Successful Reduction of Healthcare-Associated MRSA Infection Rates

Introduction

Approximately 70% of healthcare-associated infections (HAIs) in the United States are caused by antibiotic-resistant bacteria such as methicillin-resistant Staphylococcus aureus (MRSA), which is one of the most predominant and virulent pathogens in healthcare today. The Centers for Disease Control and Prevention (CDC) estimates that more than 126,000 hospitalized patients are infected with MRSA annually, with approximately 5,000 deaths. Hospitalized MRSA patients experience an increased length of stay approaching 9.1 days, associated with roughly $30,000 in additional costs per patient infection. Data from a study conducted by Davis et al. revealed that approximately 19% of patients with MRSA colonization at admission and 25% who acquire MRSA colonization during hospitalization actually become infected.2

During 2006, the Association for Professionals in Infection Control and Epidemiology (APIC) conducted a national MRSA prevalence study on inpatients at U.S. healthcare facilities. The results suggest that approximately 70% of MRSA isolates were most likely acquired in the hospital rather than brought in from the community.3

The Pennsylvania Health Care Cost Containment Council released a research brief in August of 2006, highlighting the incidence of MRSA in Pennsylvania hospitalizations for 2004. While the data does not distinguish between community-acquired and healthcare-associated infections, it does provide an in-depth look at the issues related to MRSA in the hospital setting throughout the state. The brief includes data on hospitalizations with MRSA by body system, summarized by condition, age group, and geographic location. The MRSA infection rate for 2004 was similar in hospitals of all sizes.4

An article in the December 2007 Pennsylvania Patient Safety Advisory discusses the fact that prompt identification and effective communication of the status of patients may result in a reduction of MRSA.5

A number of U.S. healthcare facilities have significantly reduced rates of MRSA transmission and associated infections. Success in transferring best practices to and replicating positive changes in other units or hospitals has been limited. In contrast, for more than two decades, MRSA infections have been significantly reduced or even eradicated in several European healthcare systems, compared to a far smaller number of U.S. healthcare facilities.6 These European countries achieved success through implementation of aggressive programs such as transmission-based control policies that included active surveillance cultures to identify colonized patients followed by strict isolation precautions for those patients. These contrasting results likely represent a difference in culture rather than a knowledge deficit. In Pennsylvania, some healthcare systems have successfully implemented system-based strategies to achieve cultural change. This article discusses two healthcare systems that have reduced and sustained a reduction in MRSA-related HAIs.

The VA Pittsburgh Healthcare System

The VA Pittsburgh Healthcare System (VAPHS) is an integrated three-division system consisting of 692 operational beds serving a veteran population of more than 58,869 unique patients. Services include acute care, long-term care, and behavioral health, as well as tertiary services such as cardiac surgery and solid organ transplantation.

In October 2002, VAPHS made a firm commitment to reducing HAIs. Its initiative, “Getting to Zero,” was developed with the goal of MRSA prevention. Working in partnership with the Pittsburgh Regional Healthcare Initiative and CDC, VAPHS designed and implemented the MRSA Prevention Initiative. A number of principles based on the Toyota Production System (TPS) (see “The Toyota Production System Approach”) were incorporated to identify specific organizational structures and processes related to HAI and MRSA transmission.7 The primary aim was to transform the organizational culture to improve compliance with hand hygiene and isolation procedures and thus reduce MRSA transmission and infection. The MRSA Prevention Initiative was initially implemented with dedicated supportive nursing and educational resources on a 36-bed general surgical unit over a four-year period, expanding to an 11-bed surgical intensive care unit in 2003, and followed by facilitywide implementation in 2005. Support from the medical center’s executive team was critical in achieving the goals. Key content and procedural strategies were identified using evidence-based guidelines proposed by the Society for Healthcare Epidemiology of America, APIC, and CDC.8

The following strategies were implemented and maintained:

- MRSA surveillance cultures were obtained. Nares swabbing was conducted on every patient on admission, discharge, or transfer, followed by notification to the unit staff in a timely fashion of positive results.

- Prompt isolation precautions were instituted, which were applicable to staff and visitors. Contact precautions were initiated for colonized and infected patients. This included wearing gowns and gloves when providing care and masks if the patient had MRSA pneumonia. Visitors were also instructed to adhere to hand hygiene protocols on entry and exit to the patient’s room but were not required to wear gowns and gloves. Red tape was strategically placed on the floor in the patient’s...
room to alert staff and visitors that contact precautions were in place.

