

# The Missing Link to Success

## Using a Business Process Management System to Automate and Manage Process Improvement

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### KEYWORDS

Process improvement, business process management, business activity monitoring, workflow/process automation, workflow/process engine, outcome metrics.

### ABSTRACT

Healthcare continues to face many significant challenges in its quest to provide optimal patient care. Many hospitals have instituted various process improvement methodologies to address these challenges. The outcome of these efforts still produces a large volume of manual tasks that must be addressed by the caregiver. The Chester County Hospital employed a Business Process Management (BPM) engine to automate and manage several of these processes. A BPM engine can perform key tasks and interact with the clinician to decrease the manual requirements of a process. The result is reduced workloads and improved outcomes. The Chester County Hospital has been able to demonstrate significant decreases in hospital acquired MRSA infections and compliance with several CMS core measures. There are multiple items to evaluate before attempting to use a BPM engine. This paper reviews the work at Chester County, its outcomes and the considerations that were important for achieving success.

Today's healthcare environment is extremely daunting. Hospitals have been challenged with increasing complexity of care,<sup>1</sup> decreased resources<sup>2</sup> and increased regulatory requirements<sup>3</sup> such as CMS core measure reporting. The quality of care delivered is under expanded scrutiny and hospitals have employed various process improvement methodologies such as Lean<sup>4</sup> and Six Sigma<sup>5</sup> to improve and optimize their processes. Many of these process improvement strategies have been successful.<sup>6</sup> However, as multiple optimized processes are given to clinicians, it becomes difficult to juggle all the requirements of the various initiatives. The manual nature in which healthcare is provided predisposes care delivery to errors and omissions due to human factors.<sup>7</sup>

This paper reviews the use of a Business Process Management engine to provide automated control of processes in an acute healthcare setting resulting in the realization of more consistent and positive outcomes. It will review several process improvement efforts at The Chester County Hospital in West Chester, Pennsylvania, and how Business Process Management (BPM) was incorporated into the infection control, smoking cessation education and congestive heart failure (CHF) processes. It will provide evidence that process automation provided a vital component which was needed to obtain the successful outcomes realized by The Chester County Hospital.

### OVERVIEW OF BUSINESS PROCESS MANAGEMENT

According to Mark Treat from the BPM Institute, "Business Process Management (BPM) is a disciplined approach to identify,

design, execute, document, monitor, control, and measure both automated and non-automated business processes to achieve consistent, targeted results consistent with an organization's strategic goals. BPM involves the deliberate, collaborative and increasingly technology-aided definition, improvement, innovation and management of end-to-end business processes that drive business results, create value and enable an organization to meet its business objectives with more agility.<sup>8</sup> BPM has been used successfully in many industries.<sup>9</sup> However, the healthcare sector has some unique challenges and consequently has been slower to adopt the technology when compared to other industries<sup>10</sup>

BPM is a comprehensive approach to process optimization. At the heart of BPM is an engine that automates and manages processes for the end-user. The Workflow Management Coalition defines a workflow (business process) management system as "a system that defines, creates and manages the execution of workflows through the use of software, running on one or more workflow engines, which is able to interpret the process definition, interact with workflow participants and, where required, invoke the use of IT tools and applications."<sup>11</sup> Key elements of process automation include the process flow being input into a system, creation of rules and business logic that allow the system to manage the process, interactions with people, and the system directing activities. An important aspect of BPM is Business Activity Monitoring (BAM) which is defined as a focused monitoring and measuring of business activity across systems and processes.<sup>12</sup> It is beyond the scope of this paper to give an in-depth overview of BPM. A good primer of terms and definitions can be found on the Workflow Management Coalition Web site.<sup>13</sup>

There are many robust BPM systems on the market today. The challenge for any healthcare institution is the ability to integrate the BPM system with the hospital's HIS system to the degree that it can monitor events within that system and provide directions to the system and its end-users. Most BPM engines are designed to interact with other systems. Unfortunately, many HIS systems are much less open and accessible. This roadblock should diminish as HIS vendors come out with the next generation of systems that employ service oriented architecture and newer interoperability standards.

