A Strategy for Reducing Catheter Occlusions and Infections: The Experience at St. Joseph's Hospital

Voice of Experience: Topics in Venous Access

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INTRODUCTION

St. Joseph's Hospital is a 709-bed facility located in Tampa, Florida. In reviewing our central venous catheter data, we observed a high rate of line occlusions and infections. Infection rates in the ICU were above the 2004 published National Nosocomial Infection Surveillance (NNIS) System[1] data at the 50th percentile, while the occlusion rate peaked at 23% of the peripherally inserted central catheter (PICC) lines placed.

Figure 1. IHI "Save 100,000 Lives" Campaign Checklist. Reinforcement of good infection control practice. Full body draping. Sterile gown donned appropriately.

Figure 2. St. Joseph's Skills Fair included hands-on practice and review of flushing, blood drawing and care.

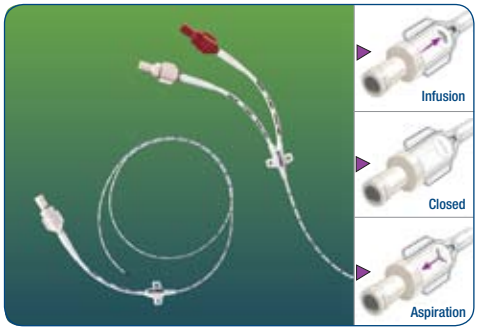

Figure 3. Navilyst Medical Vaxcel PICC with PASV Valve Technology.

As part of the effort to decrease the infection rates to below the median NNIS level, the PICC team concurrently implemented the following measures. Beginning in May 2005, infection control practices were reinforced through training including the use of maximal sterile barrier precautions and "Central Line Bundle" checklist published by the Institute for Healthcare Improvement (IHI) in association with the "Save 100,000 Lives" campaign[2] (Figure 1). House-wide re-education related to central venous catheter care and maintenance was conducted (Figure 2). They also selected an insertion kit consisting of readily available PICC supplies in a single kit. This "full tray" was later replaced by an enhanced Convenience Kit (Navilyst Medical, Marlborough, MA), consisting of readily available PICC supplies in a single kit as well as the full drape and ancillary supplies to facilitate compliance with the maximal sterile barrier precautions. In September 2005, Vaxcel® PICCs with PASV® (Pressure Activated Safety Valve) Technology (Navilyst Medical, Marlborough, MA) was implemented as the designated PICC (Figure 3).

The purpose of this paper is to demonstrate the specific clinical interventions that led to a reduction in PICC occlusions and catheter-related bloodstream infections (CR-BSI) at St. Joseph's Hospital between January 2005 and December 2006.

A STRATEGY FOR REDUCING CATHETER OCCLUSIONS AND INFECTIONS: THE EXPERIENCE AT ST. JOSEPH'S HOSPITAL

MATERIALS AND METHODS

Data was collected to examine the rates of infections and occlusions in both the ICU and non-ICU at St. Joseph's Hospital from 2004 through December 2006 while infection control practices were reinforced. Infection rates were calculated based on the number of infections per 1,000 central line days (CLDs). The number of CR-BSIs was identified by the Infection Control Practitioner (ICP) in accordance to the Centers for Disease Control and Prevention (CDC) definition of infection[3] and captured monthly. The number of central line days was reported on a monthly basis by the ICU and non-ICU nursing units. Additionally, the occlusion rate was determined by counting the number of PICC line occlusions reported by the IV team monthly and the number of times that tissue plasminogen activator (tPA) was administered annually.

SAS version 9.1 was used for statistical analysis and Microsoft Excel was used to generate graphical displays. Standard statistical methods were employed to analyze the data. Analysis of variance (ANOVA) techniques were used to examine the infection and occlusion rates over time. Monthly infection rates were analyzed using the Wilcoxon Rank Sum test. All p-values are the results of two-sided tests. P-values less than 0.05 were considered statistically significant, and p-values between 0.05 and 0.10 were considered borderline statistically significant.

