



## Surgical Site Infection Prevention Utilizing Patient Screening and Decolonization: The PA-HEN SSI Prevention Collaboration

James Davis, MSN, RN, CCRN, CIC, HEM  
Senior Infection Prevention Analyst  
Pennsylvania Patient Safety Authority

Mary Catanzaro, BSMT(ASCP), RN, CIC  
Project Manager, Healthcare-Associated Infections  
Clare Edelmayer, MS, RN, MT(ASCP), CIC  
Project Manager, Healthcare-Associated Infections

Lynda Martin, MPA, BSN, RN  
Director, Pennsylvania Hospital Engagement Network

The Hospital and Healthsystem Association of Pennsylvania

### ABSTRACT

*Infection prevention interventions rarely engage the patient in the infection prevention process. Through the Partnership for Patients, the Hospital and Healthsystem Association of Pennsylvania (HAP) and the Pennsylvania Patient Safety Authority developed the initial surgical site infection (SSI) prevention project design, then HAP collaborated successfully with 40 participating hospitals to empower patients for the prevention of SSIs. The intervention included systematic screening and decolonization of surgical patients prior to the day of surgery. Baseline standardized infection ratio (SIR) aggregates in 2010 and 2011 were 1.274 and 1.167, respectively, while the SIR aggregates postintervention in 2012 and 2013 were 0.797 and 0.735, respectively. This work adds to the body of knowledge related to successful reduction of SSIs through screening and decolonization and also adds important information about the impact of empowering patients and institutional partners to augment prevention protocols to fit institutional culture and the needs of the patient. (Pa Patient Saf Advis 2014 Sep;11[3]:131-5.)*

### Corresponding Author

James Davis



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### INTRODUCTION

The Hospital and Healthsystem Association of Pennsylvania (HAP) is one of only 26 Hospital Engagement Networks (HENs) as part of the federal Partnership for Patients (PfP) campaign. The PfP is a three-year initiative with two overarching goals to be achieved by the end of 2014: reduce preventable harm by 40% and reduce readmissions by 20%. These goals are to be accomplished through the partnering of HENs and acute care hospitals on improvement work across the most common preventable hospital-acquired conditions, as well as work on targeted focus areas.

HAP formed the Pennsylvania Hospital Engagement Network (PA-HEN) to provide Pennsylvania hospitals with opportunities to enhance the patient healthcare experience through participation in collaborative programs and with a portfolio of projects designed to reduce preventable harm and readmissions. HAP leads and directs the PA-HEN collaboration along with its four subcontractor partners, one of which is the Pennsylvania Patient Safety Authority. HAP partnered with the Authority for leadership on several HEN projects for which the Authority had a proven track record and, through the use of Authority experts, developed the initial SSI prevention intervention design, methodology, and preparation related to education and tool kit development.\*

When it comes to making surgery safer from an infection prevention standpoint, there have been previous efforts through the National Surgical Infection Prevention Project and the Surgical Care Improvement Project.<sup>1</sup> However, the interventions rarely actively engage the patient in the infection prevention process. HAP and the Authority sought to design an intervention that would actively engage patients in their care. As such, HAP and the Authority focused on active screening and decolonization as the main intervention for the PA-HEN collaboration. The Authority had previous experience with the Western Pennsylvania SSI collaboration of 2011, which required patient participation as part of the decolonization protocol prior to the day of surgery. Lessons learned from the Western Pennsylvania SSI collaboration were incorporated into the SSI reduction initiative under the PA-HEN collaboration. See "Western Pennsylvania SSI Collaboration," exclusively available in the online version of this article.

### METHODS

#### Collaborative Approach

To best inform development of the PA-HEN SSI prevention and reduction project design and interventions, Authority analysts queried the National Healthcare Safety Network (NHSN) database to determine which pathogens most commonly caused SSIs. Table 1 depicts the results of that query. *Staphylococcus aureus* had a marked effect on those procedures selected, and there were, in most instances, a greater number of incidences of methicillin-susceptible *S. aureus* (MSSA) than methicillin-resistant *S. aureus* (MRSA). Since preoperative patient participation would be required for the intervention to be successful, the Authority also assessed for the incidence of SSI related to elective, clean procedures. Baseline data for 2010 and 2011 was compared with postintervention years 2012 and 2013 by means of standardized infection ratio (SIR).