## **PROCESS IMPROVEMENT**

The Chester County Hospital (CCH) uses FOCUS-PDCA<sup>14</sup> as its primary process improvement (PI) methodology. A PI opportunity is identified and a multi-disciplinary team is convened to evaluate the process. In many cases the objective is clear such as meeting a CMS core measure requirement. Once assembled, the team usually begins by documenting and flowcharting out the current process looking for variability, errors, bottlenecks, and other items that impede the desired outcomes. A new and optimized process is developed, tested and deployed. While the process is "improved" sometimes the desired results do not materialize.

The problem that occurred at CCH was not the optimization of one process but the collective effect of many "optimized" manual processes on the clinical care team. Each process, even if efficient, added a level of burden and complexity that had the cumulative outcome of making it extremely difficult to effectively handle the

volume of tasks required. Examples include multiple screening assessments, extra data collection requirements and new complex order sets and checklists which needed to be followed or completed. This was compounded by extreme clinical workloads as well as variable levels of staff skill and experience. The result was that the team often ended up not achieving the goals it had set.

## **ADDING BPM TO PROCESS IMPROVEMENT PROJECT**

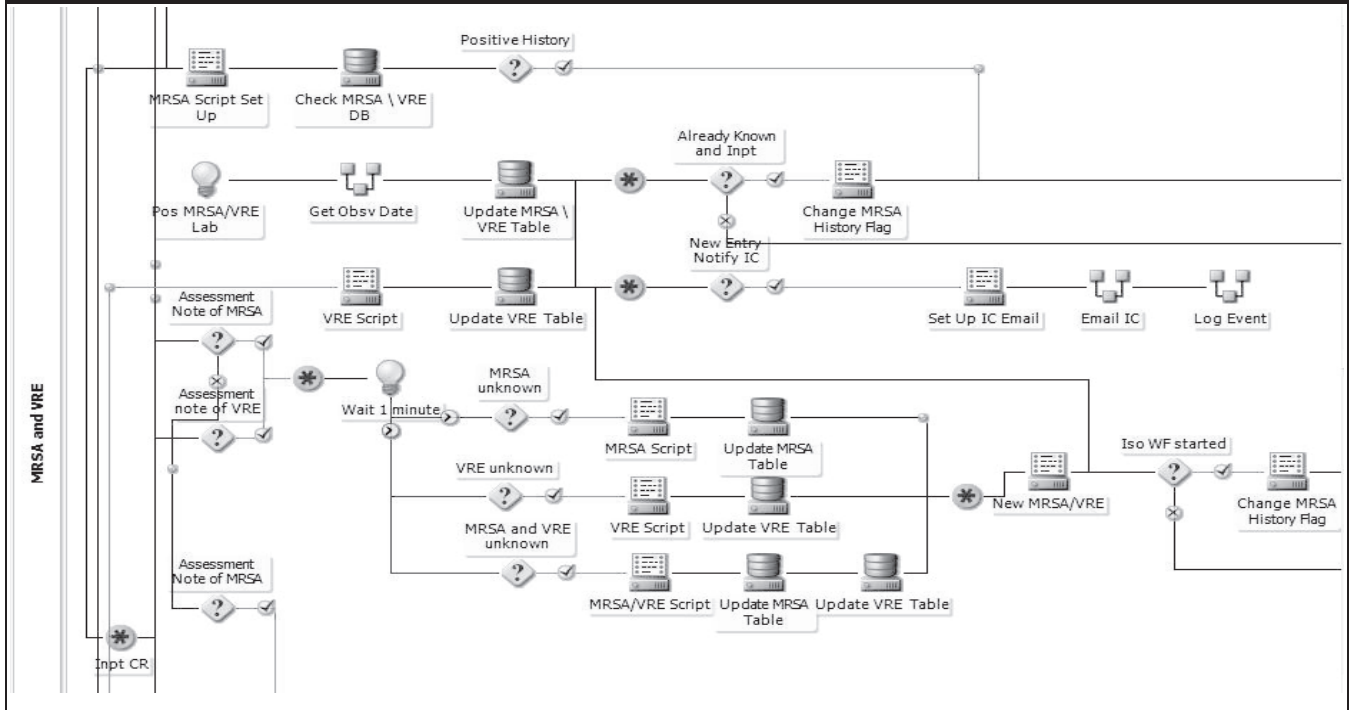
Gartner describes BPM as "the management of explicit processes from beginning to end."<sup>15</sup> In every PI project there is an explicit process with the goal of managing it as efficiently and effectively as possible. A workflow or BPM engine is used to accomplish some or all of that management electronically. BPM automation allows for a much higher degree of reproducibility, decreased variation in the execution of each process step, decreases in missed or delayed steps, fewer errors, more timely completion of the process, decreased workload for the staff and ultimately improved outcomes. Accomplishing this automation requires the successful determination of how steps on a flowchart can be made electronically "discoverable" to the BPM system and how that system can seamlessly interact with the clinician. Consequently, the resource that will be creating the automated process logic needs to be included on the PI team from its inception. This is a key factor in achieving success.

