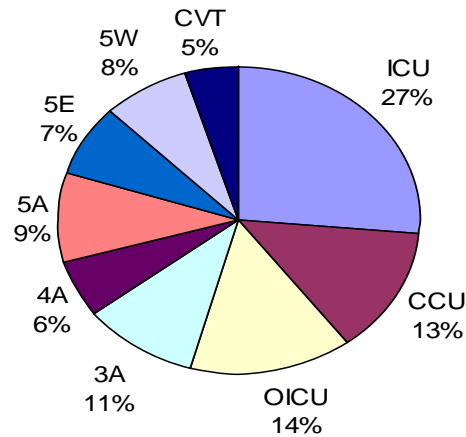
questions was the beginning of empowerment of the nursing staff to presumptively isolate based off of the questions. It was not, however, until we tagged the biohazard symbol with an order for isolation and then tied it to the nursing assessment for “Presumptive Isolation based off of Nursing Assessment” that we began to see staff isolating patients earlier and a reduction in our transmission rate of Healthcare Associated Infections (HAIs). There has been a consistent decrease since 2008 for MRSA (42% total house, 50% in Critical Care), VRE (62% in Critical Care) and C difficile (13% total house, 55% Critical Care). We have also developed a guidance algorithm to lead the staff in the correct path to isolate as well as an “Isolation Cheat Sheet” which is a quick and colorful tool for the physicians to think about potential infections based off of patient presentation. The “Cheat Sheet” is laminated and at every practice area.

A final ongoing barrier is time – validation of accuracy of data has been a priority from the start for the Infection Preventionist at RRMC and as NIP-IT has continued to be refined, the data options have expanded to being available for the other facilities in the Riverside Health System – Walter Reed Hospital, Tappahannock Hospital, Shore Memorial Hospital and Hampton Roads Specialty Hospital. RRMC is the only facility to have a dedicated position for Infection Prevention and NIP-IT is checked daily and sent manually to IV therapy, NICU, Environmental Services, Radiology and Pharmacy. Because of the privacy issues involved with Health Information Management and a “need to know” basis, NIP-IT access is not yet available to these departments and so is processed with a daily send, seven days a week to each department by the RRMC Infection Prevention Manager. Work is ongoing to have a secure portal that is unit specific for individual departments to access this information daily. However, the NIP-IT project has no separate budget or dedicated personnel, so progress is sometimes a tad slow. With the adage that “Rome wasn’t built in a day,” we continue to devote as much time as possible and celebrate each small accomplishment along the way.

Challenges Faced:

A key factor in the success of this project has relied upon accurate validation and reporting back to the bedside clinician regarding MDRO rates, both HAI and CAIs as well as continual feedback to the direct patient care providers. The Infection Prevention team created manuals for each nursing unit labeled “Infection Prevention Tools” which contained the current Infection Prevention plan, risk assessment and priority focus as well as unit specific rates. Here are some examples of targeted information:

2009 HAI Unit Rates: Adjusted per patient days



Critical Care Infection Summaries

HAI = Healthcare Associated Infection

HAI Infection Days				
TYPE OF INFECTION	DATES		# of Days Since Last Infection	# of Weeks Since Last Infection
	Date of Infection	Current Date		
ICU				
MRSA	06/04/10	09/01/10	89	12
VRE	05/08/10	09/01/10	116	16
Cdiff	06/16/10	09/01/10	77	11
ESBL	05/15/10	09/01/10	109	15
CCU				
MRSA	05/28/10	09/01/10	96	13
VRE	04/23/10	09/01/10	131	18
Cdiff	05/26/10	09/01/10	98	14
ESBL	05/10/10	09/01/10	114	16

Feedback on the project has been a continual circuit of dialogue from the Infection Prevention team to the nursing staff via unit meetings, retreats and written postings, either in the Infection Prevention tools manuals or via posters. Finding the quickest, most easily understood method of communication has been an evolving learning curve for all.

