

# Infection control for the Reduction of Catheter Related Blood Stream Infection (CRBSI)



Boonma P, MD

email : paithoon@bgh.co.th

Paithoon Boonma, MD<sup>1</sup>

Sonchai Hiranniramol, MD<sup>2</sup>

Wilai Aiumpatoomsak, RN<sup>3</sup>

Poonrut Leeyatikun, RN<sup>3</sup>

Arisara Suwanarit, RN<sup>3</sup>

<sup>1</sup>Infection Control Unit, Bangkok Hospital, Bangkok Hospital Group, Bangkok, Thailand.

<sup>2</sup>Intensive Care Unit, Bangkok Hospital, Bangkok Hospital Group, Bangkok, Thailand.

<sup>3</sup>Infection Control Nurse Department, Bangkok Hospital, Bangkok Hospital Group, Bangkok, Thailand

## Keywords:

Nosocomial infection, CRBSI, Catheter Related Blood Stream Infection

**OBJECTIVE.** The purpose of this research was to reduce rate of CRBSI at Bangkok Hospital by using 2002 CDC evidence-based guidelines as a preventive of CRBSI.<sup>1</sup>

**MATERIALS AND METHODS.** A target surveillance on CRBSI was conducted in all 4 adult intensive care units at the Bangkok Hospital. The findings were compared with the CDC recommendations. Then we set up a multidisciplinary patient-care project team who applied the CDC guidelines in order to work towards the reduction and eventual prevention of CRBSI's in our hospital.

**RESULTS.** The reduction of CRBSI incidence was observed to be sustainable after the new guidelines were implemented in October 2004. The rate of CRBSI incidence reduced gradually especially in the year of 2010. It approached to zero per 1000 catheter-day.

**CONCLUSION.** Nowadays, all healthcare personnel must take responsibility for preventing nosocomial infection. We has demonstrated that our multidisciplinary team can reduce the infection rates sharply.

Catheter Related Blood Stream Infection (CRBSI) is the third most common nosocomial infection. The infection results in higher antibiotic costs, prolonged hospitalization days and is even related to high morbidity and death.<sup>2-4</sup>

The Centers for Disease Control and Prevention (CDC) of the United States of America has provided evidence-based guidelines for catheter care to reduce Blood Stream Infections (BSI). They refer to recommendations for hand hygiene,<sup>5</sup> maximal sterile personnel protection equipment (PPE),<sup>6, 7</sup> preferred antiseptics for skin preparation,<sup>8, 9</sup> catheter site dressing regimens,<sup>10</sup> the site chosen for catheter placement,<sup>11, 12</sup> etc. In 2004, our Infection Control Committee set up a project aimed at reducing CRBSI at Bangkok Hospital by using the aforementioned 2002 CDC evidence-based guidelines as a preventive of CRBSI.<sup>1</sup>

## Materials and Methods

### *Case Definitions for CRBSI including*

1. Bacteremia/fungemia in a patient with an intravascular catheter, with at least one positive blood culture obtained from a peripheral vein and clinical manifestation of infections (such as fever, chills, and/or hypotension) but no apparent source for the BSI except for the catheter.

2. One of the following should be present:

- A positive semiquantitative (>15 Colony forming unit (CFU)/catheter segment) or quantitative (>103 CFU/catheter segment)
- Culture whereby the same organism is isolated both from the catheter segment and peripheral blood; differential period of CVC culture versus peripheral blood culture positively of > 2 hours.

Target surveillance on CRBSI was conducted in all 4 adult intensive care units at our hospital. The objective was to evaluate the incidence of CRBSI and observe how physicians performed central line insertion, their use of antiseptics, the contents in the central line insertion kit and what the daily care routine for the central line was. Then, the findings were compared with the CDC recommendations.

We set up a multidisciplinary patient-care project team working towards the reduction of CRBSI's. The team's job was in working out how to apply the CDC guidelines to prevent CRBSI in our hospital. For example, Central Supply Service Department (CSSD) was requested to provide ready to use kits for central venous catheter (CVCs) insertion, which included a sterile gown and sterile gloves, a mask, a cap, a large sized sterile drape and a bottle of 2% chlorhexidine gluconate in 70% alcohol for skin preparation, instead of 10% providone iodine solution.