The PI team meets and conducts its work according to the FOCUS-PDCA methodology with several steps added. The first steps are determining if key data exists in an electronic format and whether the system can determine if an action is occurring. The team must ascertain whether the information is in a consistent format. Data that exists from free-text input is generally unreliable. It is usually necessary to convert from free-text items to defined data inputs. Another challenge is establishing the exact business logic for evaluating and managing condition or state. In traditional PI plans there are many decisions that have a level of ambiguity and require intuitiveness on the clinician's part. A BPM system needs precision and exact rule logic to follow. The team also needs to work on how the process can be monitored in a real-time fashion and who will be responsible for the monitoring. A final hurdle is deciding how the system will interact with the end-user. Questions that must be answered: What information do they need? How will they get it (pop-up alert, pager, telephone, etc.)? How will they respond? What will the system do with their responses?

CCH has taken the stance that system generated alerts should have three characteristics. The first is that the information should be new and valuable to the recipient. Nuisance alerts with stale or redundant data quickly disenchant the staff. The second principle that the hospital follows is that the notification must be actionable. The person needs to be able to do something with the information. Finally, the alert should reduce the work burden for the individual. These are keys for end-user buy-in. Whenever possible, the team tries to have all three elements in place.

BPM success is closely tied to the level of staff acceptance which is correlated to the staff perception of benefit and to the ease of use of the system. Process automations are usually very complex, but they cannot be cumbersome to the end-user. Ultimately the success of most PI efforts comes down to how well the end-users

**Fig. 1: MRSA process in the BPM system.**



buy into the new process. The more change is thrust upon them or they see no benefit, the less they will embrace it. This is one of the main challenges for all PI teams to master. Automation offers great opportunities to improve staff acceptance of new processes, but only if it is done well. Overcoming this challenge is a key to successful process improvement.

**CLINICAL EXAMPLE: MRSA ALERTING**

Decreasing hospital acquired infections is a major patient safety concern and the focus of CMS and other regulatory agencies.<sup>16,17</sup> Methicillin-Resistant Staphylococcus aureus (MRSA) is one organism that has received a considerable amount of attention over the past several years in the medical world<sup>18</sup> and the community at large.<sup>19</sup> CCH convened a Resistant Organism Task Force to specifically address how it should handle the challenges of several problematic organisms. MRSA was one of the microbes being addressed. A person infected with MRSA is considered to be a carrier for life. Consequently, a primary requirement for the institution is the identification of all patients who have a known history of MRSA so that they can be properly isolated until screening tests determine if the organism is still present.