Interventions that include active screening and decolonization to control both MSSA and MRSA have been published. The majority of these interventions and results have

\* The analyses upon which this publication is based were in part funded and performed under contract number HHSM-500-2012-00022C, entitled "Hospital Engagement Contractor for Partnership for Patients Initiative."



been documented in the orthopedic literature.<sup>29</sup> The following *S. aureus* targeting protocol was designed by HAP, PA-HEN, and the Authority:

**Overview**

- Preoperative screening of the elective surgical patient is to be performed via the anterior nares for the presence of MRSA and MSSA.
- Patients are to bathe daily with 4% chlorhexidine gluconate (CHG) or 2% cloths the night before and the morning of the day of surgery.
- Patients who screened positive for MSSA or MRSA will apply mupirocin 2% nasal two times a day for five days before surgery.
- Patients are to receive a day-of-surgery cleansing of the surgical site with 4% CHG applied by a health-care worker or 2% cloths.
- Patients are to receive prepping of the surgical site in the operating room suite with an alcohol-based product designated as a surgical skin preparation.

**Office Visit**

If the planned procedure is one of the procedures that is eligible for the decolonization intervention (elective/nonemergent):

- Patient education is to be provided related to screening and the intervention (verbally).
- The patient is to be screened for *S. aureus* if there is no preadmission testing policy.
- Written patient educational materials are provided to the patient.
- Preadmission (preoperative) appointment is optimally scheduled at least seven days before surgery.

**Preadmission/Preoperative Visit Scheduled at Least Seven Days Prior to Surgery**

- The patient is to be informed by phone of the screening result.

- Education, both written and verbal, is to be provided related to the screening result.
- The patient is then assigned to a decolonization protocol.
- Written and verbal education is provided related to the protocol, data collection, and expectations.
- Prescriptions and any other materials are then provided or called into the pharmacy for the patient.
- If MRSA-positive, ensure staff consults with infection prevention.
- The patient has the overall responsibility to comply with the protocol assigned to him or her based on the screening result.
- The patient will have access to a professional if questions arise or if there are concerns related to the decolonization process.
- The patient needs to have access to the decolonization supplies.
- Either prescriptions or supplies are provided by the facility.
- The patient should be informed of the importance of compliance and documentation of compliance using the provided forms.
- If the patient is unable to comply for any reason, staff may consult with family or other services.

**Acute Care**

- During patient admission, patient compliance data forms are collected and forwarded to the appropriate department by the healthcare worker.
- Application of infection control measures by staff may be considered as per facility policy (for example, contact precautions).
- Day-of-surgery preoperative CHG wipe of surgical site is done by the healthcare worker.
- Screening results are communicated to operating room staff.

**Operating Room**

- Application of infection control measures is to be implemented by staff as per facility policy (e.g., contact precautions).
- Operating room decolonization checklist is then completed by health-care staff.
- Completed decolonization checklist is forwarded to the appropriate department.
- Patient’s surgical site is prepped in the surgical suite with alcohol-based surgical skin prep by the operating room team.
- Immediate preoperative incision site skin prep is allowed to dry prior to procedure start.

**Institutional Recruitment and Support Framework**

In early 2012, Pennsylvania hospitals were invited to join the PA-HEN SSI prevention and reduction immersion project. Forty hospitals, collectively known as the immersion group, elected to participate in the project and completed a signed senior executive commitment form. In May 2012, the HAP PA-HEN project managers launched the SSI project and have conducted at least one or more activities per month throughout the duration of the project.