- Weekly MRSA briefings were conducted, which included the executive team, unit staff (e.g., nursing environment management), and infection prevention and control, to share the unit’s successes and to identify resources and barriers needing administrative intervention.

- Aggressive hand hygiene protocols before and after patient contact were instituted. A hospitalwide education campaign on hand hygiene was developed for the benefit of staff and visitors. Posters were visibly placed on each unit.

- Barriers to hand hygiene were removed. Alcohol handrub dispensers were placed at the entry/exit of patient rooms and other staff-identified locations.

- Staff were provided with hand hygiene training in the form of in-services and online tutorials to increase awareness.

- Hand hygiene compliance was observed. Staff monitored usage patterns of alcohol hand sanitizer on the units and performed visual observation of hand hygiene practices.

- Executive management support for resources (equipment and supplies) was obtained.

- Systems for terminal cleaning of all the patient’s rooms and adequate disinfection of shared equipment were implemented.

- Formal reporting of MRSA and HAI transmission rates to staff and hospital management was maintained.

- Ancillary departments such as physical therapy were provided with updated lists of colonized/infected patients for the purpose of appropriate scheduling of patients to prevent transmission.

The ultimate goals of this initiative were realized through changing workflow patterns, eliminating impediments to compliance with established infection prevention and isolation procedures, and enlisting committed staff and senior executive support for cultural transformation. As a result of the sustained and significant reduction in MRSA-related infections, the MRSA Prevention Initiative expanded to include

The Toyota Production System Approach

The Toyota Production System (TPS) approach is a systems engineering strategy used in manufacturing. The central principle is that all work processes are controlled experiments continuously being improved by the people doing the work. TPS relies on the workers controlling the change, thereby allowing more work efficiency and success. The TPS model holds that people are the most significant corporate asset and that investments in their knowledge and skills are necessary to build competitiveness. Managers are expected to be able to perform the jobs of everyone they supervise and also to teach their workers how to solve problems according to the scientific method. The leadership model applies as much to first-level team leader supervisors as it does to those at the top of the organization. This evolves into a cascading pathway for teaching, which starts with managers delivering training to each employee.

The main objectives of the TPS approach are to design out excess work and inconsistency and to eliminate waste. The challenge with TPS is to facilitate a culture change so that staff adopts the TPS approach and related interventions as a component of the traditional work process. A cultural transformation allows an organization to reach its goals, anchor the changes in practice, and sustain ongoing compliance. Since TPS relies on the workers controlling the change, staff are engaged, empowered, and provided resources to be successful. Shared decision-making improves staff satisfaction.

The principles of TPS include using a rigorous problem-solving process that requires a detailed assessment of the current state of affairs and a plan for improvement that is, in effect, an experimental test of the proposed changes. Managers who employ TPS do not tell workers and supervisors specifically how to do their work. Rather, they use a teaching and learning approach that allows their workers to discover the rules as a consequence of solving problems. Identifying problems is just the first step. In order for people to consistently make effective changes, they must know how to change and who is responsible for making the changes. TPS explicitly teaches people how to improve and does not expect them to learn strictly from personal experience. TPS creates ownership by holding staff accountable.1

The Four Rules of TPS

1. All work shall be highly specified as to the content, sequence, timing, and outcome.

2. Every “customer supplier” connection must be direct, and there must be an unambiguous yes-or-no way to send requests and receive responses.

3. The pathway for every product and service must be simple and direct.

4. Any improvement must be made in accordance with the scientific method, under the guidance of a teacher, at the lowest possible level in the organization.

Note

other VAPHS units, and ultimately, a national Veterans Health Administration (VHA) directive was instituted.

**Rationale/Motivation for Instituting the Initiative**

VAPHS employed TPS in order to make the necessary system changes, which enabled the healthcare worker to implement active surveillance and appropriate precautions. The challenge was to facilitate a culture change so that nursing staff employed TPS and related interventions as a component of the traditional nursing process. This cultural transformation was regarded as necessary to achieve the goal, as well as to anchor the changes in practice and sustain ongoing compliance. Since TPS relies on the workers controlling the change, nursing staff were immediately engaged, empowered, and provided with the resources to be successful. One aspect of TPS was to change work to be more efficient. Staff satisfaction increased in the area of shared decision making. Specifically, in comparison to all VAPHS acute inpatient units, the nurses working on the piloted 36-bed nurse coordinator and the changes recommended by the “father of PD,” described positive deviants as “people whose behavior and practices produce better solutions to prevalent, seemingly intractable problems already exist within the community. PD projects can sustain themselves because they are founded on the already-present capacity of people to discover and implement home-grown solutions to long-standing problems.蒲

The PD approach has six steps:

**Define.** The group begins its work by defining the problem and describing what success would look like—the inverse of the problem statement.