The team also gave workshops on these new implementation regulations to the physicians who were privileged to perform central line insertion.

Instructions were issued to nurses on how to care for CVCs and how to use a 7 day-color-coded-sticker to ensure timely dressing and intravenous solution kits changes.

During follow up, the team also used quality improvement tools such as GAP analysis or Cause and Effect diagrams in order to improve performance in accordance with the new CDC recommendations for CRBSI prevention.

## Results

The CRBSI rate is best determined by analyzing rate of infection by BSIs per 1000 catheter-day.<sup>1</sup> These rates can be used as benchmarks by individual hospitals to estimate how their rates compare with other institutions.

During January to August 2004, the incidence of CRBSI at the Bangkok Hospital was an average 12 per 1000 catheter-day.

Before the implementation of the new guidelines for prevention of CRBSI, more than 90% of physicians did not use all appropriate personnel protective equipment during central line catheter insertion, for example, only 20% of them used sterile gowns, usually because equipment was not readily available (Table 1). The drapes provided in the central line insertion kit were too small. The disinfectant commonly used was 10% providone-iodine solution and there was no specific system set up to remind nurses when to change dressings or intravenous solution on a timely basis.

After making new central line kits available (Figure 1) and educating physicians on the new protocol, giving nurses the new instructions for aseptic techniques for looking after CVCs and demonstrating how to use a 7 day-color-coded-color sticker (Figure 2) to ensure timely changes of specific intravenous sets and dressings, the incidence rate of CRBSI had reduced to an average 5.9 per 1000 catheter-days during September to December 2004 (Figure 3). Figure 4 shows surveillance compliance for the CVCs project. The performance improved year by year.

The reduction of CRBSI incidence was observed to be sustainable after the new guidelines were implemented in October 2004. Figure 5 shows the surveillance rate of CRBSI from 2004-2010. The rate of CRBSI incidence reduced gradually especially in 2010. It approached to zero per 1000 catheter-day.

**Table 1:** Summarized physician's performance during central venous catheter (CVC) insertion compared to the CDC new guidelines for CRBSI prevention.

Prevention	Amount of CVC insertion (n=38)	(%)
Maximal PPE*	3	7.9
Partial PPE*	35	92.1
sterile gown	7	
mask	12	
cap	1	
goggle	7	
<b>Total</b>	<b>38</b>	<b>100</b>

PPE\* = Personnel Protection Equipment

## แนวทางปฏิบัติการแทงสายสวนหลอดเลือดดำส่วนกลาง (Central Line)

**1.ให้เลือกแทง Central line ในตำแหน่ง**  
เรียงลำดับโอกาสเสี่ยงการมีเชื้อ Colonization  
น้อยไปสู่มากกว่าดังต่อไปนี้

Subclavian < Jugular < Femoral

**2.อุปกรณ์แทงสายสวนหลอดเลือดดำ ดังต่อไปนี้**  
ให้ถือว่าเป็นการแทง Central line ได้แก่

Swanz gang, Triple lumen, Double lumen,  
PICC, IABP, Umbilical catheter

**3.แพทย์ผู้แทงสายสวนต้องสวมอุปกรณ์ป้องกัน**  
ร่างกาย (Personel Protective Equipment) ต่อไปนี้



- เสื้อคลุมกันน้ำ Sterile
- หมวกคลุมผม
- ผ้าปิดปาก จมูก
- ถุงมือ Sterile
- แว่นป้องกันตา

**4.ต้องใช้ชุดอุปกรณ์ Central line set ในการแทงสายสวนหลอดเลือด**  
ประกอบด้วย



- อุปกรณ์ใส่สายสวน 1 ห่อ
- ผ้า Drape ขนาดมาตรฐาน 36 X 60 นิ้ว 1 ผืน
- ชุดอุปกรณ์ป้องกันร่างกาย