One simplistic annual recognition was to have the annual “BUG OFF!” awards which recognizes individual units for reduction measures. We began the awards in 2009. As an example of the awards, in 2010, the BUG OFF categories were: Lowest Total HAI MDRO Rate (Medical Hospitalist unit with total HAI rate of 17%); Most Significant Reduction in SSIs (Labor and Delivery – reduction in cesarean section post-op infections of 90%); Largest Reduction in HAI MDROs from 2009 (CCU for its reduction in HAI C difficile by 41%); and Most Significant Reduction in Cost Avoidance (Emergency Room for reduction in false positive blood culture results for a cost avoidance of \$1,777,000). The units were recognized with a plaque, a medallion and personalized presentations at unit meetings by the facility top administration team. Simple recognition and accolades have gone a long way to help with empowering bedside staff to see that their efforts truly do make a difference.

The ultimate goal for this project is to deploy NIP-IT directly to the caregiver at the bedside so that they have an accurate snapshot of information. This is the last challenge to be conquered and access to unit specific data only is something that has required slow progress to ensure that privacy of Health Information is maintained. We are working on a portal for this information that can be accessed only by the individual’s unique sign-on information so that access can be tracked as well for appropriate use.

Summary:

Our facility administrator said it best: “Reduction of preventable infections is a patient safety priority and the logical and ethical best practice to being a viable and preferred choice to all who are in need of health care services. It’s the right thing to do, it’s the best thing to do, and it’s the way our facility will provide care to its patients in the same manner each employee would wish for their own family members to be cared for. Our electronic medical record has provided the foundation for a unique data mining program, NIP-IT, and this revolutionary program has been the key to unlock a magnitude of information for the bedside clinician to help them make timely and informed decisions to prevent infections.”

Dr. Patrick Parcels, Senior Vice President and Administrator
Riverside Regional Medical Center

Interpretation:

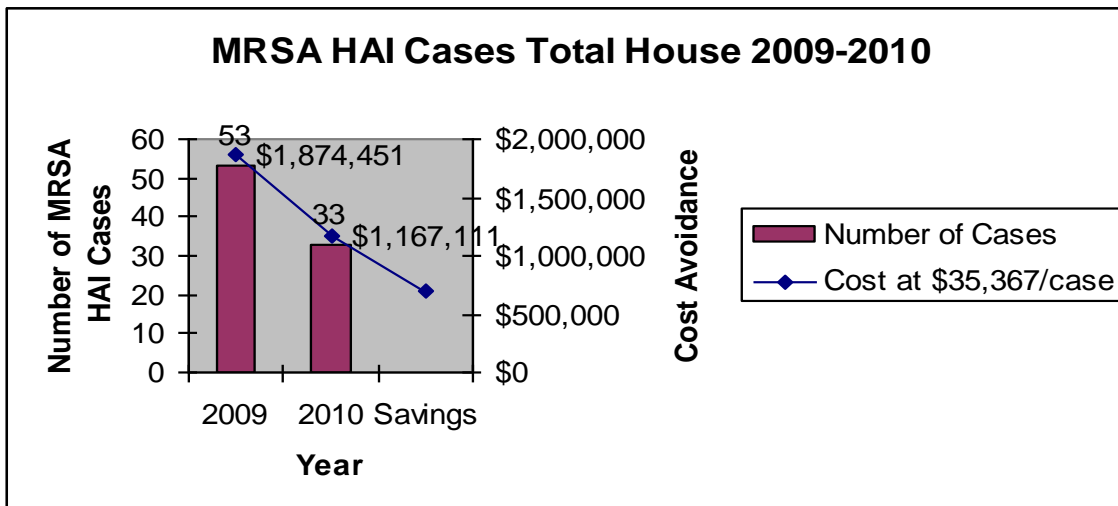
The creation of an accurate tool to draw information from actual nursing documentation has provided the framework to have accurate baseline data as well as track and trend responses to changes and improvements in gathering both historical data on MDRO presence as well as changes in patient condition.

