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Reducing Health-Care Associated Infections: An Organizational How-To Guide

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Executive Summary

When a patient enters a hospital, how do we ensure that medical treatment does not actually make them worse? This is a serious concern. In 2000, an Institute of Medicine report drew attention to the costs and consequences of adverse events in healthcare. Tens of thousands of patients die annually, and billions of dollars are lost.

Since that report, health-care providers have embraced the concept of patient safety and have actively sought to reduce preventable adverse events for patients. Health-care funders are increasingly refusing to pay the financial costs of such events, thereby creating a strong incentive for providers to do a better job. Despite these advances, there remains significant evidence that providers have trouble implementing effective systems to prevent such occurrences. This is essentially a problem of organizational implementation. This report addresses this problem by drawing concepts from the field of organizational theory and marries them to the empirical study of patient safety efforts.

Many health-care services are characterized by complexity and consequentiality. A provider has many opportunities to make a mistake, and the costs associated with those mistakes are potentially devastating. Leaders in the patient safety movement argue that the rigorous use of checklists can help maintain very high levels of consistency in dealing with complex tasks. This is surely part of the solution. Studies of organizations that have mastered complex and consequential tasks – called high reliability organizations – are also characterized by the rigorous implementation of essential procedures. However, research on high reliability organizations also suggests that it is not just the process or checklist that matters, but also a wider set of organizational characteristics that enable rigorous implementation.

The question facing advocates for patient safety is not about what to do – the technical processes are already known – but how to encourage and enable users of sub-optimal embedded processes and norms to employ a better approach. This problem is not unique to health-care, and indeed is common to a broad range of organizations. What lessons can we draw from organization theory?

Research on organizational change finds that successful change initiatives incorporate three basic steps: unfreezing existing processes (and beliefs about those processes), introducing a change, and freezing this change in place.

This report reviews efforts to reduce three types of healthcare-associated infections that are among the leading adverse events faced by hospital patients: surgical site infections, catheter-associated urinary tract infections, and central-line associated bloodstream infections. In all, 142 peer-reviewed journal articles published between 2003 and 2009 were studied. We looked specifically for the characteristics of change efforts that seemed to be successful. What emerged was a basic five stage process that followed the unfreezing-change-freezing model of organizational change.

1. Design intervention: In the first stage, the intervention was designed, usually by a multidisciplinary team that represented not just different specialties but also the front-line providers charged with implementing the process change. This widespread participation helped facilitate early buy-in into the intervention among key players.

2. *Educate and create buy-in:* Once an intervention was designed, it was rolled out to the community of users via education and training events. One function of these events was to disseminate the technical knowledge about appropriate procedures and their importance. Another clear function was to demonstrate the value of the new approach relative to the old.
3. *Adopt process change:* These first two stages represent the unfreezing of perspectives about the old system and preparing the way for the third stage, the process change. In many of the studies, this involved the adoption of a new process (or "bundle" of processes) along with an accompanying checklist. The checklist served to clarify and remind providers about the correct approach, facilitate communication about basic standards, and ensure compliance with these standards.
4. *Reinforce change as new norm:* The final two steps involve the freezing of the new approach in place. This requires leadership, not just from the organizational leaders but also from champions of the new process throughout the organization. Such leadership is characterized by a credible commitment to the new change, motivating others to use it, modeling appropriate behavior, and altering organizational power structures to allow lower-level staff to ensure the compliance of physicians. In doing so, leadership helps shape the existing culture so that the new process will be seen as appropriate.
5. *Use performance data to monitor and evaluate:* The final step seeks to use performance metrics to help providers understand their relative success, ensure compliance with the new process, and create the opportunity for organizational learning regarding how to continue to modify processes to improve in the future.

While organizational concepts – such as participation, leadership, culture, communication, and learning – were rarely studied in a systematic way in the studies reviewed, it became clear that they had an essential role to play in the success of these efforts. As the health-care field continues to deal with the issue of patient safety, the issue of how to shape organizational factors to enable implementation of safer processes should be at the top of the research agenda.

Introduction

If the goals of healthcare providers are to do no harm and to make people better, then healthcare associated infections (HAI) stand out as deadly and expensive anomalies. By entering a hospital, a patient takes the risk that they will acquire a HAI between 5 and 10 percent of the time. An estimated two million patients in American hospitals do so every year, and 90,000 die as a result (Klevens et al., 2007). Beyond the extraordinary costs in human suffering and mortality, the financial costs are staggering. An Institute of Medicine study estimated the cost of these infections at 4.5 to 5.7 billion dollars per year; per-patient costs ranged from 5,000 to 50,000 dollars per episode (Herskkowitz, 2006; Wachter and Pronovost, 2006).

Are such costs simply a regrettable but inevitable part of modern medicine? The provision of health services has become increasingly complex. New techniques and technologies save more lives than ever before, but also create new vulnerabilities to medical error – "adverse events." In the last decade, researchers and government funders have begun to argue that these failures can be largely prevented. A report released by the Institute of Medicine in 2000 (Kohn, Corrigan and Donaldson, 2000) drew widespread attention to the issue of adverse events. This report is sometimes described as the starting point of the patient safety movement (Wachter, 2009). Policymakers have subsequently sought ways to reduce adverse events in a number of ways. Federal legislation requires hospitals to seek to establish Quality Assessment and Performance Improvement Programs that "track medical errors and adverse patient events, analyze their causes, and implement preventive actions."[1] Quality Improvement Organizations also contract with Centers for Medicare and Medicaid Services (CMS) to provide consulting expertise with hospitals to improve outcomes. In 2008 the CMS announced it will no longer cover the cost of care resulting from preventable conditions, including three types of HAI: surgical site infections (SSI), catheter-associated urinary tract infections (CAUTI) and central line-associated bloodstream infections (CLABSI). Many private funders followed suit. Increasingly, hospitals must now directly bear the financial cost of these infections. Moreover, more and more states are moving toward public reporting of HAI rates and comparing hospitals on the basis of infection rates.

Despite the efforts of policymakers and the introduction of programs to reduce adverse events among health-care providers, recent evidence suggests that the incidence of these events remains unacceptably high. A 2010 report from the Department of Health and Human Services estimated that that 13.5 percent of Medicare patients experienced adverse events during hospital stays, and that medical error contributed to deaths of 1.5 percent of patients. A study of hospitals in North Carolina, a state regarded as one of the leaders in patient safety initiatives, found that these initiatives had not resulted in reduced errors between the years 2002 and 2007. The authors conclude that "Despite substantial resource allocation and efforts to draw attention to the patient-safety epidemic on the part of government agencies, health care regulators, and private organizations, the penetration of evidence-based safety practices has been quite modest" (Landrigan et al, 2010, 2130).

Dr. Robert Wachter, a leader in the patient safety movement reacted to the findings of the North Carolina study by reflecting that: "Process changes, like a new computer system or the use of a

[1] 5 42 CFR § 482.21(c)(2).

checklist, may help a bit, but if they are not embedded in a system in which the providers are engaged in safety efforts, educated about how to identify safety hazards and fix them, and have a culture of strong communication and teamwork, progress may be painfully slow" (Grady, 2010, A1). Wachter is describing an essentially organizational problem: how do you encourage and enable users of sub-optimal embedded processes and norms to employ a better approach? This is a common problem for many types of organizations.

This report frames the organizational processes that health-care providers must negotiate as they try to reduce HAI. To accomplish this, we a) rely upon a review of empirically-based studies of efforts to reduce the three infections mentioned above, and b) use organizational theory to make sense of how the findings from this review fit within a set of organizational processes. This report does not describe a set of interventions to address a specific infection, or address other factors that are shown to reduce adverse events, e.g. resources (Wachter, 2010). Rather, we seek to offer a prototype of successful organizational change efforts to reduce infections.

Implementation in Complex Systems: Towards High Reliability

The battle against HAI is fortunate in one respect. There is relatively high evidence-based consensus on the causes of infections and the appropriate practices to prevent them from occurring. We know how to solve the problem (see e.g. Anderson et al., 2008; Lo et al., 2008; Marschall et al., 2008; Yokoe et al., 2008). The key challenge, therefore, is not understanding why infections occur or how to reduce them; rather, it is to ensure the implementation of existing knowledge in clinical practice. For this reason, we draw from studies of the implementation of organizational changes, particularly Fernandez and Rainey (2006), and Weinert and Mahn (2006).

A central challenge in the delivery of health services is the inherent level of complexity (Gawande, 2009). Even if we ignore the mix of public and private actors and incentives that shape the overall health system and only focus on the specific processes utilized by a health provider aiming to achieve a specific outcome for a single patient, the task is often extremely complex. At the high end of this complexity is intensive care. One study found that administering medications in an intensive care unit involved 107 steps (Berenholtz and Pronovost, 2006), and another identified an average of 178 actions to be taken to provide overall care (Israel study). This represents, on a daily basis, an extraordinary array of tasks that have to be done correctly in order to avoid adversely affecting a patient's health. Doing the right thing 99 percent of the time still leaves the possibility of regular failure.

Some organization theorists have argued that complex sociotechnical systems fail on such a regular basis that accidents should be perceived as a "normal" or routine attribute of the system, rather than an aberration (Perrow, 1999). The high prevalence of adverse events in healthcare seems to confirm this view. The potential for failure amid complexity is exacerbated if organizational actors have high discretion and relatively low information on errors – they have room to make mistakes without feedback to prevent such errors from occurring. Add the fact that providers may operate under intense time pressure or with limited resources for many tasks, and the potential for failure becomes greater still.