(Personel Protective Equipment) 1 SET

**5.ใช้น้ำยา 2 % Chlorhexidine in 70% Alcohol ในการ**



- เช็ดเตรียมผิวหนังก่อนแทงสายสวน
- เช็ดทำความสะอาดบริเวณตำแหน่ง

ที่แทงเข็มก่อนเปลี่ยน Dressing

หมายเหตุ ห้ามใช้ในเด็กอายุต่ำกว่า 3 เดือน

อย่าลืม ! ล้างมือก่อนและหลังทำหัตถการทุกครั้ง และก่อน - หลังสวมและถอดถุงมือ



แผนกควบคุมโรคติดเชื้อ

Figure 1: Guideline of the new standard of central venous insertion kit















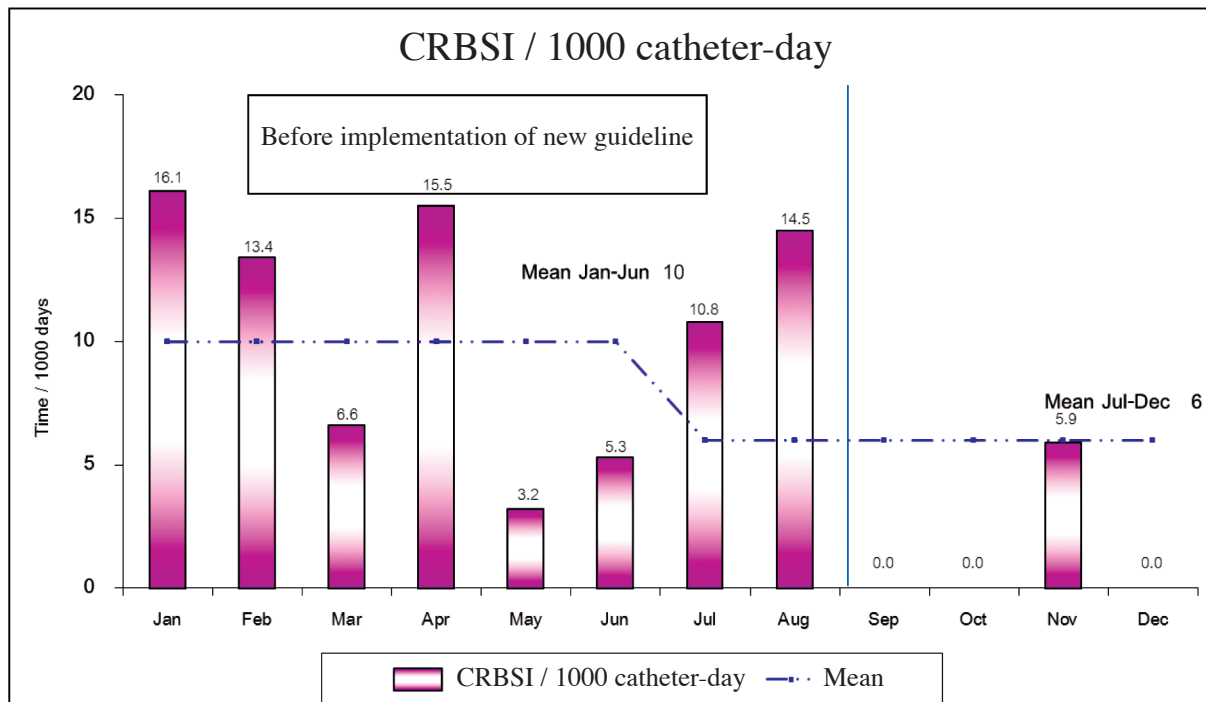
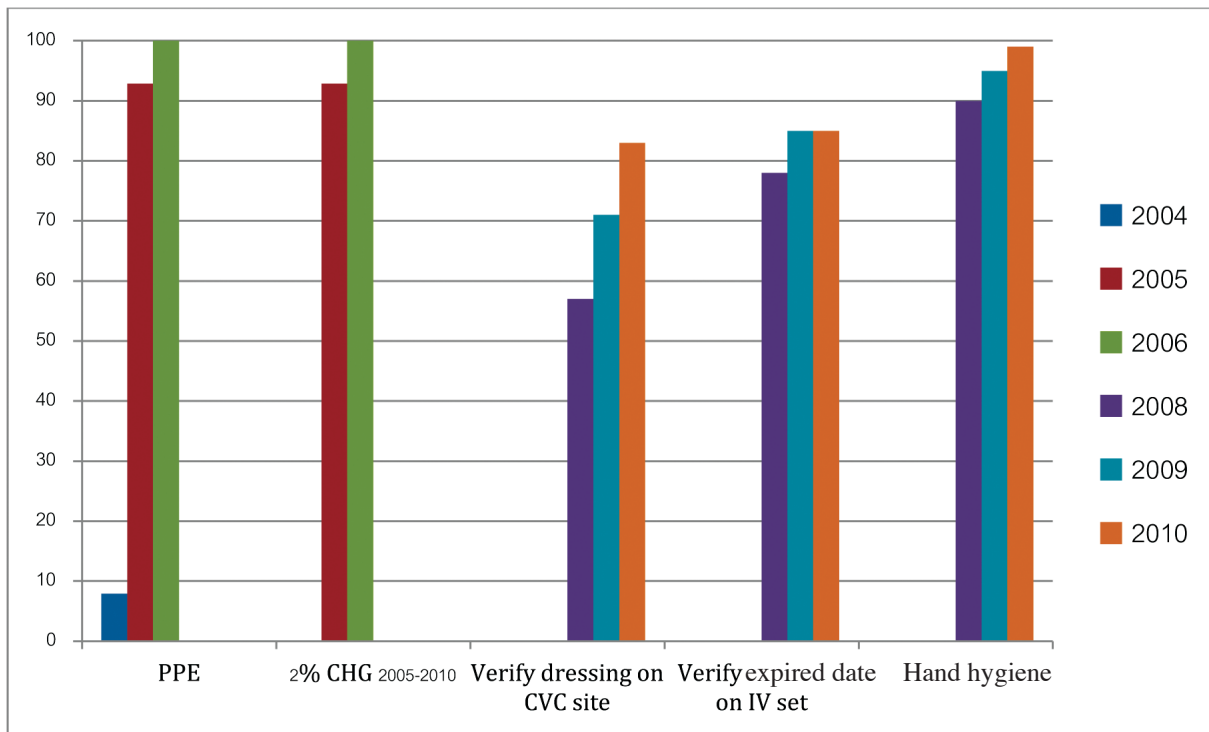
size 6 x 1.5 cm		size 3 x 1.5 cm		size 6 x 1.5 cm		size 3 x 1.5 cm	
วันที่เริ่ม	/ /	วันที่เริ่ม	/ /	วันที่เริ่ม	/ /	วันที่เริ่ม	/ /
วันที่เปลี่ยน	/ /	วันที่เปลี่ยน	/ /	วันที่เปลี่ยน	/ /	วันที่เปลี่ยน	/ /
							