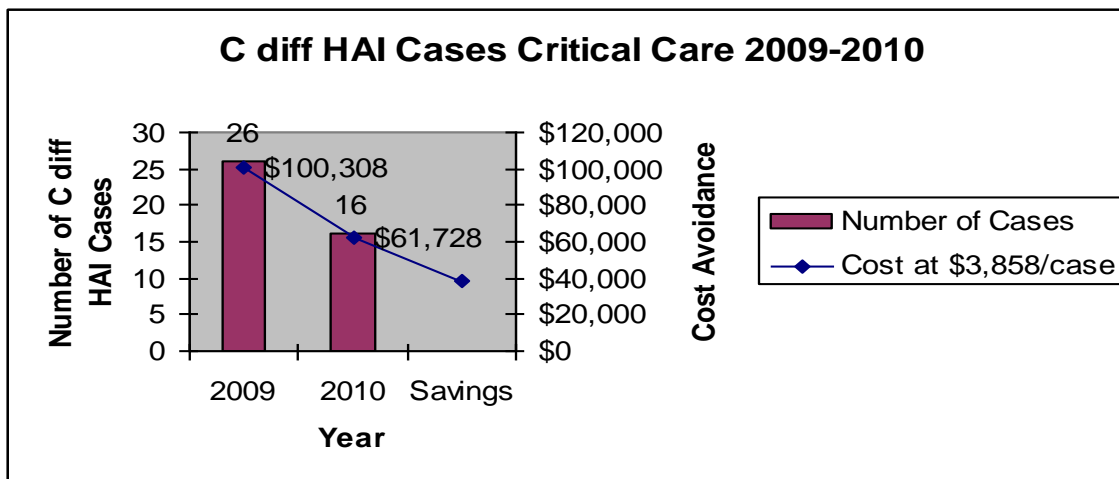
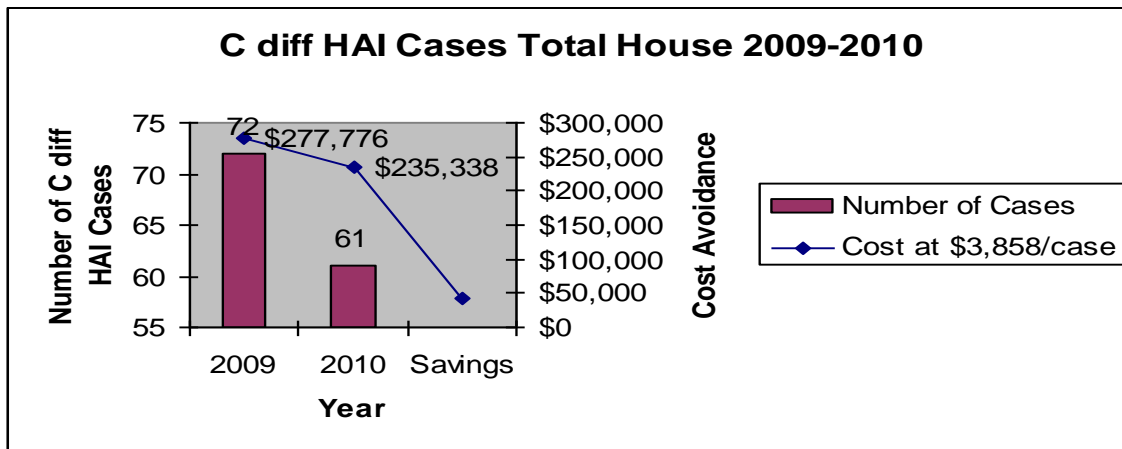
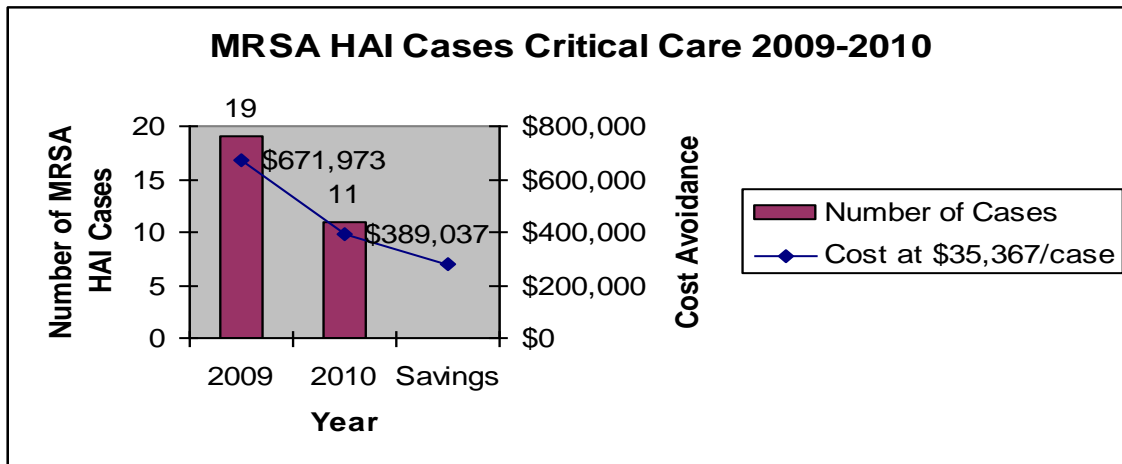
Conclusions: RRMC has been reporting on surveillance of HAIs since 2005 and since 2007 appears to have had a fairly stable annual rate per 1000 patient days. While the rates have been obtained via infection prevention surveillance for comparative measure, there was never a reliable program in place to measure frequency of isolation, type of isolation or number of isolation patient days. Because NIP-IT draws directly off of nursing documentation, this is an accurate and reliable tool to evaluate any infection prevention measures aimed at reducing MRSA infections. The full impact of presumptive isolation is only beginning to be realized and will continue to be trended for its relationship to reducing time to isolation, which is another measure to reduce infection transmission.