Given the inherent complexity of the system, how does one manage to reduce the potential for error? Another perspective on complex systems is high reliability theory. This approach looks at organizations that have mastered complex, high-consequence tasks, e.g., managing the flow of planes on an aircraft carrier, or overcoming forest fires. These organizations create and perfect detailed processes to ensure extraordinary consistency in terms of error prevention (La Porte, 1996). In addition to understanding research on organizational change, health service providers should be particularly interested in research on high reliability organizations. The organizations that have developed such characteristics have done so because failure is too costly to be accepted as normal. If they do not achieve high reliability, these organizations lose their legitimacy among stakeholders. In a very real sense, health-service providers now face an environment that is forcing them to move toward high reliability. Key stakeholders, particularly public and private funders, are demanding that providers become high reliability organizations with respect to HAI and other adverse events.

Some doctors who have faced the challenge of HAI arrive at a conclusion that mirror the claims of high reliability theory: new processes, set out in detail and rigorously monitored, can manage complexity. For example, Peter Pronovost of Johns Hopkins designed checklists for medical staff in order to cut down on infections. There was nothing new or surprising in the checklists, and all staff should have already been following all of the basic steps involved. However, Pronovost noted that a third of the staff skipped at least one step. The introduction of this checklist made such skipping less common. Pronovost's efforts were profiled by New Yorker writer Atul Gawande, in a book titled *The Checklist Manifesto: How to Get Things Right* (2009), while Pronovost himself authored *Safe Patients, Smart Hospitals: How One Doctor's Checklist Can Help Us Change Health Care from the Inside Out* (2010). The titles of the books are indicative of the perceived central importance of the checklist as a solution to the problem to HAI. Like high reliability theorists, Gawande looked for parallels among professions that deal with complex issues, such as airline pilots and architects, and found that they relied on checklists. A clear lesson, consistent with Pronovost's experience, was to extend such checklists to all complex medical procedures.

However, high reliability researchers pointed out that it was not just the process itself, but an ancillary set of organizational characteristics that helped such organizations succeed. These characteristics include high technical competence, sustained high technical performance, regular and continuous training, flexible decision-making processes involving operating teams, collegial and decentralized authority patterns in the face of high-tempo operational demands, processes that reward error discovery and reporting, and a continual search for system improvement (LaPorte, 1996). The characteristics of high reliability organizations are elusive, difficult to apply, and demand substantial internal change in most organizations. If these supporting characteristics are not in place, introducing a checklist will have little effect.

As we reviewed studies of health-care provider efforts to reduce HAI, we found that success was the result of more than just checklists. While research teams often described the "intervention" as the introduction of a checklist or some other type of *process* change, they also portrayed a more detailed *system* change that relied a broader and more complex set of organizational factors akin to those described in high reliability theory. The checklist might have been at the heart of the intervention, but the intervention was more substantial than that. Buy-in had to be created, resistance overcome, cultural norms changed, and organizational learning routines had to be put

in place. There were, in effect, multiple interventions occurring. Simply providing doctors and nurses with a checklist does not enable these significant organizational changes to occur.

From a methodological point of view, there is a unit of analysis problem here that centers on the question of what exactly constitutes the treatment, i.e. the intervention designed to reduce infections. The concern is that researchers may specify the intervention too narrowly by underestimating the degree of organizational change required for that intervention to work. In doing so, there is a risk of overestimating the causal power of one part of the intervention, i.e., the checklist, and it becomes more difficult to know whether, and to what degree, related but unmeasured aspects of the intervention were important. We noted that many studies of infection-reduction efforts described leadership and culture as quite important to positive outcomes but did not measure these concepts, mentioning them only in passing. Additionally, the studies failed to lay out a causal logic describing how such factors mattered. The idea of a system-wide intervention means expanding the notion of intervention much more broadly. In doing so, we lose the elegant simplicity and persuasiveness of a well-defined intervention but hope to provide a more accurate picture of the challenge.

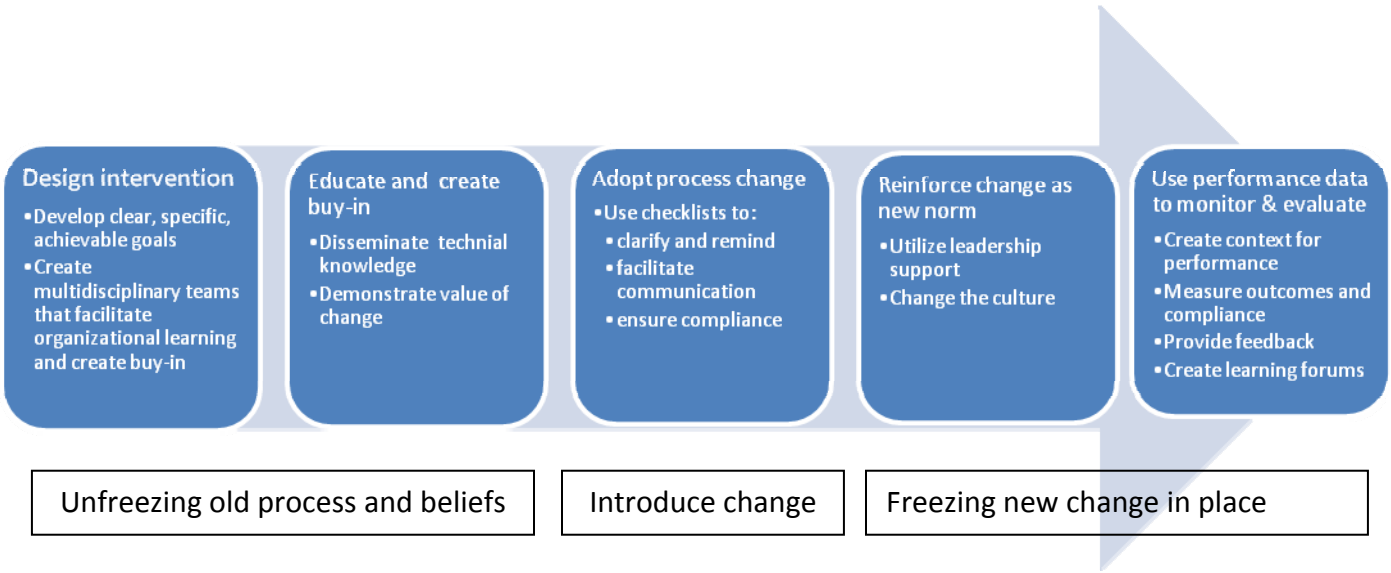
Even if well-defined interventions are possible, we still need basic knowledge of system change.[2] Barriers to implementation have to be identified and overcome, new systems and processes created, power structures may need to be renegotiated, and new cultural norms adopted. Health providers need this organizational knowledge. Studies that rely on abstract interventions that ignore the implementation barriers will often generalize the wrong lesson, or one that is too limited, underestimating and understudying the organizational factors that need to change.

The policy message that healthcare practitioners are increasingly directed towards – introducing a checklist – undersells the difficulty of the change required, and does not adequately identify the organizational variables that need to be in place for the checklist to work. Benrenholz and Pronovost (2006) have recognized this point, arguing that HAI-reduction efforts need to focus on the organizational characteristics of the particular healthcare system. They propose Total Quality Management techniques, which define a system in which teams of organizational actors seek constant and incremental improvement. Some studies indicated that some health-providers were using associated tools, such as Six Sigma performance improvement strategies. In the following sections we do not propose a pre-existing approach such as Total Quality Management, but offer a coherent framework of processes that appear to be common in studies of efforts to reduce HAI. For each of the factors identified below, there is repeated mention of its presence across a range of studies of successful HAI-reduction, and the factor also aligns with pre-existing research on what fosters organizational change. By identifying common characteristics of interventions that appear to have been successful, we broaden the basic

[2] In considering the development of implementation science, Weinert and Mahn (2010) note that many implementation studies suffer from the problem of including multiple interventions simultaneously. They argue for more specific identification of the intervention. In some cases, this may be possible. The authors offer the example of the effects of incentives. If we offered financial incentives to reduce hospital infections, as the CMS is now doing, and this reduces health outcomes, we still need to understand the nuances of how organizations have changed their behavior to reduce infections. Perhaps the policymaker does not care about such detail, but the hospitals themselves still need to understand how to effectively change their behavior.

interpretation of the appropriate intervention to reduce HAI and help fit this framework within broader organizational theory.

Figure 1: An Organizational Model for Reducing HAI



The following sections lay out the key steps that appeared to be common in successful HAI-reduction efforts. These steps are summarized in Figure 1. Overall, the process follows the pattern of change observed by psychologist Kurt Lewin (1947) more than 60 years ago, which is that major reforms in organizations require three stages: unfreezing existing processes (and beliefs about those processes), introducing a change, and freezing this change in place. The durability of Lewin's basic insight about the process of change is a testament to its relevance. In reviewing the field of organizational change, Hendry (1996, 624) observed: "Scratch any account of creating and managing change and the idea that change is a three-stage process which necessarily begins with a process of unfreezing will not be far below the surface. Indeed it has been said that the whole theory of change is reducible to this one idea of Kurt Lewin's." In the model above, the first two steps involve collecting and disseminating information that seeks to challenge beliefs about the efficacy of existing approaches, identifies superior alternatives, and prepares employees for change (unfreezing). Then, a process change is introduced. The final two steps involve reinforcement and institutionalizing of the change in order to freeze the intervention in place.

Method

In total, 142 articles were reviewed. We focused on the three major infections that the CMS has identified that it will not reimburse for: SSI, CAUTI and CLABSI. We used search terms related to these infections. We then selected articles that reported quantitative changes in infection rates or a process variable as a result of an intervention. Of these articles, abstracts were read, and only articles that appeared to consider some organizational component were selected for closer

attention. This excluded articles that were qualitative or non-empirical, as well as research whose design gave no role to organizational factors (e.g., tests of technological interventions). The articles were gathered from PubMed and ISI Web of Knowledge across the period of 2003-2009.[3] Research was limited to English language articles.