**Determine.** The group determines whether there are individuals who have already achieved success (i.e., positive deviants).

**Discover.** The group discovers the uncommon but demonstrably successful behaviors and practices used by the positive deviants to solve the problem.

**Design.** The group designs an intervention, which enables its members to practice those demonstrably successful practices.

**Discern.** The group discerns the effectiveness of the intervention, which is determined by ongoing monitoring and evaluation.

**Disseminate.** The group makes the intervention accessible to a broader constituency.

**Notes**


staff. The coordinator engaged all interdisciplinary team members associated with patient care on the unit, including environmental services, management, physical therapy, and laboratory personnel. Through the engagement of surgical staff, collaborative rounds were established, which helped achieve a decreased length of stay from 6 to 4.5 days. Management supported by providing resources and/or removing barriers (modified hospital systems) when needed. During expansion of the initiative to all acute and long-term care units, VAPHS dedicated a new, full-time MRSA prevention coordinator position to long-term care.

In transitioning to PD, focus group discussions inspired a core group of interdisciplinary volunteers to solve problems. Select long-term care residents assisted with changing the behavior of fellow veterans (e.g., performing hand hygiene). Referencing guidelines from Partners in Care,11 staff and residents discussed how imperative hand hygiene is to preventing infections and created a hand hygiene educational pamphlet for fellow veterans. This approach, coupled with the Joint Commission National Patient Safety Goal 7 (compliance with World Health Organization and/or CDC hand-hygiene guidelines),12 made VAPHS successful in achieving its goals for “Getting to Zero.”

Scope of Initiative

VAPHS adapted TPS as a strategy to reduce the transmission of MRSA infection on a 36-bed general surgical unit over a four-year period, expanding to an 11-bed surgical intensive care unit for the last 18 months of the initiative. Implementation was accomplished by changing workflow patterns, identifying and eliminating impediments to compliance with established infection prevention and isolation procedures. Regular reporting of MRSA HAIs and transmission rates to staff and hospital management was a key component of change. These changes were sustained over time to improve compliance with isolation procedures and reduce MRSA infection rates. This initiative has been sustained throughout the organization for approximately six years—as evidenced by a reduction in MRSA HAI, a sustained increase in the use of personal protective equipment (PPE), and improved hand hygiene compliance rates.

The VAPHS results serve as a model for MRSA reduction efforts regionally, nationally, and internationally. Of particular note are the collective campaigning efforts with the U.S. Department of Veterans Affairs, which resulted in a rollout of the initiative to all 165 VHA facilities in the United States in March 2007.

Impact

Process Improvement. The key process monitors were hand hygiene and contact precaution compliance. Staff ownership of the process drove both the clinical and systems improvement of this initiative. Active surveillance culture compliance rose significantly in both acute and long-term care settings. Observation data from March 2007 reflected a significant improvement in hand hygiene compliance rates for both acute and long-term care. This data includes a 63% compliance rate with entry hand hygiene and 88% with exit hand hygiene in comparison to March 2006, whereby the entry hand hygiene compliance rate was reflected as 48% and exit hand hygiene at 76%. With the heightened awareness of MRSA and infection precautions, the use of PPE also increased.

Nursing-Sensitive Quality Indicators. The outcome measures were MRSA HAIs and MRSA transmissions. From 2004 to 2008, the infection rate in acute care decreased from 0.94 per 1,000 bed-days of care (BDOC) to 0.25 per 1,000 BDOC (see Figure 1). Long-term care rates decreased from 0.54 per 1,000 BDOC in 2005 to 0.33 per 1,000 BDOC in 2006 (See Figure 2).