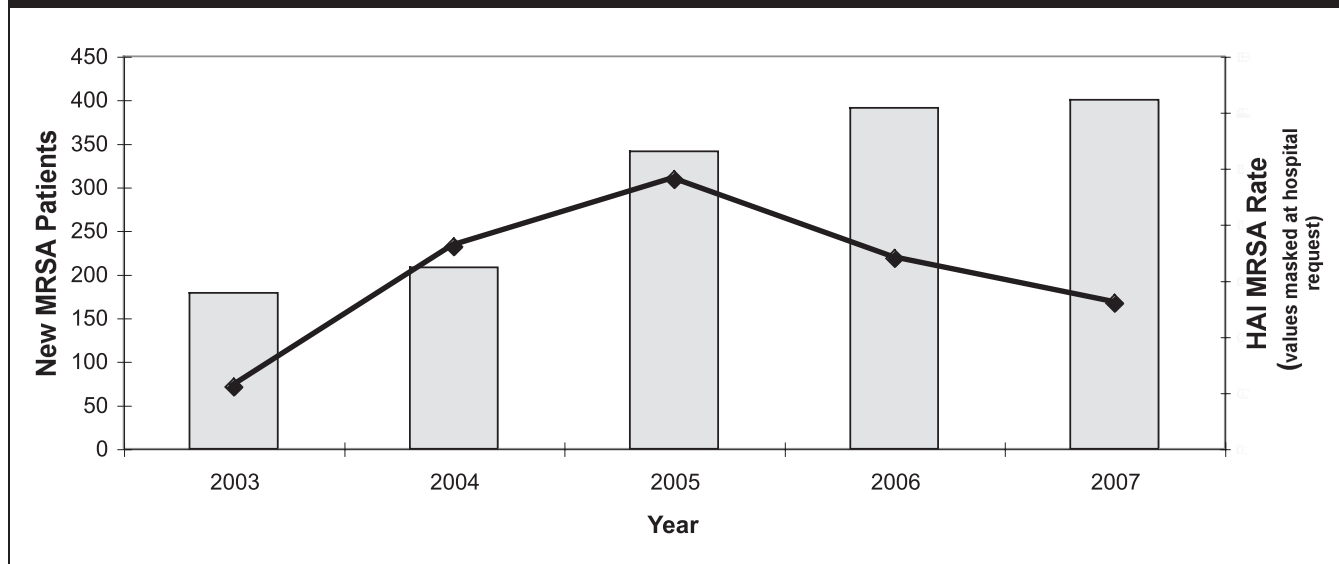
There are multiple steps involved in assuring that the proper identification, notification, and screening occurs for each potential MRSA patient. The team’s review of its data showed a high dependence on a manual process which allowed some MRSA positive patients to go unrecognized. Identifying and alerting the staff regarding these patients was an ideal process for automation. Many of the key elements already existed within the HIS system or were electronically discoverable. The results for all hospital

performed lab tests resided in the clinical repository. Admission assessment data from nursing was stored electronically and all new lab results where in HL7 transactions which could be scanned for relevant information as they came into the system. By developing proper logic the BPM system was able to identify every patient that had a history of MRSA or a new positive MRSA culture. The system was also programmed to listen for negative MRSA screen tests that would allow a patient to come out of isolation.

A BPM process was set up that was triggered on admission. The system would check for a history of positive MRSA cultures and for notations of MRSA in the admission assessment. If the history existed the system created a text-to-speech message which is called to the nursing bed manager/supervisor alerting her to the condition. The bed manager must acknowledge the call via the telephone keypad or the system will call back. Along with the bed manager, the doctor, staff nurse, and the infection control department are also notified via system alerts or e-mail. The notification includes the source of previous infections and the need for a MRSA screen if the patient is a history-only patient. The system then listens for screen results to determine whether or not the patient should stay in isolation. In all cases the information is pushed immediately to the appropriate person so isolation status is optimized. Figure 1 shows part of the MRSA automation process as it is defined in the BPM engine. Note the graphic nature of the steps. Each icon, if clicked on, has scripting code, a SQL stored procedure, XML, or other programming methods behind it.