There were some differences between the studies that were tied to the type of infection. While many CAUTI or CLABSI articles described specific interventions and the ensuing infection rates, many of the SSI articles concentrated on identifying risk factors that could be the focus of future interventions, or on reviewing obstacles to implementation. Articles on CAUTI were also more likely to focus on removing unnecessary catheters and minimizing the number of days they were in place – a cause of infection – rather than actual infections as a dependent variable.

One limitation of the study is that we cannot estimate how much each identified stage contributed to the final outcome. This is a direct result of our judgment that the intervention itself was often not well-specified. In many studies the level of detail in each step of the intervention was not sufficient. Another limitation of the research we reviewed was that it often relied to a greater extent on an observational rather than experimental design. Studies usually tracked efforts to introduce an intervention to a hospital unit in one time period, and then estimated changes in infection rates (or some equivalent measure) at a later period. The inference is that the intervention is responsible for the subsequent change in infection rates, but the lack of a control group is a limitation of such research. Some studies attempted to minimize this bias by addition of a nonequivalent dependent variable (e.g., monitoring CAUTI rates for interventions designed to reduce CLABSI). The units who attempted the changes were also usually not randomly selected, thus raising concerns about a selection bias. Finally, as noted above, the dependent variable was not always equivalent from study to study. Together, these limitations make a more formal cross-study analysis (such as a meta-analysis) impossible, and the findings could be fairly characterized as impressionistic, rather than definitive.

Stage 1: Intervention Design

The first step in the process was to design a plan that described the goals of the intervention and how it was to be achieved. Providing a plan is an almost ubiquitous part of any formal organizational change. How should such plans be designed?

Develop clear, specific, and achievable goals

Organizational change research has found that individuals are most responsive to goals that are clear, specific, and achievable (Fernandez and Rainey, 2006; see also Locke and Latham 2002). In most cases, HAI-reduction efforts identified specific indicators to be improved, sometimes with quantitative targets (e.g., Ewing, Bruder, Baroco, Hill and Sparkman, 2007).

An intervention promoted by the Greater Cincinnati Health Council provides an example. "The teams were to come up with the following: (1) A SMART aim (one that was specific, measurable, actionable, reliable, and time driven) (2) A 90–day goal, with communication strategy, measurement, and tests of change (3) A 3–day itemized action plan that addressed recruitment of additional team members, the first test of change, and roles," (Render et al., 2006,

[3] The search found 25 articles on CAUTI, 54 on CRSBI, and 63 on SSI. Because the volume of appropriate articles on SSI was so large, we just searched PubMed for this particular infection.

255). This training, along with other intervention components, led CLABSI rates in the participating hospitals to fall by more than 50 percent.

Create Multidisciplinary Teams

A second factor we observed was the use of multidisciplinary teams. Multidisciplinary teams involve members from different part of the healthcare organization. Collaborative teams were most often local in nature (from the hospital or hospitals where the intervention was to take place) and included nurses, infection control personnel, physicians (including surgeons), anesthesiologists, clinicians, hospital leadership, epidemiology or infection control experts, and others. The prominence of such teams was striking because, as one study notes, "the interdisciplinary team design represented a paradigm shift for most hospitals, where infection prevention traditionally fell to individual practitioners" (Koll et al., 2008, 715).

In their meta-review of organizational improvement interventions, Weinert and Mahn (2006) concluded that multidisciplinary teams can improve patient outcomes, but they provided little detail on why that might be the case. Based on the studies we reviewed, these multidisciplinary teams seemed to offer two significant advantages. First, they provided a basis for knowledge creation and organizational learning. Second, they also fostered early participation among internal organizational stakeholders whose buy-in would be essential for the intervention's success.

Organizational Learning: Organizational learning theory proposes that organizations that can bring together the insights of different members enjoy a higher capacity to learn and exploit that knowledge (Arygris and Schon, 1997; Moynihan, 2005). A simple point is that regular meetings, often weekly or monthly, created routine processes for learning (Koll et al., 2008). By pooling multidisciplinary knowledge, the intervention design teams were less likely to suffer from groupthink (Janis, 1972), i.e., the acceptance of shared assumptions that limits critical thinking. One report testified to the knowledge value of these teams: "The diversity of our team was perhaps our greatest strength…Each member brought his or her expertise to the table but we also found that brainstorming resulted in solutions that no one had thought of previously. Often, these were simple solutions, like putting the needleless ports next to the dressing change kits, but these simple changes made all the difference in achieving results," (Racco and Horn, 2007, 79).

By and large, the causes and solutions to HAI are not mysterious. The multidisciplinary teams usually did not come up with an entirely new approach to battling HAI, but primarily drew from or refined preexisting approaches (Gokula, Smith and Hickner, 2007). Indeed, one study of five hospitals that used interventions to decrease their SSI rates found that most such interventions were not new, but simply focused on the implementation of existing guidelines (Geubbels et al., 2004). However, these hospitals still generally used multidisciplinary teams to lay out the specific intervention, assign responsibility for the intervention, and agree upon an evaluation process.

In terms of knowledge management, the multidisciplinary nature of the team matters in two ways. It brings together a set of actors who collectively have strong technical competence pertaining to the nature of the problem. They also are familiar with necessary solutions through

their own training and via their knowledge of information sources such as research on HAI, national guidelines,[4] or first-hand knowledge of the efforts of other providers.

The second source of knowledge a multidisciplinary team offers is implementation knowledge. Informed organizational actors could provide insights on possible challenges that were likely to arise in implementing the intervention and provide suggestions about how those challenges could be resolved. Plans that sounded promising in the abstract faced a basic credibility test and could be tailored to the context of a particular health-care provider (Hatler et al., 2006; Saint et al., 2008).

Since much of the responsibility for infection prevention falls on those directly interacting with the patients, the involvement of nurses was especially important (Elpern et al., 2009). Nurses could tell if check-lists were clear enough and how difficult it would be to collect data on compliance and outcomes (Berenholtz et al., 2004). Both high reliability and organizational learning theory show that learning forums work best in collegial environments, where the perceived status of different team members can be put aside, the input of each team member is valued, and members view the problem as an organizational one, rather than seeking to defend their organizational turf (La Porte, 1996; Moynihan, 2005). The widespread reliance on nurses in design teams seems to reflect these principles, or at least the importance of incorporating the viewpoints of members from different levels of the organizational hierarchy.

Buy-in via participation: Beyond providing knowledge, multidisciplinary teams provided another valuable function. They created buy-in into the intervention. To the degree that implementation of new processes depends upon the discretion of employees, it becomes vital for them to support process change. Research on organizational change shows that a standard way to build such support is to foster participation at the front end of the change process (Fernandez and Rainey, 2006, 170). Selecting influential and respected members from all parts of the organization gives visibility to the intervention, helps communicate goals, establishes a sense of ownership of the process, and creates champions who can support and enforce the changes required (Jain et al., 2006; Reilly et al., 2006).

Maintaining buy-in is an ongoing process. In many cases the multidisciplinary teams that designed the intervention stayed in existence to help with staff education, oversee compliance, and to monitor outcomes (e.g., Render et al., 2006; Warren et al., 2004). This is discussed below.

Stage 2: Educate and Create Buy-in

A basic step for any successful organizational change is to build internal support for the change and overcome resistance (Fernandez and Rainey 2006). The most extreme forms of employee resistance arise from changes that threaten the status or position of employees. This is largely not the case for efforts to reduce HAI. Instead, such interventions change existing routines. This disrupts existing standard operating procedures and informal norms and may be perceived as increasing employee workload. Such interventions may also threaten some basic hospital

[4] Examples include guidelines from the Surgical Care Improvement Project, a collaborative developed under the Centers for Medicare and Medicaid Services and the Centers for Disease Control.

cultural norms. Gawande (2009) notes that checklists undermine the idea that the presiding physician is omniscient and deserving of absolute discretion. Instead, the checklist demands a certain level of humility, communicating that strict adherence to a set process is more important than professional judgment.

In the studies reviewed, there was a consistent pattern of healthcare providers making a deliberate effort to build support for the intervention. This most often took the form of education campaigns, sometimes led by members of the multidisciplinary described above, sometimes the primary responsibility of infection control specialists, and in some cases included outside experts. In many cases communication efforts were aided by the active involvement of organization leadership and project leaders (Hatler et al., 2006). The importance of leadership is discussed in further detail below.

An example comes from an effort to reduce CAUTI infections across multiple hospitals in Michigan (Saint et al., 2009). Participating hospitals received information and presentations during conference calls with the collaborative organizing the intervention. Sites were also provided with face-to-face workshops and a bundle toolkit with the description of the intervention steps, measures, and supporting references. Throughout the study, weekly conference calls provided coaching and information on specific bundle topics from experts.

An intervention by one emergency department to decrease inappropriate use of indwelling urinary tract catheters included six educational sessions led by the principal investigator (Fakih et al., 2008). Each session opened with a presentation of baseline rates of appropriate use of catheters at that hospital. The principal investigator then educated staff about the criteria for appropriate use and the problems associated with overuse. The nursing director also held weekly sessions for nursing staff over a six week period to educate and remind them about appropriate use of the catheters. Along with several other components, this intervention was successful in increasing the appropriate use of catheters from 37 percent to 51 percent.

Similar to the use of multidisciplinary teams in the intervention design stage, education campaigns served two functions. The first was to share technical knowledge with staff, and the second was to create buy-in by explaining the value of the proposed intervention.