Core activities of the PA-HEN SSI prevention project include the provision of ongoing technical assistance; monthly education, including content calls and webinars by national expert faculty; sharing of evidence-based practices, resources, and tools; coaching calls; networking events; and the opportunity to share and spread learning and best practices for broad applicability and implementation. These activities utilize various interactive formats such as “All Teach, All Learn” and facilitate peer-led discussions, information sharing, and coaching. These activities provide updates on project results, successes, challenges, lessons learned, and action

Table 1. Prevalence Analysis of Pennsylvania National Healthcare Safety Network 2010 Data for Selected Procedures

| PROCEDURE                  | NO. OF INFECTIONS | NO. OF CLEAN WOUNDS* | NO. OF MRSA† (% OF TOTAL INFECTIONS) | NO. OF MSSA‡ (% OF TOTAL INFECTIONS) |
|----------------------------|-------------------|----------------------|--------------------------------------|--------------------------------------|
| Breast surgery             | 156               | 90                   | 26 (16.7)                            | 55 (35.3)                            |
| Hip prosthesis             | 321               | 313                  | 83 (25.9)                            | 88 (27.4)                            |
| Knee prosthesis            | 345               | 341                  | 55 (15.9)                            | 92 (26.7)                            |
| Laminectomy                | 193               | 155                  | 31 (16.1)                            | 86 (44.6)                            |
| Limb amputation            | 70                | 21                   | 16 (22.9)                            | 12 (17.1)                            |
| Open reduction of fracture | 299               | 165                  | 67 (22.4)                            | 78 (26.1)                            |
| Pacemaker surgery          | 93                | 53                   | 25 (26.9)                            | 32 (34.4)                            |
| Spinal fusion              | 370               | 295                  | 69 (18.6)                            | 143 (38.6)                           |

\* Wounds classified as “clean” according to the National Healthcare Safety Network definition

† Methicillin-resistant *Staphylococcus aureus*

‡ Methicillin-susceptible *Staphylococcus aureus*

plans for implementation to close the gaps, as well as to provide tailored technical and educational assistance to hospitals. Utilizing focus group feedback, PA-HEN project managers made modifications to the protocol and toolkit previously developed by the Authority and disseminated it to participating immersion group hospitals. The toolkit consisted of educational materials for the staff and patients, checklists, data collection tools, and protocol algorithms.

### Statistical Approach

All 40 hospitals participating in the immersion group entered their infection data into the NHSN. Rights to the data were conferred to the collaboration by the participants. Authority analysts retrieved the data from the NHSN for the analysis presented herein using the facility identification numbers specific to the NHSN. The SIR formula was used for comparative purposes. SIR represents the actual number of infections divided by the predicted number of expected infections. The predicted number of infections is risk-adjusted for procedure type and is based on national baseline data collected by the NHSN. If the SIR is less than 1.0, the actual number of infections is less than predicted. SIRs were calculated by

entering the data into the NHSN SIR analytic calculator. The immersion group hospitals started their SSI interventions in 2012. Results are presented in Table 2.

### RESULTS

Baseline SIR aggregates in 2010 and 2011 were 1.274 and 1.167, respectively, and the SIR aggregates postintervention in 2012 and 2013 were 0.797 and 0.735, respectively. The greatest reductions in SIR from baseline to the end of 2013 were in the following procedure categories: colon, cesarean section, hip replacement, knee replacement, and laminectomy (NHSN procedure codes COLO, CSEC, HPRO, KPRO, and LAM, respectively).

Pacemaker (NHSN code PACE) SIR decreased; however, due to small sample size, the SIR remains significantly greater than 1.0. The same holds true for hernia repair (NHSN code HER) in years 2010 and 2011 as far as sample size. Note, however, the sample sizes for 2012 and 2013 are greater than the baseline in 2010 and 2011; therefore, meaningful comparison is difficult especially since the SIR for HER in 2013 is greater than in 2012.

Coronary artery bypass graft with both chest and donor site incisions (NHSN code CBGB) and coronary artery bypass

graft with chest incision only (NHSN code CBGC) seemed to run without much change from baseline. Preoperative prepping and decolonization has been performed in this group of surgical patients for some time.<sup>10</sup>










Reductions were also noted in HPRO and KPRO despite the fact that the majority of the orthopedic literature supports screening and decolonization. This intervention in most cases stretched out the decolonization process and may warrant further investigation, as it seems that (at least in this study) orthopedic replacement SIRs are able to be reduced.

Finally, the aggregate SIR shows a baseline reduction over time that falls below an SIR of 1.0 postimplementation.