RESULTS

Primary Bloodstream Infections

Primary bloodstream infections (PBSI) are common infections that are transmitted via central catheters. The PBSI rate in the ICU and non-ICU was examined for changes before and after Vaxcel® PICCs with PASV® Valve Technology were introduced. These results are provided in Table 1.

Improved infection control practices in conjunction with the use of PASV resulted in decreases in the PBSI rate for both the ICU and non-ICU. The ANOVA resulted in a borderline statistically significant decrease in the PBSI rate in the ICU and a statistically significant decrease in both locations combined (p-value=0.06 and 0.04, respectively). While the reduction in the PBSI rate was not statistically significant in the non-ICU, the reduction in the PBSI was clinically significant.

PASV Technology in Use?	ICU		Non-ICU		Total	
	No	Yes	No	Yes	No	Yes
Days	7,470	5,081	12,821	3,759	20,291	8,840
Infections	30	11	27	5	57	16
Infection Rate (/1,000 Days)	4.02	2.02	2.11	1.33	2.81	1.81
ANOVA p-value	0.0629		0.3299		0.0404	

Table 1. ICU, Non-ICU and Total Primary Bloodstream Infection Rate (PBSI infections per 1,000 CLD days) at St. Joseph's Hospital. Data collected from January 2004 through December 2006. Vaxcel PICCs with PASV Valve Technology were introduced in September 2005. The total PBSI rate demonstrated a statistically significant decrease associated with the introduction of Vaxcel PICCs with PASV Valve Technology.

Despite having initiated the improved infection control practices, the PBSI rate in the ICU still exceeded the NNIS median in most months prior to the availability of PASV Valve Technology. After PASV was available, the PBSI rates for both the ICU and non-ICU floor were below the NNIS median in most months, and there were many months where there were no infections (Figure 4).

To assess the rate of PICC infections, the number of infections in PICC lines was counted each month to determine a monthly rate before and after the PICC with PASV Valve Technology was available for use. These infection rates are displayed graphically in Figure 5.

In the ICU, PICC infections dropped from 1.38 infections per month from January 2005 to August 2005 (before the technology was available) to 0.40 infections per month after PASV Valve Technology was available in conjunction with the line care and maintenance education and infection control practice reinforcement (September 2005 through December 2006). On the non-ICU floor, infection rates were 0.38 infections per month and 0.19 infections per month, respectively. PICC infections were reduced by 71% in the ICU and by 50% on the non-ICU floor. The reduction in the number of PICC infections per month in the ICU was statistically significant (p-value=0.048).

PICC Line Occlusions

The number of PICC line occlusions was counted quarterly by the hospital IV team. Upon the availability of the PICC with PASV® Valve Technology and reinforcement of flushing protocols during the third quarter of 2005, the occlusion rate was reduced from 60.49 occlusions per 1,000 CLDs during the first two (2) quarters of 2005 to 4.71 occlusions per 1,000 CLDs during the last two (2) quarters of 2005 and subsequent four (4) quarters of 2006.

Because of the reduction in the number of occlusions, fewer doses of tissue plasminogen activator (tPA) were required to remove the occlusions (Figure 6). In the 1,348 central lines placed during 2005, 599 doses of tPA were administered (0.44 tPA doses per central line). Through December 2006, data is available for 2,357 central lines placed during 2006 and only 70 doses of tPA were administered (0.03 tPA doses per central line). This resulted in a 93% decrease in the number of tPA doses administered per central line between 2005 and 2006.