Pennsylvania Act 52 which requires proactive MRSA screens for patients identified as “high risk” went into law in 2007.<sup>20</sup> The BPM process was modified to evaluate all non-MRSA patients

Fig. 2: New MRSA case with hospital acquired rate.



for high-risk status and to alert clinical staff to obtain a screening test when needed. The system automatically maintains and updates the infection control database with the patient's latest information. It alerts laundry via a printed report of exact floor census, including isolation patients, so that the proper number of isolation gowns is available on each floor. It alerts housekeeping to the fact that the room held an isolation patient and needs an "isolation clean" any time the patient is transferred or discharged. The process was further extended to request the proper supplies from Central Supply, to monitor that the correct isolation flags are set in the system, to set the flags when appropriate, and to create nursing notes for the clinical staff. This saves them documentation time and assures accurate and complete notes.

The PI committee worked on many other facets of infection control as well. These included elements such as proper hand washing, strict adherence to gowning, as well as other isolation practices. The committee ran multiple educational programs, worked on optimizing test turn-around from the lab, developed the list of "high risk" patient groups, tracked multiple resistant organisms, and conducted other PI activities.

Nationally, the prevalence of MRSA has risen significantly over the past several years.<sup>21</sup> At CCH we have seen a 123-percent increase in newly diagnosed MRSA patients between 2003 and 2007. From 2003 through 2005 the hospital acquired MRSA rate increased along with the total volume of MRSA patients. This increase placed a substantial stress on the manual notification process which, while being consistent with current practice guidelines, was not robust enough to handle the additional burden effectively. The automated process went into full effect in 2005. Over the next two years new cases continued to rise but the incidence rate of hospital acquired MRSA infections dropped by 38 percent. This is the key metric defining success, a drop in hospital acquired MRSA. Figure 2 shows these results graphically.

This rate drop cannot be attributed solely to the BPM process. It

was a multi-disciplinary PI effort of which BPM automation was only a piece of the solution puzzle. However, based on the success of the infection reduction efforts with MRSA, the Chester County Hospital has moved forward with using BPM automations as a key element of its strategy to reduce other hospital acquired resistant organism infections.

### CMS CORE MEASURE AUTOMATIONS

CMS has enacted a program where hospitals are required to collect and report key quality metrics which will be available for public review.<sup>22</sup> The need to be compliant with these metrics has been a focus of multiple PI teams at CCH. BPM automations have played a role in several of these efforts. This paper will focus on two of these processes. The first will be smoking cessation education which is a core measure in three categories: AMI, CHF, and pneumonia. This review will focus on metric compliance, the ability to customize automations, and the subsequent outcomes of this automation. The second example is Congestive Heart Failure (CHF) which will focus on the automation of tasks to assist the staff in managing key elements of the process.

**Smoking Cessation.** Smoking has been identified as a major health issue in the United States<sup>23</sup> and CMS has developed requirements that hospitals provide smoking cessation education to smokers during their stay in the hospital. CCH convened a multi-disciplinary PI team to look at the smoking cessation education process and to optimize it. The team determined who would best provide the education, what to include in the education, and the elements of proper documentation that met the criteria for CMS compliance. Key activities necessary for success included identifying all smokers, making sure that the proper staff member was notified to provide education, tracking that the education was completed, and assuring that proper documentation was created.

A BPM process was developed to assure that the identified tasks were completed properly. Upon admission the system was

set-up to query the past medical history for notation of smoking and to listen for documentation within the nursing assessment that indicated the patient was a smoker. If either of these trigger events occurred, the system would determine which Respiratory Therapist was assigned to the patient's floor and alert him/her via a text beeper to give the education. It also printed the information to the respiratory printer. The system was set up so that there was a real time BAM report showing all patients awaiting education for the Respiratory managerial staff to monitor. The system re-pages the appropriate therapist every morning until the education is complete. An electronic alert is created in the hospital HIS system reminding the therapist of the work and giving them several options for outcomes. The therapist needed only to click an option (education given, patient declined, patient reported they have quit) and the system created a full documentation note of the activity for the therapist that satisfied CMS requirements. This documentation is an example of how the BPM engine reduces work for the clinician.