### DISCUSSION

Implementing an intervention to prevent *S. aureus* SSI, as described above, requires engagement and dedication of healthcare workers and patients. If the healthcare team fosters patient autonomy through empowerment in terms of active participation of patients in caring for themselves, preventing preventable infections is possible. These intervention results are repeatable by following a standardized protocol for screening and decolonization.

Table 2. Pennsylvania Hospital Engagement Network Immersion Group SIRs by National Healthcare Safety Network Surgical Procedure Code, by Year

| PROCEDURE CODE | 2010          |            |              | 2011          |            |              | 2012          |            |              | 2013          |            |              | SIR TREND LINE                                                                      |
|----------------|---------------|------------|--------------|---------------|------------|--------------|---------------|------------|--------------|---------------|------------|--------------|-------------------------------------------------------------------------------------|
|                | # Proc        | # Inf      | SIR          | # Proc        | # Inf      | SIR          | # Proc        | # Inf      | SIR          | # Proc        | # Inf      | SIR          |                                                                                     |
| CARD           | 2,610         | 9          | 1.010        | 2,454         | 9          | 1.081        | 2,740         | 10         | 1.104        | 2,814         | 6          | 0.640        |  |
| CBGB           | 1,963         | 21         | 0.887        | 1,789         | 16         | 0.729        | 1,737         | 20         | 0.960        | 1,713         | 17         | 0.837        |  |
| CBGC           | 280           | 2          | 0.559        | 248           | 2          | 0.639        | 303           | 2          | 0.525        | 273           | 2          | 0.577        |  |
| COLO           | 677           | 43         | 2.069        | 769           | 41         | 1.747        | 3,117         | 55         | 0.605        | 3,273         | 74         | 0.729        |  |
| CSEC           | 284           | 3          | 1.796        | 399           | 7          | 2.896        | 4,326         | 13         | 0.593        | 4,273         | 18         | 0.800        |  |
| HER            | 95            | 15         | 9.836        | 100           | 21         | 13.444       | 676           | 11         | 1.401        | 592           | 16         | 1.919        |  |
| HPRO           | 5,587         | 58         | 1.143        | 5,889         | 53         | 0.983        | 5,903         | 54         | 1.023        | 5,765         | 34         | 0.664        |  |
| HYST           | 3,756         | 24         | 0.828        | 3,365         | 30         | 1.143        | 3,304         | 20         | 0.731        | 3,047         | 20         | 0.775        |  |
| KPRO           | 10,169        | 65         | 1.000        | 10,579        | 45         | 0.677        | 10,972        | 48         | 0.688        | 10,351        | 28         | 0.432        |  |
| LAM            | 716           | 19         | 5.001        | 556           | 13         | 4.206        | 1,192         | 10         | 1.504        | 1,502         | 14         | 1.743        |  |
| PACE           | 76            | 7          | 46.053       | 110           | 9          | 40.909       | 80            | 5          | 31.250       | 86            | 3          | 17.442       |  |
| <b>Total</b>   | <b>26,213</b> | <b>266</b> | <b>1.274</b> | <b>26,258</b> | <b>246</b> | <b>1.167</b> | <b>34,350</b> | <b>248</b> | <b>0.797</b> | <b>33,689</b> | <b>232</b> | <b>0.735</b> |  |

Note: # Proc = number of procedures; # Inf = number of infections; SIR = standardized infection ratio; CARD = cardiac surgery; CBGB = coronary artery bypass graft with both chest and donor site incisions; CBGC = coronary artery bypass graft with chest incision only; COLO = colon surgery; CSEC = cesarean section; HER = herniorrhaphy; HPRO = hip prosthesis; HYST = abdominal hysterectomy; KPRO = knee prosthesis; LAM = laminectomy; PACE = pacemaker surgery

It is easy to treat patient compliance like a variable, even trying to control for the variable. In an intervention as described herein, patient compliance is a variable; however, as per the results of this intervention, even the variable of limited noncompliance is minimized in the result simply because it is positive. In other words, if the intervention of CHG bathing by the patient was performed less than optimally, the patient was empowered even if they were noncompliant with the intervention; furthermore, the patient was autonomous. While providing the patient with autonomy may not lead to 100% compliance, in this example, any compliance could affect colonization. Therefore, empowering the patient and allowing for autonomy may lead to healthcare-associated infection (HAI) reduction through better compliance with the intervention as compared with zero compliance, hence decreasing SSI risk.