Disseminate Technical Knowledge

Some educational sessions were specifically focused on the dissemination of technical knowledge about the nature of the problem and the proposed solution, making them essentially a form of training. For example, at one urban teaching hospital, the MICU infection control committee implemented an educational initiative that was successful in lowering CLABSI rates (Warren et al., 2004). The program consisted of "45-min lectures, posters, and fact sheets distributed at each patient computer terminal located directly outside of the patient room, and the administration of the education module. The education module was administered to all nurses working in the medical ICU by the end of January 2002. Newly hired nurses during the study period were required to complete the education module as part of their job orientation. Physicians (interns, residents, fellows, attending physicians) completed the module during the first 3 days of their ICU rotation" (Warren et al., 2004, 1613).

In some cases, participants in the training module faced a testing component. One intervention started with a pre-test of nurse's knowledge of appropriate techniques (Costello et al., 2008). Other interventions had post-training tests with a requirement to retake the module if the employee scored below a passing level (Warrant et al., 2004). Some of the research pointed to the limits of education and training. Specifically, it may be important to require yearly training and competencies exams or reinforce educational efforts over time. For example, one unit required staff to participate in training sessions and perform three successful, supervised catheter insertions before they were allowed to perform them on the floor (Cooley and Grady, 2009). Staff in this unit were also required to take yearly competencies exams. One interesting study used simulation-based education to improve procedural competence in catheter insertion, with resident physicains training with an ultrasonographic that allowed for "deliberate practice on the simulator with focused feedback," (Barsuk et al., 2009, 1421).

Demonstrate Value of Change

Explain costs of status-quo and benefits of change: Some of the educational component was not technical, but instead focused on demonstrating the value of the intervention in order to build support for it. These educational efforts sought to demonstrate the costs of the status quo, and the relative benefits of the intervention. As described in the introduction, the costs of HAI are staggering and can be fairly described as a crisis in American healthcare. But a crisis can provide an opportunity for leaders to explain why change is necessary (Fernandez and Rainey 2006). Simply providing employees with information about the costs of HAI underscores the importance of the task. The growing resistance of funders to pay for HAI treatments further underlines the urgency of the need for change, since it has a direct impact on the resource base of health providers.

Explain credibility of intervention: Since changes almost inevitably imply some costs, those affected are likely to be more supportive if benefits are also evident. Providing a clear causal theory that the change will provide such benefits helps build support. According to Fernandez and Rainey (2006, 170), "a mandate for change based on sound causal theory helps eliminate inconsistent or conflicting directives that can undermine efforts to implement change." Given the growing evidence of success of strategies for HAIs, change proponents can claim with some confidence that the intervention will have positive impacts if implemented properly. The use of experts on infection control, standards proposed by nationally recognized bodies, and evidence-based research of the efficacy of the intervention were frequently-used tactics (Berenholtz et al., 2004; Bonnello et al., 2008). Potenza et al. (2009) also noted that local examples of successful implementation of the intervention seemed to be especially compelling. As time passes and the intervention is implemented, communicating the change in infection rates reinforces the credibility of the causal approach.

The credibility of the approach could also be reinforced if leadership indicated that they were willing to listen to suggestions about how to modify the intervention in ways that would make it more effective. One study of an effort to reduce CLABSI in a MICU in Arizona implemented an intervention that utilized pre-intervention communication to reshape norms and beliefs. At the beginning of the intervention, rationales for change were clearly laid out to nursing staff in a single page document detailing new strategies to address HAI. For nurses, "giving them an explanation for change several weeks before the implementation date allowed them to ask

questions and resolve concerns and to prepare for action," (Hatler et al., 2006, 553). Staff were also told that some processes might not work right away but would be changed until they did work. This allowed researchers to tailor components of the intervention to the existing culture. It is important to note, however, that flexibility should be directed toward adapting the intervention in functional ways that improve its chance for success, rather than undermine it.

Emphasize shared goals: A general problem for organizational theory is how to encourage cooperation between individuals to undertake action that create organizational benefits, but provide no particular benefit to individuals. One answer is to create a sense of collective purpose (Miller, 1990), where all organizational members view themselves as working together toward important goals. This strategy was apparent in some of the studies we observed. Berenholtz and Pronovost (2003, 324) emphasized a focus on patients as the basis for reminding caregivers that the intervention could impact shared goals: "A powerful tool in overcoming cultural barriers is to find a common interest among caregivers. By focusing efforts exclusively on patients, we created a common interest among caregivers on which they could unite."

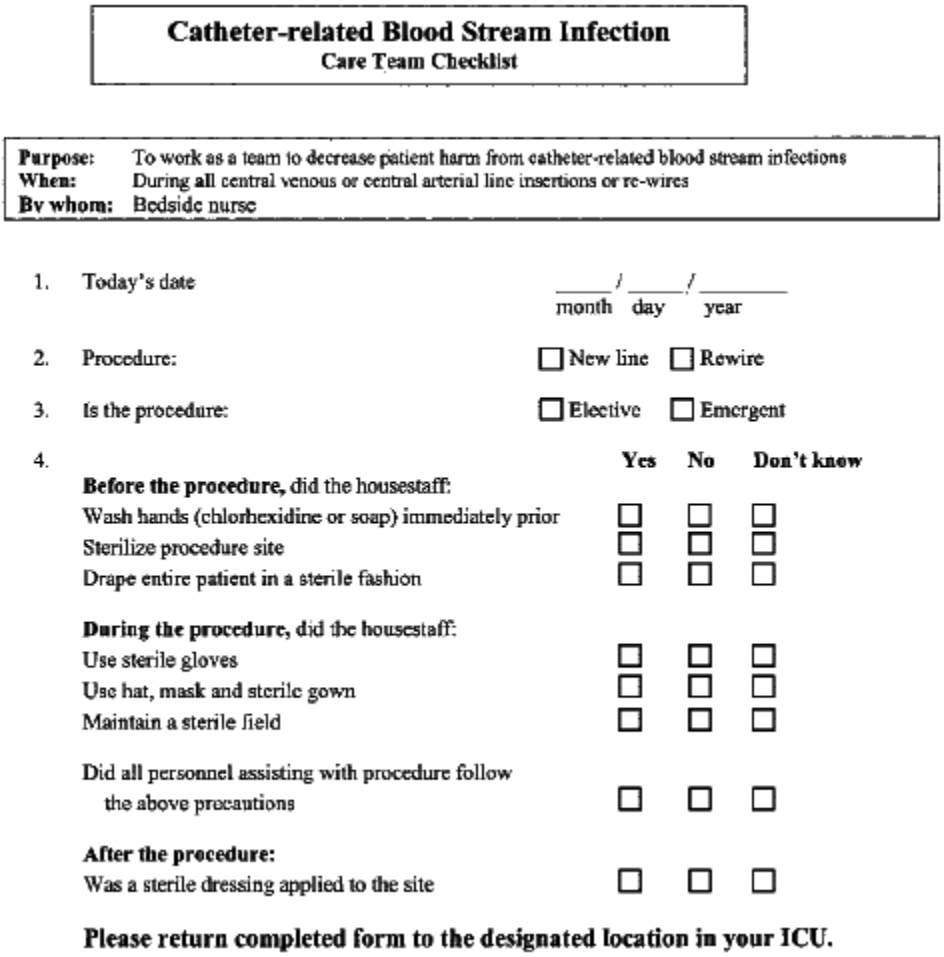
Stage 3: Adopt Process Change

The central aspect to the interventions was to adopt some form of process change. These were sometimes described as bundles, or checklists. Bundles are defined as "sets of evidence-based best practices designed to optimize treatment and prevent complications" (Jain, Miller, Belt, King and Berwick, 2006, 237). They are created based on evidence that they are effective and are expected to be applied together (Schulman et al., 2009, 592). Checklists are documentation of formal steps to be taken in the treatment process (see Figures 2 and 3 for example). In practice, the two are closely connected, since checklists aiming to reduce HAI are usually based on bundles. While bundles provide the content, checklists provide the implementation mechanism. It is possible for bundles not to be accompanied by checklists, but in practice efforts to reduce reform efforts usually combine the two.

Many studies featured checklists to standardize the procedure for catheter insertions (e.g., Render et al., 2006). These checklists typically featured binary choices (yes/no) for hand washing, chlorhexidine use, bed sized sterile drape, and use by the operator of a cap/mask/sterile gown/sterile gloves during insertion, as well as date and site of catheter. In some cases this checklist was combined with redesign of the physical provision of supplies to reduce the potential for error. In a SICU at John Hopkins Hospital (Berenholtz et al., 2004), researchers created a central catheter insertion cart with four different drawers for supplies that could be rolled to patients' bedsides. Previously, caregivers had to find materials from multiple places in order to follow CDC guidelines, creating the potential that a step could be skipped. A single location made the process easier on the care provider, and therefore more likely to be followed. In addition to the checklist for catheter insertions, there was also a checklist to ensure that the cart was regularly stocked. Finally, another checklist was added to the cart that queried the need to keep a catheter in place. It was filled out during daily rounds.