The power of the BPM system was evident in the hospital's ability to modify the process to meet real life challenges. There were several floors where the alert could not be acted upon at time of discovery. These areas included Ambulatory Care, Labor and Delivery, the Cardiovascular Unit, and the Emergency Department. The system was programmed to wait 24 hours before sending the alert for patients on these units. For Intensive Care patients the team decided to wait until the patients were transferred out of the unit to raise the alert. Furthermore, the team decided that it was inappropriate to provide the education at night so alerts after 9 p.m. were held to the next morning. This system programming flexibility kept the staff from becoming frustrated by notifications that could not be acted upon. It greatly increased buy-in and, therefore, improved outcomes.

The system removes the notification burden from nursing, the work distribution and documentation burden from Respiratory, and eases the task of the staff abstracting chart data for CMS reporting. Before the process improvement project the composite compliance percentage for these metrics was 57 percent. After the implementation of the automation the hospital was able to achieve 100-percent compliance for the next four quarters. During the fifth quarter one pneumonia patient was missed although the alert went out to the appropriate therapist. In that quarter the composite score was 98 percent. This consistent level of result being achieved while reducing the staff workload demonstrates the power of BPM in process improvement.

**CHF Automations.** The hospital also created automated processes to assist the CHF nurses with their management of the CHF patient population. CHF represented the largest non-obstetrical patient population in the hospital. Since these cases are often complex the workload exceeded staffing resources. Consequently, the hospital was not able to identify and properly manage all the aspects of CHF patient care nor was it able to achieve the levels of compliance needed to improve patient care. A PI team was convened and process automation was part of the endeavor.

The team looked at all aspects of the CHF care plan. The first major challenge was identifying patients who currently have or previously had CHF. The BPM process was called upon to evaluate every admission for criteria that would indicate CHF. This included a history of CHF from previous admissions, an admitting diagnosis suggesting CHF, a history of a low ejection fraction, a high BNP blood level, participation in the outpatient CHF program, or a nursing admission assessment noting CHF. The system also evaluates all new BNP values and new ejection fraction values. If any of these conditions are present a CHF alert was created and the patient was added to the CHF census that is used by the CHF nursing team.

This workflow, while supporting core measure compliance, is designed to help the nurse manage his or her workload. It does much of the patient assessment work and provides the nurse with a list of items needing attention. These items include a check of what medications the patient is on every 12 hours with alerting for the need for certain medications. It also checks and reports the most recent left ventricular ejection fraction and/or alerts for the need to perform an echocardiogram. It manages the patient educational requirements and writes the education note for the nurses when they indicate the education has been given. It checks and reports several other items and manages a database of information on each patient for easy abstraction and analysis. The big-

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gest provision for nursing is the comprehensive list of patients and automated census management capabilities. They can easily update or alter the patient's status and the information is always current for a seamless handoff to the next care provider.

The CHF core measures have been difficult to advance but the automated process has made its impact by helping to increase the ACEI/ARB medication compliance from 63 percent to 90 percent, providing written discharge instructions from 23 percent to 78 percent, and by raising LVF assessment to 100 percent. The next logical extension of the workflow is to push notifications to other members of the care team instead of just to the CHF nurses. This includes the ability to offer physician alerts of key medications that are needed (beta blocker, ace inhibitors, or Angio Retention Blockers) and giving them one click ordering capability if they agree with the system recommendation. These items while created are not live as of the writing of this paper. They should be live at the time of publication.

### **GENERAL RESULTS AT CCH**

The Chester County Hospital has been working with BPM since 2003 and now has over 55 processes automated. These processes check and/or manage something on every patient registered at the hospital with the exception of recurring outpatients. The system has sent out over 350,000 text pages, made over 15,000 telephone calls, created over 85,000 e-mails, and written over 30,000 clinical notes. Process automation has become a stan-

ard part of the hospital's PI efforts so much so that the list of desired automations is backlogged with many requests. The ability to improve outcomes while reducing workload is indeed compelling. These BPM augmented PI efforts have resulted in significant improvements to many key quality metrics. This data is regularly shared with the patients and community. However, the transition did not occur easily and there have been a lot of challenges along the way.