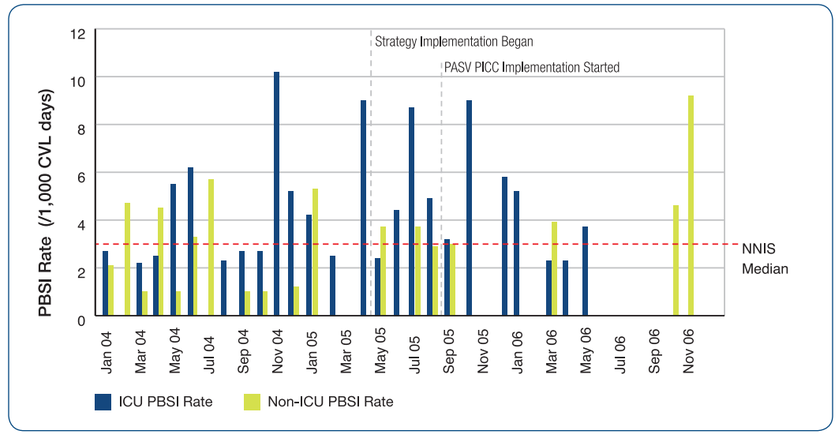

Figure 4. Monthly ICU and Non-ICU PBSI Rates for All Central Lines from January 2004 through December 2006. Numbers presented indicate the PBSI rate per 1,000 CLD days during each month. The NNIS median of 3.1 infections/1,000 CLD days is provided as a reference. PASV PICC was available for use beginning in September 2005. After PASV PICC was available, the PBSI rates for both floors were below the NNIS median in most months.

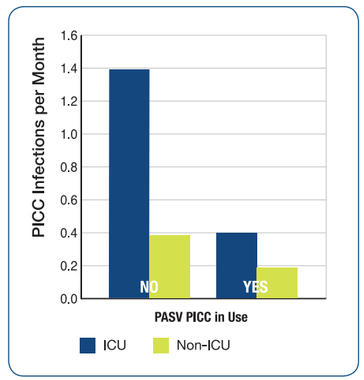

Figure 5. Infection Control Refinement—ICU and Non-ICU PICC Line Infection Rates from January 2005 through December 2006. Numbers presented indicate the number of infections per month before and after PASV PICC was available for use. There was a statistically significant decrease in the number of PICC line infections per month in the ICU (p-value=0.048).

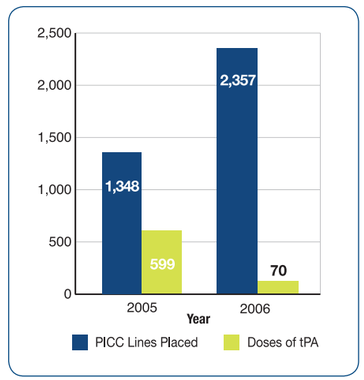

Figure 6. PICC Lines Placed and the Number of tPA Doses Administered at St. Joseph's Hospital in 2005 and 2006. Numbers presented indicate the number of PICC lines placed and the number of doses of tPA administered annually. PASV PICC was available for use beginning in September 2005. The reduction in the number of occlusions resulted in a 93% decrease in the number of tPA doses administered per central line.

RESULTS (continued)

Since the PICC with PASV® Valve Technology was available for use beginning in September 2005, this analysis may underestimate the effect that PASV has on the use of tPA by including the new catheter technology in the 2005 data.

Due to the methods of data collection, the limited number of data points and the lack of control group, it is not possible to assess the individual contributions that maximum sterile barrier, educational activities and introduction of the PASV proximal valve PICC technology played in the overall reduction in infections and occlusions at St. Joseph's Hospital.

CONCLUSIONS

This strategy was successful in reducing the rate of occlusions and CR-BSIs. The decreases in both catheter occlusions and CR-BSIs can be attributed to the introduction of Vaxcel® PICCs with PASV Technology, increased compliance with maximal sterile barrier precautions and re-education of staff on care and maintenance of central venous lines.

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Note: St. Joseph's Hospital and Navilyst Medical employed the services of a statistical consultant in the analysis of the data used in this paper. Results from clinical experiences are not predictive of results in other cases.

1. National Nosocomial Infections Surveillance (NNIS) System Report, data summary from January 1992 through June 2004, issued October 2004. *Am J Infect Control* 2004;21(8):470-485.

2. Institute for Healthcare Improvement (IHI) "Save 100,000 Lives" Campaign. www.ihi.org.

3. Hughes JM, Solomon S, et al. Guidelines for the Prevention of Intravascular Catheter-related Infections. *Centers for Disease Control Morbidity and Mortality Weekly Report*, August 9, 2002;51:1-13.