Introducing a bundle implies replacing existing practice with a new process, or at the very least formalizing and ensuring compliance with existing practices. As such, the interventions seek to

Figure 2: Central Line Insertion Checklist
Source: Berenholtz et al. (2004)



Catheter-related Blood Stream Infection
Care Team Checklist

Purpose: To work as a team to decrease patient harm from catheter-related blood stream infections
When: During **all** central venous or central arterial line insertions or re-wires
By whom: Bedside nurse

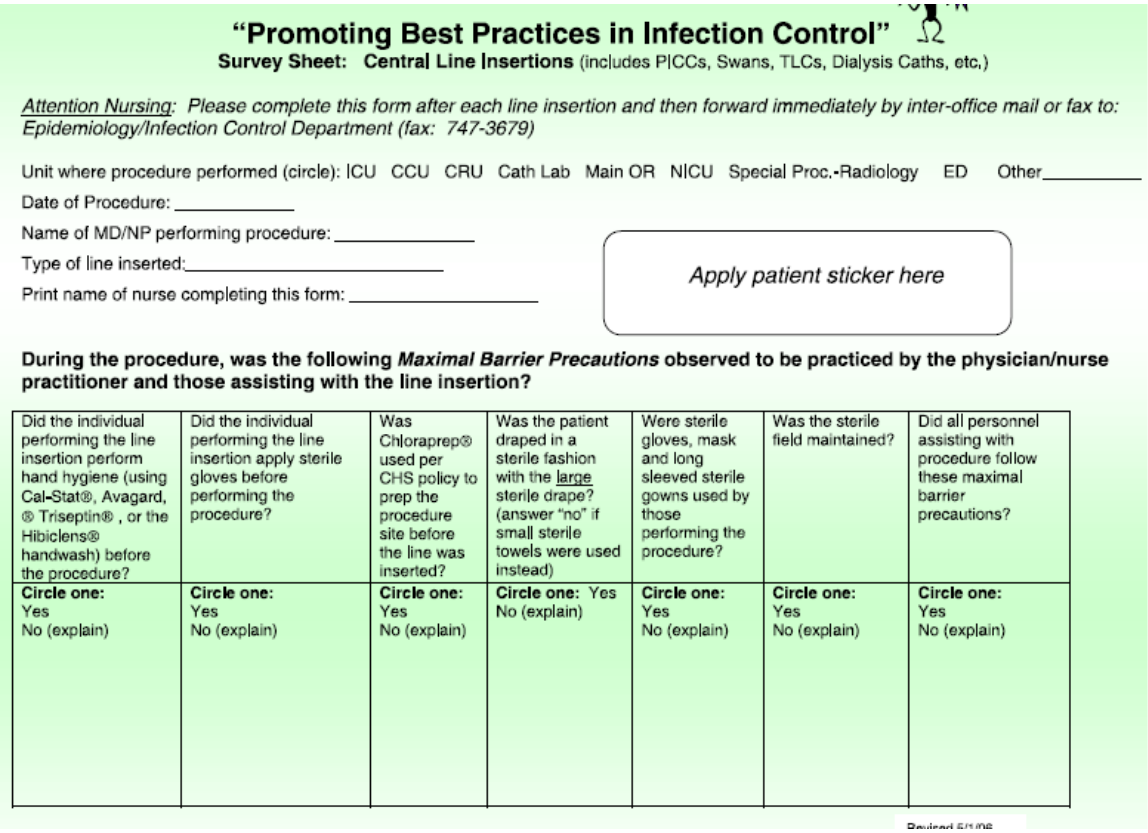
1. Today's date _____/_____/_____ (month / day / year)
2. Procedure: ☐ New line ☐ Rewire
3. Is the procedure: ☐ Elective ☐ Emergent
4.

	Yes	No	Don't know
Before the procedure, did the housestaff:			
Wash hands (chlorhexidine or soap) immediately prior	☐	☐	☐
Sterilize procedure site	☐	☐	☐
Drape entire patient in a sterile fashion	☐	☐	☐
During the procedure, did the housestaff:			
Use sterile gloves	☐	☐	☐
Use hat, mask and sterile gown	☐	☐	☐
Maintain a sterile field	☐	☐	☐
Did all personnel assisting with procedure follow the above precautions	☐	☐	☐
After the procedure:			
Was a sterile dressing applied to the site	☐	☐	☐

Please return completed form to the designated location in your ICU.

establish new standard operating procedures (SOPs). SOPs sometimes get a bad press. They can easily become inflexible red tape, forcing skilled professionals to follow time-consuming procedures that may do little to solve problems (Bozeman, 2000). SOPs imply a "one-best way" approach that echoes back to the scientific management movement of the early twentieth century, but which became increasingly unfashionable among management theorists as the century progressed, especially in functions where professional discretion was deemed important.

Figure 3: Best Practices Survey Sheet
Source: Berenholtz et al. (2004)



"Promoting Best Practices in Infection Control"

Survey Sheet: Central Line Insertions (includes PICCs, Swans, TLCs, Dialysis Caths, etc.)

Attention Nursing: Please complete this form after each line insertion and then forward immediately by inter-office mail or fax to: Epidemiology/Infection Control Department (fax: 747-3679)

Unit where procedure performed (circle): ICU CCU CRU Cath Lab Main OR NICU Special Proc.-Radiology ED Other_____

Date of Procedure: _____

Name of MD/NP performing procedure: _____

Type of line inserted:_____

Print name of nurse completing this form: _____

Apply patient sticker here

During the procedure, was the following *Maximal Barrier Precautions* observed to be practiced by the physician/nurse practitioner and those assisting with the line insertion?

Did the individual performing the line insertion perform hand hygiene (using Cal-Stat®, Avagard, ® Triseptin® , or the Hibiclens® handwash) before the procedure?	Did the individual performing the line insertion apply sterile gloves before performing the procedure?	Was Chloraprep® used per CHS policy to prep the procedure site before the line was inserted?	Was the patient draped in a sterile fashion with the large sterile drape? (answer "no" if small sterile towels were used instead)	Were sterile gloves, mask and long sleeved sterile gowns used by those performing the procedure?	Was the sterile field maintained?	Did all personnel assisting with procedure follow these maximal barrier precautions?
Circle one: Yes No (explain)	**Circle one:** Yes No (explain)	**Circle one:** Yes No (explain)	**Circle one:** Yes No (explain)	**Circle one:** Yes No (explain)	**Circle one:** Yes No (explain)	**Circle one:** Yes No (explain)

But for many functions, SOPs are essential and effective. The use of SOPs is a common characteristic of high reliability organizations (Alvarez and Hall, 2008; LaPorte and Consolini, 1991). Whether SOPs will improve effectiveness depends on the nature of the task. For some functions, goals or appropriate processes are unclear, and we depend upon professionals to use their discretion to make sense of the situation (Wilson, 1989). But in contexts where the goals are clear, and the practices to achieve those goals are well-understood and observable, SOPs can help (LaPorte and Consolini, 1991). This is true even if the task is otherwise complex and involves multiple steps. Indeed, SOPs are perhaps at their most useful in such contexts, since they provide a tool to make multi-step complexity an understandable routine that ensures a standard level of performance. Checklists that capture these SOPs perform a number of basic functions: they communicate standards to staff, clarify and remind the steps to be taken, and help ensure compliance.

Use Checklists to Communicate Basic Standards

What is it that SOPs actually do to foster organizational improvement? First, checklists provide a basis for communication. One study emphasized that checklists reduced the need for nurses to

rely on handwritten notes, speeding up communication (Wall et al., 2005). At the most basic level, they communicate expectations from the organization to its employees about minimally acceptable practices. But at the operating level, SOPs help ensure coordination between nurses, perioperative staff, surgeons, anesthesiologists, and others. The checklist should clearly indicate their respective tasks and provide a record of completion.

A checklist can, but does not always, define responsibility for a task. This reduces another problem found in HAIs, which is any potential ambiguity over responsibility. For example, in one multi-hospital initiative many hospitals found that there was no one person in the perioperative routine who had an acknowledged responsibility for administration of the prophylactic antibiotic. New processes made clear who was responsible for this task (Delligner et al., 2005, 12).

Use Checklists to Clarify and Remind

SOPs clarify and remind employees what the policies are. In most cases, employees already know (or should know) what the appropriate approach is. However, studies have shown that even among those who know the appropriate steps, a high percentage will not follow them, either because they see them as unnecessary, or simply through an oversight. In some cases, employees may not be aware of the evidentiary support for a particular step, and therefore are less likely to follow it. As Gawande (2009) points out, oversight may also occur because of memory failure. This is especially likely if there are an exceptionally high number of steps to follow, if the patient requires urgent attention, or the caregiver is distracted by multiple tasks.

The consistent use of checklists throughout a variety of studies sought to exploit their ability to clarify basic standards and avoid missed steps. One study summarized SOPs as facilitating "the active implementation of evidence based medicine. The bundles provided for completeness, consistency, and application of evidence based medicine interventions by acting as a reminder system" (Jain et al., 2006).

Use Checklists to Ensure Compliance

Checklists act as a compliance tool, with the capacity to record whether employees followed SOPs. At one hospital, researchers tested an intervention to improve compliance with guidelines for antibiotic prophylaxis administration (Rosenberg et al., 2008). All surgeries already had an existing ''time-out'' to avoid wrong-site surgery, and the new process simply piggybacked a verification that antibiotics had been provided in a timely fashion. "Performing the ''time-out'' to verify antibiotic administration prior to incision and documenting it on the ''time-out sheet'' not only serve to remind the operating room staff to ensure that antibiotics are administered in a timely manner, but also document that the patient received the appropriate medication at the appropriate time should that verification become necessary as a pay-for-performance measure," (Rosenberg et al., 2008, 230). More on the issue of monitoring compliance is discussed in the fifth step of the process.

Stage 4: Reinforce Change as New Cultural Norm

While creating buy-in was important prior to the introduction of the new process, it was also apparent that successful efforts to reduce HAI did not take support for the new process for granted, but that there were varying degrees of attention to reinforce the new practices. In the publications reviewed, this stage was perhaps the least well-defined. It was rarely a primary focus of researchers and was not measured. However, there were enough references to factors relevant to this step, particularly leadership and culture, to suggest that they were important and merited further attention.