วันที่เริ่ม	/ /	วันที่เริ่ม	/ /	วันที่เริ่ม	/ /	วันที่เริ่ม	/ /
วันที่เปลี่ยน	/ /	วันที่เปลี่ยน	/ /	วันที่เปลี่ยน	/ /	วันที่เปลี่ยน	/ /
							
วันที่เริ่ม	/ /	วันที่เริ่ม	/ /	วันที่เริ่ม	/ /	วันที่เริ่ม	/ /
วันที่เปลี่ยน	/ /	วันที่เปลี่ยน	/ /	วันที่เปลี่ยน	/ /	วันที่เปลี่ยน	/ /
							
วันที่เริ่ม	/ /	วันที่เริ่ม	/ /				
วันที่เปลี่ยน	/ /	วันที่เปลี่ยน	/ /				
							

Figure 2: 7-day-colour-coded sticker for timely changes of intravenous catheter and dressing



**Figure 3:** Graph shows Catheter Related Blood Stream Infection Rate of Bangkok Hospital in the year of 2004.



**Figure 4:** Graph shows surveillance compliance for caring central venous catheter project. The performance improved yearly as can be seen.

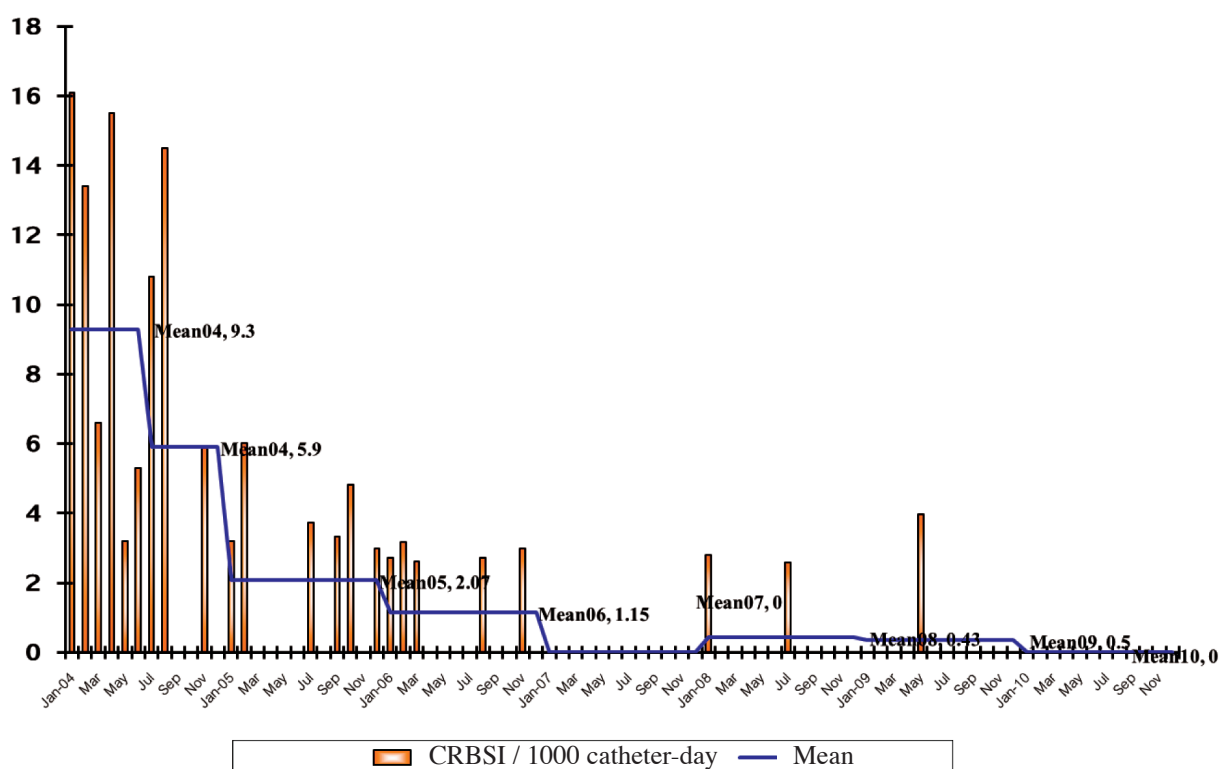


Figure 5: Graph shows Catheter Related Blood Stream Infection/1000 catheter-day in 2004-2010.

## Discussion

Nosocomial infection associated with CRBSI is now a major concern in Modern Medicine. Due to the wide use of invasive medical devices, particularly central venous catheters, complications occurring because of infection have resulted in high mortality rates.<sup>1-3</sup>

In the USA, there are an estimated 250,000 cases of CRBSI annually; attributed mortality is estimated to be 12-15% for each infection, with a cost to the health-care system \$25,000 cases per episode.<sup>1</sup>

Danchaivijitr et al<sup>13</sup> showed that in Thailand, about 10% of primary blood stream infections were found to be nosocomial. The CRBSI percentage was shown to be higher in university hospitals (4%) as opposed to general hospitals (0.8%) However, that study didn't analyze BSIs per 1000 catheter-day, (as per official formula for CRBSI rate) so we could not directly compare the prevalence at our medical center to other institutions in Thailand.