### **KEY ISSUES AND LESSONS LEARNED**

The decision to move into BPM should not be made lightly. A hospital must assess the cost and conduct its due diligence carefully. First and foremost is the choice of which BPM engine to use. There are many quality BPM vendors on the market today which have robust engines. The Workflow Management Coalition has a list of basic elements to use in the evaluation process.<sup>13</sup> These should include a graphical process definer, a process runtime engine, a monitoring (BAM) system, and system integration options. Most BPM engines are designed to integrate with other systems. A bigger challenge will be the HIS system allowing the integration. If the system is locked-down or built on older technology it may not allow this linkage. At least one vendor has taken a commercial BPM engine and integrated it into their product.<sup>24</sup> This integration allows the engine a full palette of options including alerting, writing notes, using the system's security and master files, and creating, modifying, or discontinuing orders. These are very powerful capabilities and greatly enhance the value of the BPM system.

Once the BPM system is chosen and the HIS integration is established the state of the electronic data in the hospital's systems must be assessed. What data exists in an electronic format? How consistent is the data capture? What holes exist in the data? How stringently are the rules guiding data input adhered to? Are inputs free text or are they standardized choices? What interfaces can be read? These questions run to the heart of how effectively a BPM process can be used and greatly alter the likelihood of achieving success. Missed alerts, false positives, and false negatives lead to staff dissatisfaction and can create unsafe conditions.

The automation team needs to be a part of the PI process from the beginning as their knowledge of the clinical world is extremely important. Understanding the process is often much harder than designing it in a good BPM system. When creating the process flow diagram for the PI effort each block must be evaluated for several things. How will the system know this step is happening? Does the data exist in the electronic world? If not, how can it be captured? What is the quality of that data? Who needs to be contacted and how? What can that person do and how will the system know their choice? Exact definitions (rule logic) need to be developed for each step. The system cannot intuitively figure something out. The team must ask questions like "where are the key bottlenecks?", "what are the escalation paths for no response?", "how will the system handle unexpected responses?", "how should the process be monitored and by whom?" and "what metrics need to

be captured and in what format?" These questions only represent a sampling but addressing them will take a team a long way down the road to successful BPM automations.

Once a process is built it must be tested thoroughly. This cannot be stressed highly enough. The good thing is that the BPM system will do exactly what it is told to do. The bad thing is that the system will do exactly what it is told to do. If the process logic is incorrect the system will follow the flawed logic every time. The staff very quickly gets accustomed to the automation and stops paying attention to the process. Consequently, testing must be very comprehensive. There needs to be a monitoring and reviewing mechanism to evaluate what the system is doing. If the results are not as expected, they must be investigated immediately.

Process automations usually involve many departments. All must be involved in the review, testing and sign-off. However,

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one department should be assigned the primary ownership of each process. This group should be the ultimate "owner" of the process, not the IT department. That department should be the one reviewing the outcomes on a periodic basis. They also need to check the business logic at least annually. Healthcare is not static. Elements, dosages, and guidelines change constantly. Process automations must be altered to meet these ever changing protocols and the process owner should oversee this work.

### **CONCLUSION**

BPM systems have been used in many industries for well over a decade to successfully automate and manage processes. Healthcare is a very complex environment which has not embraced BPM. The magnitude of work and the regulatory burden that now exists for the average clinician is overwhelming and can result in medical errors and inefficient care. The healthcare industry has recognized this and is focusing energy on process improvement efforts. While laudable, these efforts are hampered by the manual nature and sheer volume of the interventions that need to be followed. The use of a BPM engine to automate and control these processes can assure the processes occur as specified and reduce the workload at the same time. The BPM engine can provide the missing link to PI success for institutions that are struggling to obtain and/or maintain the gain that they desire.

At the Chester County Hospital the use of a BPM engine to automate processes has resulted in measurable success in achieving its desired goals. The engine has reduced the staff's workload and key processes are occurring with far fewer variations than before. The use of this engine is transitioning how safe and effective care is being delivered to its patients. The results have been compelling

and other institutions should consider evaluating this technology as they move forward with their PI and patient safety efforts. **JHIM**

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