As noted by Sharp et al., “Empowering patients does not require disclosing all

risks, regardless of magnitude and probability. However, patients should be provided with information when the risks in question are material, that is, when they could alter the decisions of reasonable persons who can respond in some beneficial way [such as compliance with decolonization protocols]. . . . HALs often constitute a material risk, although this determination depends on a wide variety of factors, including the particular patient and the institution.”<sup>11</sup>

A variable in this intervention is that the patient may be unable or unwilling to react to the risk in any beneficial way and engage in prevention. For example, a patient may be unable to perform activities of daily living (bathing with CHG) despite wanting to react in a beneficial way to the risk of SSI after they are informed of the risk. When patients are eligible for intervention, the team can take a holistic approach and provide solutions for limitations patients may encounter during performance of the intervention.

Similarly, institutions involved in the intervention may have the same needs for autonomy as the patients. Allowing facilities or institutions to modify protocol despite an evidence base supporting the intervention goes against a purely scientific approach. As Baudrillard observed, “It is science that masters the objects, but it is the objects that invest it with depth.”<sup>12</sup> The authors note that within an intervention this complex—spanning from prehospital to the moment the skin is incised and beyond—if one tries to control for institutional cultural variation, the collaboration may not move past kickoff. The collaboration leaders did allow for modification of the Authority’s proposed protocol if the modification was supported by the scientific literature and met the intent of the intervention, the patient being involved and empowered to react to the risk of SSI. The *objects* (institutions and patients) were able to invest depth into the science of SSI prevention rather than being constrained by a rigid protocol.

Examples of institution-based modifications to the protocol supported by the PA-HEN collaboration are as follows:

- Povidone-iodine 5% nasal solution on the day of surgery substituted in lieu of mupirocin
- Bathing protocol shortened
- Preadmission appointments shortened or lengthened from seven days
- Modification of teaching forms, educational materials, and checklists

In addition, institutions could choose any surgical procedures they wanted to focus on as long as local epidemiological evidence pointed to *S. aureus* as having an impact on the procedure(s) selected.

## CONCLUSION

This work adds to the body of knowledge related to successful reduction of SSI through screening and decolonization and also adds important information about the impact of empowering patients and institutional partners to augment prevention protocols with evidence-based

modifications that fit institutional culture and the needs of the patient. Furthermore, this work begins to replicate the work done in the orthopedic and cardiac realm for other surgical types. Further research may be warranted regarding prevention of SSI through evidence-based screening and decolonization interventions and protocols that seek to empower the patient by allowing them to participate actively in the prevention of infection.

The authors do caution those who wish to prevent SSI or potentially eradicate *S. aureus* and choose not to perform routine long-term mupirocin susceptibility testing. As stated in a Society for Healthcare Epidemiology of America guideline, “Any program attempting eradication of carriage should incorporate plans for routine susceptibility testing because eradication is less likely when the drugs selected are inactive against the colonizing strain and widespread mupirocin resistance has developed due to spread in facilities using mupirocin exclusively.”<sup>13</sup>

## Tools and Resources

The collaboration toolkit can serve as a starting point for facilities to develop their own screening and decolonization programs for the prevention of SSI. The PA-HEN toolkit, along with other resources, is available at <http://patient.safetyauthority.org/EducationalTools/PatientSafetyTools/ssi/Pages/home.aspx>. The toolkit and resource materials can be modified for individual facility use.

## Acknowledgments

Edward Finley, BS, Pennsylvania Patient Safety Authority, contributed to data acquisition and validity for this article. Jonathan R. Treadwell, PhD, ECRI Institute, consulted on the statistical approach for this article. Carlene A. Muto, MD, MS, University of Pittsburgh Health System, Center for Quality Improvement and Innovation, and Marilyn Hanchett, MA, RN, CPHQ, CIC, Association for Professionals in Infection Control and Epidemiology, consulted with the Authority during the Western Pennsylvania SSI collaboration. Lynn Leighton, MHA, RN, formerly with the Hospital and Healthsystem Association of Pennsylvania, collaborated with the Authority on the PA-HEN project design.

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