Utilize Leadership Support

A truism of studies on organizational change is that leadership matters. "Top management support and commitment to change play an especially crucial role in success," say Fernandez and Rainey (2006, 171). Repeated references to leadership in studies of HAI reinforce this point, e.g. "Leadership support is an essential component of a successful improvement project" (Berenholtz and Pronovost, 2003, 325). Often however, descriptions of leadership in research on HAI-reduction were frustratingly vague. Researchers simply refer to "leadership" or "senior leadership" without defining these terms or describing their activities in a systematic way. In reviewing research on HAI-reductions, we looked for evidence and inferences about what leaders did that seemed to make a difference.

Convene key actors and prioritize goals: One power that organizational leaders have is the ability to convene group of actors and focus their attention on an issue. In doing so, they signal what should be priorities for their employees and create working-teams that are assigned with responsibility for solving the problem. Without leadership support, the creation of the type of multi-disciplinary teams described above would have been less likely to occur.

Establish credible commitment: One of the dangers of any sort of process change is that it is viewed by employees as a symbolic or temporary initiative. As cynicism about the potential for reform increases, employee commitment to it decreases. Even if a leader deems it a priority, employees may be skeptical. Perhaps the reform is a passing whim, and will be replaced by another initiative soon. Leadership needs to provide "credible commitment" (Dull, 2009) to reassure employees that the change will endure, and that it will enjoy the resources and attention necessary to succeed.

Credible commitment theory suggests that if leaders are to persuade others to pursue a course of action, they must present persuasive, visible, and binding investments to that approach. Simply creating teams to deal with the problem is one indication of credible commitment, since it involves the use of organizational resources that the leadership could use for other purposes. The willingness to remove barriers (Jeffries et al., 2009) or provide other tangible resources to support the intervention reinforces the sense of leadership commitment, e.g. the willingness to procure new supplies made necessary by an intervention. Another indicator of credible commitment is the direct use of the leader's time in support of the intervention. One article noted the importance of their administrator's support and clinical director's "enthusiastic encouragement" to their successful implementation of prophylaxis protocols (Fonseca et al., 2006, 1112). The support of the clinical director, a surgeon, was "a key feature of convincing surgeons to adhere to the new protocols," (Fonseca et al., 2006, 1112).

Maintain stability: Leadership can support change by ensuring that they enjoy adequate resources to succeed and enough time to work (O'Toole and Meier, 2003). One study emphasized the difficulty in building up a safety culture when there was high turnover among agency nurses (Racco and Horn, 2007). Leadership can also ensure program continuity. If process changes are discontinued or relaxed, employees may revert back to previous practices. An interesting natural experiment that testifies to this point comes from Australia, where a twelve year surveillance program was interrupted for fifteen months (Sykes et al., 2005). The program monitored patients for thirty days after surgery for signs of infection and shared the results with surgeons and staff. When the program was discontinued, post-discharge infection rates rose. Once the program was reintroduced, infection rates declined once more.

Create champions: Organizational leaders can allocate responsibility for ensuring the success of an intervention, thereby creating incentives among these actors to invest effort in the intervention. One example comes from an intervention undertaken by a number of hospitals belonging to the Greater Cincinnati Health Council (Render et al., 2006). The Council president solicited commitment by leaders of nine health care systems to jointly fund a project developed by a patient safety researcher to reduce HAI. These leaders, in turn, identified project leaders responsible for the implementation. Project leaders met monthly to share effective strategies. They were also responsible for giving feedback to the Council and hospital CEOs.

As organizational leaders place responsibility on key actors, they should also empower these actors to succeed and signal support for them. In doing so, they can create champions for the reform throughout the organization. This pattern of delegated leadership is necessary given the size and complexity of the task of dealing with HAI and the time demands it imposes. It also appeared to be quite common in the HAI-reduction efforts we studied, since it was often clear that when researchers referred to leadership, they were not referring to the head of the organization. Champions could just as easily be a unit-level nurse (Tsuchida et al., 2007) as a hospital CEO (Ryckman et al., 2009). For example, one study of 108 ICUs in Michigan utilized both nurse and physician leadership (Pronovost et al., 2006). These leaders were supported for success by being trained on research, sent to interact with peers attempting similar reforms in other hospitals, guidance on data collection, and input from infection control specialists.

The importance of champions from across the organization was mentioned across several studies (e.g., Bennello et al., 2008; Venkatram et al., 2010), echoing the broader literature on organizational change: "Some studies of organizational change stress the importance of having a single change agent or 'idea champion' lead the transformation. An idea champion is a highly respected individual who maintains momentum and commitment to change, often taking personal risks in the process" (Fernandez and Rainey, 2006, 171). The description of champions in one HAI study is similar: "an advocate who takes ownership of the problem…and is willing to use his or her position to get a practice implemented by rallying others to help solve the problem. These individuals tend to be respected by others at the hospital and are persuasive. Having a champion who is highly placed in the organization, in addition to a respected unit-level champion (such as a nurse manager), facilitated the timely removal of catheters from patients…During our hospital visits, we saw firsthand the strong influence of the unit-level nurse manager champions" (Saint et al., 2008, 336).

Fostering cross-organizational collaboration and learning

Many of the efforts to reduce HAI came in the context of collaboration across multiple health-care providers. Organizational leadership was essential in deciding whether and to what extent such collaboration should be pursued. For example, a collaborative of thirty-six hospitals sought to reduce CLABSI rates in New York (Koll et al., 2008). When signing up to participate in the collaborative, hospital leadership had to sign an agreement stating they would be "committed to support their staffs' participation in specific activities, including learning sessions; identification of appropriate team composition; and embrace of an interdisciplinary, hospital wide approach to reducing infections," (Koll et al., 2008, 715). The article reported that leadership both committed to and played an active role in trying to reach zero tolerance for CLABSI. It was noted that consistent leadership involvement helped overcome physician reluctance and empower nurses.

Change the Culture

The second major factor that facilitated reinforcement was changing the organizational culture. Leadership has a central role in guiding the organizational culture (Schein, 1996), and in some aspects of culture described below (such as altering authority structures in the organization), leadership played an integral role.

The ability to reshape organizational culture is sometimes overestimated, since the pattern of norms and beliefs held by employees are often deeply embedded. In the studies reviewed, there were frequent observations about culture, but rarely was this part of a predetermined strategy. One study noted that creating a culture of patient safety "proved to be an ambitious and challenging task despite high-level support from senior leadership, general acceptance of the validity and importance of the targeted changes, and active participation of many frontline care providers" (Bonnello et al., 2008, 643).

Cultural change means taking on pre-existing beliefs. This could be about the acceptability of infections. For example, HAI-reduction efforts must battle the perception that infections are simply an inevitable part of health care. Interventions also challenged beliefs about the existing authority structures. Specifically, checklists both questioned the professional discretion of doctors and often empowered nurses to correct doctors if they missed a step. In effect, nurses are asked to publicly question the actions of individuals who enjoy higher status in the organization. This can be uncomfortable both for nurses and doctors. Without clear authority and supportive norms, it is unlikely that all will take this step.

<u>Fight embedded norms:</u> Until the organizational culture supports the intervention, there is a real danger that staff will come to view the processes promoted by the intervention as unnecessary red tape, leading to a slide back to old habits after a period of time (Munoz-Price et al., 2009, 1032; Rhodes et al., 2009). The concerns that care-givers have are therefore not trivial, but have to be faced and discussed rather than dismissed. To the extent that nurses have input in designing the decision process about the appropriate use of catheters, this appears to reduce resistance to the new interventions (Reilly et al., 2006). Researchers noted the need to pre-empt difficulties by communicating the benefits of the change. "We emphasized the positive trends in reducing monthly unit device days and rates of CAUTIs. We thought that the reductions in infections provided an upside to catheter discontinuance that helped balance nurses' worries about risks of skin breakdown and the additional work necessitated by more frequent hygiene interventions and linen changes for patients," (Elpern et al., 2009, 540).

One example of how embedded norms support sub-optimal practice is in the area of CAUTI. Here, indwelling catheters are a direct source of infection, and reducing unnecessary or inappropriate use of catheters offers the best way to reduce infection. These catheters are sometimes necessary, but sometimes remain in place because they are convenient for nurses (Elpern et al., 2009; Topal et al., 2005). Nurses and physicians sometimes justify resistance to interventions that reduce catheters by arguing that patients will be unable to tolerate the removal of a catheter (Reilly et al., 2004), but also have concerns about the additional workload and resource burdens (such as the more frequent use of external catheters, linens, and bath and skin care products) that a change demands (Elpern et al., 2009).

Interventions that created new guidelines to ensure patients received the appropriate antibiotic prophylaxis before operations ran into similar resistance. "The reasons given for non-compliance with guidelines or hospital recommendations were: the personal experience of the physician; difficulty or a perceived contamination during the operation; the belief that multiple doses are superior to one under their local conditions. One of the main concerns of our house staff was the possible increase in the rates of infection in our low-income population," (Fonseca et al., 2008, 81). In the HAI-reduction effort described by Fonseca et al., staff concerns were addressed rather than ignored. Surveillance and feedback of results played a large role in combating these fears. A similar response was used in another study, where feedback data was not just shared but actively discussed via regular meetings and qualitative reports where teams explained barriers faced and lessons learned (Jeffries et al., 2009, 646).