Figure 1. VAPHS Acute Care Campus MRSA Healthcare-Associated Infections, 2004 through 2008 Fiscal Years

![Figure 1](https://example.com/fig1.png)

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Figure 2. VAPHS Long-Term Care Campus MRSA Healthcare-Associated Infections, 2004 through 2006 Fiscal Years

![Figure 2](https://example.com/fig2.png)

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A systemwide impact has been sustained to date because of the quality of care delivery and healthcare cost avoidance. Examples of tangible costs include the following:

- Twenty-two MRSA cases at $34,369 per case = $756,118.
- Cost of MRSA screening 2,536 total cases at $21.84 for 2 lab cultures = $110,772.
- Opportunity savings valued at $756,118 - $110,772 = $645,346.

**Albert Einstein Healthcare Network**

Albert Einstein Healthcare Network (AEHN) is a 1,200-bed integrated delivery network serving the communities of North Philadelphia and Montgomery County, Pennsylvania. The network provides healthcare services through the Albert Einstein Medical Center and Einstein at Elkins Park hospitals, Moss-Rehab and Belmont Behavioral Health divisions, Germantown Community Health Services, Willow Terrace (a nursing home), Willowcrest (a center for subacute care), outpatient facilities such as Center One and Einstein Neighborhood Healthcare, and a network of primary care and specialist practices throughout the community.

During 2006, 107 patients developed MRSA-related HAIs at the medical center. These patients had an 8.3% higher mortality, an increase in average length of stay of 19.75 days, and an increase in average variable costs of $33,347 compared to matched patients who had not acquired a MRSA-related HAI. The percentage of clinical isolates of MRSA steadily increased over the years and was approaching 70% in 2006. No surveillance cultures were being performed for MRSA, and hand hygiene compliance was variable, averaging 40% to 60%. PPE was often unavailable upon entry to isolation rooms.

In May 2006, driven by concern for the increasing incidence of MRSA together with unacceptable compliance rates of hand hygiene, the medical center took steps to develop and implement a MRSA reduction program known as SMASH (Stop MRSA Acquisition and Spread in our Hospital) by using the PD approach. PD encourages the kinds of cultural changes that help people consistently adhere to practices known to control infections. The staff at Einstein rapidly took ownership of developing the initiative. Pilot projects began on the brain injury unit at MossRehab, a surgical intensive care unit, a 20-bed oncology and transplant unit, and a “step-down” unit. Multidisciplinary teams of hospital staff began to examine their own roles in preventing infections.

Risk reduction strategies similar to those of the VAPHS program were instituted, using evidence-based guidelines for preventing transmission and acquisition of MRSA. Of note at the medical center were the dedication and devotion of staff members to sustaining the program for the benefit of patient safety. The medical center held regular and spontaneous meetings, employing the “discovery and action dialogues” approach. The Plexus Institute provided PD consultants to the medical center.

Results one year later revealed that PD is “about people in the community identifying the problems you can’t see from the outside, and coming up with novel ideas that work for them, right there,” according to a key player in the SMASH initiative. “It’s about community ownership because [when] solutions are community-driven, they are likely to be accepted. People don’t reject their own solutions.”

During 2006, a rate of 0.535 infections per 1,000 patient-days was reported. Sixty-five cases of alcohol-based gel and 33,000 gowns were used per quarter.

By 2007, the number of MRSA-related HAIs had decreased to 0.408 infections per 1,000 patient-days. In the first quarter of fiscal year 2008, the rate decreased by 27%, or 0.39 infections per 1,000 patient-days (2008 data not reflected in Figure 3). Alcohol-based gel use had increased to 125 cases, and 80,000 gowns were used per quarter. Based on the decreasing HAI rates and increasing compliance with hand hygiene and isolation precautions, the PD approach was expanded to all the units.

**Summary of VAPHS and Einstein Programs**

The nurse-led interdisciplinary projects at both the VAPHS and AEHN programs demonstrate that initiatives to control healthcare-associated MRSA can lead to a significant, sustained reduction in MRSA infection in medical facilities in which MRSA had become highly endemic. Lessons learned include the ability to introduce a change in culture by empowering staff to take ownership of the initiative. By taking ownership, staff developed the ability to change the behavior

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**Figure 3. AEHN MRSA Healthcare-Associated Infections, 2006 through 2007**

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around infection control practices. Staff ownership has far more of an impact than the traditional educational programs alone. The TPS approach empowered VAPHS staff to change systems and processes. Through the PD approach, both VAPHS and AEHN created and implemented staff-owned and -operated MRSA prevention programs that are efficient, measurable, and sustainable. In addition, the success at both VAPHS and AEHN is also credited to support from the health system administration teams, who diligently supported the housewide initiatives and took great pride in attaining their HAI reduction goals.

Notes