NIP-IT continues to evolve and modify to improve data accuracy. One recent modification is the ability to view targeted days for review of Isolation which has helped the Infection Prevention department in producing its evaluation reports more quickly. Some future goals which are under review are:

- the definition of exact specific lab results which need isolation and when a patient's lab becomes positive, this would become the trigger to place the appropriate workflow to place the isolation order, place the biohazard symbol next to the patient's name, and send an electronic alert to the primary nurse, charge nurse and MD. The nurse would still be responsible for contacting the MD for any specific treatment orders but this would further reduce the time to isolation.
- The creation of a daily report for "Presumptive Isolation based on Admission Assessment" for targeted rounding by the Infection Preventionist. The goal is to only isolate those patients who truly need it and this has the potential to support the staff in their decision making as well as intervene earlier in those areas where extra patient teaching might be necessary.
- The creation of a workflow which would be triggered by the documentation of date of insertion for such things as foley catheters and central lines which would "count" the days of insertion and place it directly on the Quality section of the patient record. This would be a snapshot view of device days for physicians and nursing staff.
- The creation of a patient specific "report card" with significant dates for procedures: central line insertion and removal, urinary catheter insertion and removal, date of intubation and discontinuation of the ventilator, etc.
- Finally, the ultimate goal is to have this information easily retrievable by the bedside clinician as verification of accuracy and validation.

Financial Considerations: In health care, we have no crystal ball which will tell us which infection will ultimately lead to a negative outcome such as permanent disability or death, but it is intuitively logical that all prevention measures will be of benefit to the bottom line finances to the organization. If these measures are brought about by optimizing utilization of already used resources, the gain is also increased. At RRMCC, we have measurable improvements in our reduction of our MDROs, with the most significant impacts realized so far with MRSA and C difficile. From 2009 to 2010, we had the following cost avoidance recorded:





In essence, we believe that the use of HIT with our NIP-IT program makes great “cents” and as an institution dedicated to caring for others as we would wish to be cared for, we know that cost savings for prevention will ultimately always be: priceless.