One insightful study of the application of prophylactic antibiotics incorporated a qualitative component that directly addressed reasons for staff resistance (Tan, Naik, and Lingard, 2006). Researchers conducted twenty-seven interviews with anesthesiologists, surgeons and perioperative administrators at two large academic hospitals. Analysis showed five themes emerging as obstacles to proper timing: (1) low priority: "both anesthesiologists and surgeons declared that antibiotics were a low priority among their many responsibilities" (Tan et al., 2006, 33); (2) inconvenience: "Because the most common prophylactic antibiotic, cefazolin, almost always came as a powder which then had to be reconstituted with saline, anesthesiologists reported being deterred from preparing it" (Tan et al., 2006, 34); (3) the proposed intervention disrupted the traditional workflow of the operation; (4) lack of communication about the timing and provision of antibiotics; (5) role perception: how responsibility for administering the antibiotic was defined. The common factor in these concerns was that a new intervention would disrupt the traditional approach that staff was accustomed to.

Reinforce new norms: Deliberate cultural change requires an ongoing strategy of communication, even after the intervention is in place. At this point, leaders and key staff need to communicate that the norms and values represented in the new process are here to stay. As described below, this can be done in a number of ways.

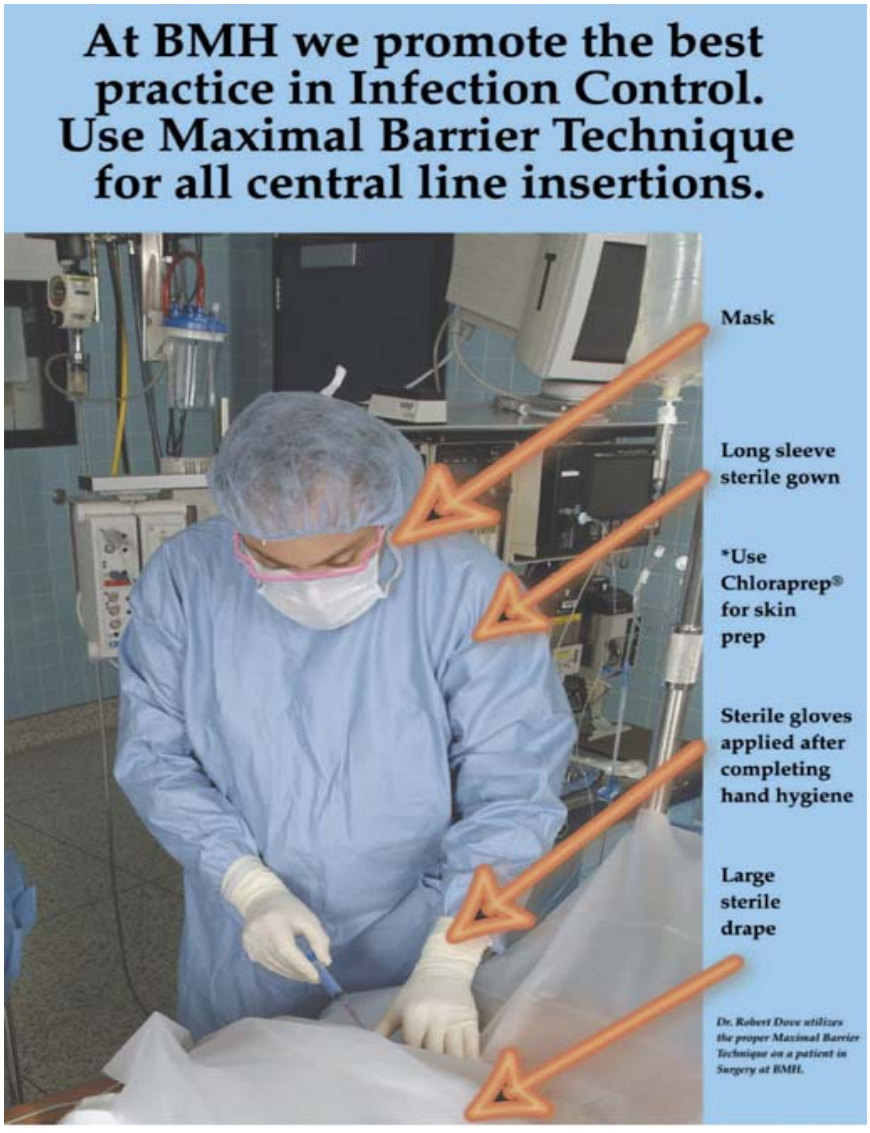
A study of CLABSI pointed to the role of daily rounds, led by the unit's nursing supervisor, in establishing adherence to the targeted procedures as "normal" behavior for staff members (Hatler et al., 2006; also Harrigan et al, 2006). Recognition of the adoption of new cultural values was also reinforced by thank-you notes and movie tickets for early adopters of changes (Hatler et al., 2006, 551).

New norms can be celebrated as a means of positive reinforcement. In one study, when a target of 100 days between catheter infections was achieved the unit celebrated with an ice cream party and gift card drawings (Curry et al., 2009). Other studies reported the use of visible awards (Harrigan et al., 2006), such as one intensive care units awarded "zero infection rate" certificates on a monthly basis (Venkatram et al., 2010). Such celebrations of achievement can make use of relatively inexpensive or symbolic rewards to reinforce desired behavior.

Norms can be facilitated by feedback from clients and social peers. One study reports the posting of thank-you letters from families in a public space and the use of "applause forms" by which staff could thank coworkers (Harrigan et al., 2006).

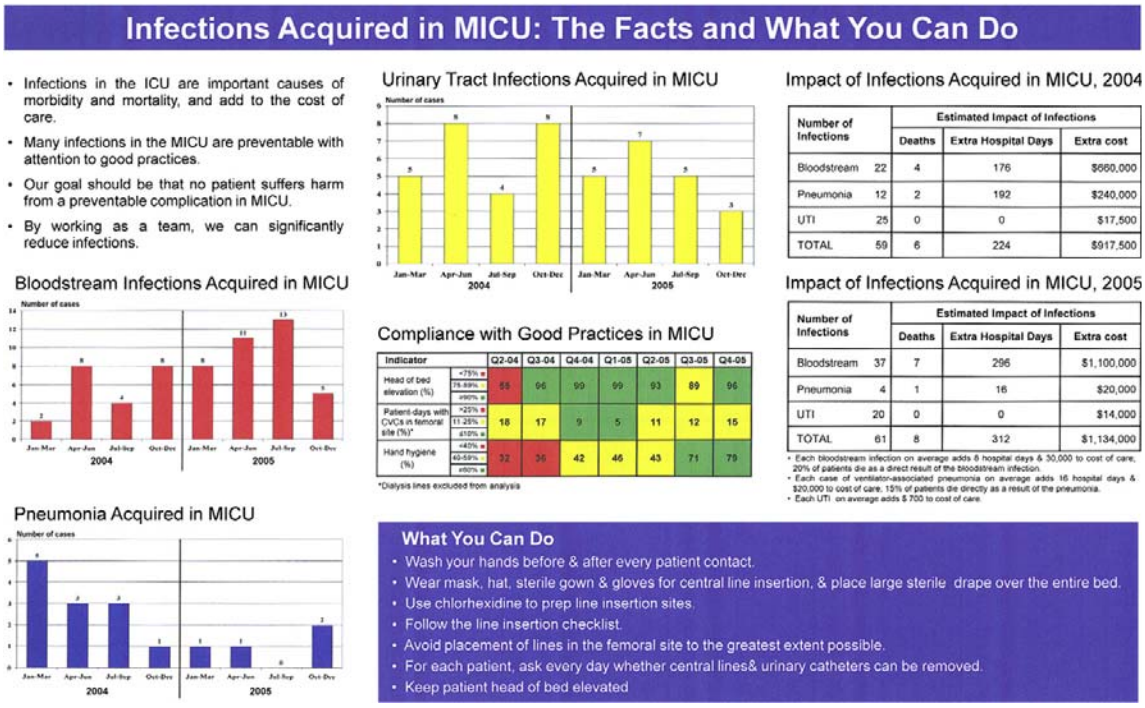
Another way by which organizations communicate norms is via cultural symbols (Schein, 1996). A number of studies report the use of posters or buttons to emphasize new values (Assanasen, Edmond and Bearman, 2008; Harrigan et al., 2006; Higuera et al., 2005; Warren et al., 2004; Stephan et al., 2006). See Figure 4 for an example. Posters sometimes emphasized technical information on appropriate procedures while still providing a daily reminder on the expectations that staff face (Coopersmith et al., 2004; Warren et al., 2004).

Figure 4: Promotional Poster
Source: Harrigan et al. (2006)



Finally, another common practice was to publicly present infection rates at a visible location on a regular basis (weekly or monthly), sometimes in the form of posters (Berenholtz et al 2004; Hatler et al. 2006; Warren et al., 2004). Figure 5 provides an example. The need for consistent feedback on performance will be discussed in more detail below, but the simple communication of progress on measures serves a key function in organizational culture: it directs attention to organizational goals, indicating their importance to employees. In one case, an intervention used a "traffic-light" approach to communicating rates on infection – units with lower infection received a green flag, while poor performers received a red flag (Frankel et al., 2005).

Figure 5: Performance Feedback Poster
Source: Assanasen et al. (2008)



Restructure authority to support change: The structure of organizational authority reflects and reinforces organizational culture (Hill and Lynn, 2009). A wide-spread characteristic of the interventions to reduce HAI was the disruption of existing authority patterns; to succeed, these initiatives need explicit support. Many interventions reduced physician discretion and encouraged lower-level staff to challenge physicians judgment if a step was missed or if appropriate procedures were delayed or not followed (Crouzet et al. 2007; Gotelli et al. 2008; Harrigan et al., 2006; Huang et al., 2004; Pronovost et al, 2006; Saint et al., 2009). This subverts the (usually unspoken) norms about hospital hierarchy, and can be both uncomfortable for both nurses and physicians. A basic tenet of organizational learning is that the natural response to criticism is defensiveness (Arygris and Schon, 1996). This creates a reluctance for nurses to voice a criticism and can create tensions when they do. How can these tendencies be overcome?

The existence of a checklist and a formal mandate to intervene makes nurses more willing to step in. In a study undertaken at John Hopkins Hospital, nurses were empowered to stop physicians if they skipped a step on the catheter insertion checklist (except in emergencies) and indicate if the procedure was stopped on the checklist (Berenholtz et al., 2004). Researchers discussed with both nurses and physicians that the nurse should page the SICU attending physician if the resident, after the nurse identifies a violation, fails to correct the violation. "A nursing intervention was required in 32% (12/38) of central venous catheter insertions… The SICU nurses also indicated that they found the form helpful in that they were more comfortable intervening if they observed a violation, because they felt that an expectation had been set and as a result, they were less likely to have an uncomfortable encounter with the physician inserting the central venous catheter," (Berenholtz et al., 2004, p2016).

The willingness to facilitate such checks on process is encouraged where staff perceives that they are jointly accountable for outcomes, rather than assuming that physicians are the ones who are accountable for errors. When nurses and physicians had difficulties with a change that allowed nurses to question physicians, "SICU leadership met with both groups of providers and emphasized our focus on patient safety and teamwork," (Berenholtz et al., 2004, 2018). Some nurse objections to overseeing checklists rested on the notion that: "It's not my job to police the physicians" (Bonnello et al., 2008, 642). One intervention that used an electronic system to remind physicians to remove unnecessary catheters and empowered nurses to remove catheters without a physician's order pointed to the "power of collaboration" between physicians and nurses as vital to their success (Topal et al., 2005). "We recognized that the 40-year culture of indwelling catheter use was an interdisciplinary norm and that the norm was likely motivated differently for doctors and nurses. Rather than trying to address the issues separately and assess blame for inappropriate catheter use, we shaped the program to promote shared accountability and responsibility between the disciplines. This joint culture shift occurred as a result of heightened awareness of the risks of catheterization and clear directives to avoid and to remove devices whenever possible. Only through this culture change could we have sustained and improved on our reduction in CAUTI over a 2-year period," (Topal et al., 2005, 126).

Ultimately, nurses must feel confident that organizational leadership will support them in overseeing physicians. It also helped if nurses had an immediate resource to call on to back them up. One study of thirty-six hospitals in New York noted the importance of empowering nurses to step in or comment when clinicians missed a step on their checklist (Koll et al., 2008). Nurses were often hesitant to step in when physicians were not compliant with central line protocols. During the intervention, hospital teams were able to contact an "expert-on-call" if they were experiencing resistance from a doctor. The expert-on-call provided guidance, solutions, and education for doctors on why changes were important. Nurses became more willing to intervene, the study reports, thanks to "consistent leadership involvement and reinforcement by physician and nurse champions," (Koll et al., 2008, 720).

Stage 5: Use Performance Data to Monitor and Evaluate

HAI is ultimately a performance problem, centered on the occurrence of undesired and preventable events. But health care providers have not traditionally used the tools of

performance measurement to manage this problem. In institutionalizing new processes, many of the interventions examined sought to establish performance reporting systems that would monitor outcomes, provide feedback to key organizational actors, induce a basic level of accountability, and, hopefully, spur ongoing organizational learning practices.

The study of performance management suggests that useful data have certain qualities: they reflect important goals that the organization has an influence on, can be disaggregated to the level where specific units can see their contribution, flow to individuals whose behavior impacts the performance outcome, and are available in a timely fashion so that a quick feedback loop is formed (see Bouckaert, 1993; Hatry, 2007). In short, effective performance information systems get the right information to the right people at the right time (Moynihan and Landuyt, 2009).

Create a context for performance

Performance scores by themselves, do not tell us much. To be more than just a set of numbers on a page, they need to be contextualized, i.e., accompanied by other information that helps to give a sense to users if performance scores are good or bad, improving or worsening. Some studies explicitly mentioned the importance of timely data (Collignon et al., 2007; Render et al., 2006; Ryckman et al., 2009). Regular data generates a sense of momentum about the intervention: "reliable and regular reporting of results also sustained enthusiasm for ongoing vigilance," report Collignon et al., (2007, 552). Timely data helps create a temporal context that enables users to make sense of results. Users have an easier time relating their actions to outcomes in limited and recent timeframes (for example, the last month) rather than longer periods (the last year).

There are other ways in which data can be contextualized. Identifying performance relative to a benchmark can give staff a sense of a realistic goal and motivate greater effort (Locke and Latham 2002). These benchmarks can be previous time periods (especially useful after an intervention in order to measure progress), a pre-set target, peers in a health-care collaborative, or national averages for equivalent health-care providers.

Measure outcomes and compliance

Performance indicators should be established during the design intervention (see, for example, Wall et al., 2005, 296 for a discussion of this process) and described clearly enough so that data is being collected in the same way by different individuals and units. At a minimum, a performance information system should be established to collect data on incidence of HAI events. However, a performance information system can also collect information on processes that lead to those outcomes, such as fidelity with guidelines through checklists (Mowbray et al., 2003). This is important because even if staff are educated on the need for a new intervention, they may not comply (Coopersmith et al., 2004, 133). In the absence of evaluations, many staff instead return to pre-intervention patterns approaches (Munoz-Price et al., 2009, 1032). However, performance monitoring and feedback serves to enhance compliance (Rosenthal et al., 2003, 407), suggesting the need for accountability systems that rely on something other than trust.

Provide Feedback

Collecting information is not enough; it must be actively disseminated. As noted above, posters were a frequent part of the communication process with staff, and these posters often included

process or outcome measures (Berenholtz et al., 2004; Hatler et al., 2006; Higuera et al., 2005; Warren et al., 2004). In other cases, data was shared in meetings with staff and leadership (Rosenthal et al., 2003).

A study in Cincinnati gives a sense of the range of techniques used and actors reached as performance data was disseminated (Render et al., 2006). "Each project leader reported processes and outcomes to the unit staff, usually posting the monthly project presentation slides on a bulletin board throughout the unit. Results were also reported through the preexisting hospital committee structure (for example, surgical service committee, infection control, critical care committee) in each organization and to the hospital as a whole through its newsletter. At the community level, project leadership reported outcomes of the project to the GCHC infection control and patient safety committees. Twice a year, project leadership informed the hospital CEOs of the results of the project, which compared local process adherence and outcomes to the mean of the group," (Render et al., 2006, 255). The authors concluded that "as the project progressed, reports of monthly process adherence alongside falling infection rates minimized resistance," (Render et al., 2006, 258).

Create Learning Forums

A classic problem with performance information systems is that much data is collected, but no-one uses it (Moynihan, 2008). Even if data is actively disseminated, there is still the challenge of how to establish routines that cause personnel to pay attention to data. One study emphasizes the importance of regular meetings where key personnel took the time to collectively consider the meaning of the data and next steps, finding that "a presentation of the data in front of the healthcare personnel of the department together with a careful interpretation of the results and a discussion about findings seems to be more stimulating for improving infection control activities" (Gastmeier et al., 2009, 13) than the simple provision of data. Such meetings can be characterized as "learning forums" – routine processes by which organizations seek to engage in a deliberate shared inquiry about key information (Moynihan, 2008).

Cross-institutional learning forums can be especially useful, since it widens the number of actors who have experimented with different initiatives and provides an opportunity for staff to swap ideas on which strategies work best (Gastmeier et al., 2008, 13). This helps explain the popularity of collaborative approaches to HAI-reduction (Campbell et al., 2009; Koll et al., 2008). Effective collaboratives of multiple health-care providers create a collective commitment (and social pressure) to reduce infections, and are also characterized as venues for idea-sharing that spur new initiatives at the hospital level.

One collaborative of private hospitals sought to apply the Veteran's Affairs National Surgical Quality Improvement Program in order to achieve its low level of infection. Members of the collaborative held semi-annual meetings to share information where participants discussed the data and implications. The authors ascribed the resulting reduction in postoperative morbidity as "probably a result of the periodic feedback of reliable comparative risk and outcomes data to the providers…(which) empowers surgeons and managers with information that enables local process improvement and, subsequently, improvement in outcomes," (Khuri et al., 2008, p334).

Another surveillance system also used semi-annual yearly workshops to consider the meaning of the data and "share experiences of successful or failing prevention strategies," (Geubbels et al., 2006, 128). One observation made by the researchers was that it took four years before the system appeared to result in reduced infection rates. This suggests that such new systems may take time to shape the culture. The reviewers suggest that the lesson is that "that infection control teams need to be perseverant and that surveillance programmes should be given time before evaluation," (Geubbels et al., 2006, 127). An alternative interpretation is that there is a significant difference between twice-yearly, versus monthly, learning forums. The latter will feel like a regular routine, part of an ongoing dialogue, while the former is an episodic commitment.

Organizational learning theory offers some suggestions about the ideal characteristics of learning forums. Learning forums are characterized by a non-confrontational approach to avoid defensive reactions, collegiality and equality among participants, and feature diverse sets of organizational actors responsible for producing the outcomes under review. They are dialogue centered, focused on organizational goals, and employ a mix of quantitative information and experiential knowledge of process and work conditions that explain successes, failures, and the possibility of innovation (Moynihan, 2008). These characteristics help avoid the natural defensiveness that individuals experience when performance is discussed. One study noted explicitly that leaders tried to overcome such defensiveness by having leadership emphasize that the data did not include individual identifiers, and was meant to encourage innovation rather than blame (Wall et al. 2005, 297). Such openness also facilitates a willingness to modify the intervention. For example, one study described that discussions of the performance of an intervention worked because project leaders were flexible enough to listen to reasonable objections to protocols, and modify as a result (Misset et al., 2004, 399; see also Hatler et al., 2006, 553).

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