The key issues which are so different from previous practices of CVCs insertion and post insertion care include more stringent hand hygiene and aseptic technique during CVCs insertion, with maximal personal protective equipment (PEE), using a larger drape and skin antiseptic with 2% chlorhexidine gluconate in 70% alcohol.

Using maximal PEE and 2% chlohexidine glutconate for skin preparation prior to CVCs insertion lowered BSI rate when compared with previous standard precautions.<sup>7-9</sup>

The benefit of using 2% chlohexidine glutconate in 70% Alcohol instead of providone-iodine in preventing catheter-related infections is its superior and rapid skin decontamination.<sup>8,9</sup>

Since our project to apply these recommendations from the CDC to reduce CRBSI reduction began in 2004, due to good cooperation from our multidisciplinary team, by 2010 we had succeeded in controlling CRBSI rate to zero rate per 1000 catheter-day.

CDC revised their guidelines yet again in 2011.<sup>14</sup> The major differences from their 2004 guideline are;

- 1) Using antiseptic/antibiotic impregnated short-term central venous catheters and chlohexidine impregnated sponge dressing.
- 2) An emphasis on performance improvement by implementing bundled strategies.
- 3) Definition of CRBSI that requires specific laboratory testing.

Since it is often problematic to establish a diagnosis, a simple definition used for surveillance purposes is

CLABSI (Central Line Associated Blood Stream Infection). A CLABSI is a primary BSI in a patient that had a central line within a 48-hour period and is not blood stream related to an infection at another site.

This year, 2012, our Infection Control Committee will revise the case definition of CRBSI to CLABSI to be in line with CDC's latest guidelines.

## Conclusion

Nowadays, all healthcare personnel must take responsibility for preventing nosocomial infections. Our Team

has demonstrated that a multidisciplinary team following the CDC guidelines could indeed reduce the infection. In the near future CRBSI may be the first nosocomial infection that can be eliminated from all patient-care areas.

## Acknowledgement

The author would like to thank all staff from each of the BMC-ICU unit for their excellent cooperation and support of the project. This project was also partially supported by a Vejdasit Foundation's Scholarship Grant in 2005.

## References

1. Naomi P, O'Grady, Alexander M, et al. Guideline for the Prevention of Intravascular Device-related infections. Hospital Infection Control Practreous Advisory Committee Center for Disease Control, Allanta: MMWR 2002;51 (No. RR-10).
2. Pittet D, Tarara D, Wenzel R. Nosocomial bloodstream infection in critically ill patients: excess length of stay, extra costs, and attributable mortality. *JAMA* 1994; 271:1598-601.
3. Rello J, Ochagavia A, Sabanes E, et al. Evaluation of out-come of intravenous catheter-related infections in critically ill patients, *Am J Respir Crit Care Med* 2000; 162:1027-30.
4. Kluger D, Maki DG. The relative risk of intravenous device-related bloodstream infection with different types of intravenous devices in adults: a meta-analysis of 206 published studies (abstract). *Infect Control Hosp Epidemiol* 2000;21:95-6.
5. Coopersmith CM, Rebmman TL, Zack JE, et al. Effect of an education program on dressing catheter-related bloodstream infections in the surgical intensive care unit. *Crit Care Med* 2002;30:59-64.
6. Sherertz RJ, Ely FW, Westhrook DM, et al. Education of physicians in-training can decrease the risk for vascular catheter infection. *Ann Inter Med* 2000;132:641-8.
7. Mermel LA and Maki DG. Infection complications of Swan-Ganz pulmonary artery catheter. Pathogenesis, *Crit Care Med* 1994;149:1020-36.
8. Maki DG, Ringer M and Alvarado CJ. Prospective randomized trial of providone-iodine, alcohol, and chlorhexidine for prevention of infection associated with central venous and arterial catheter. *Lancet* 1991;338:339-43.
9. Mimoz O, Pieroni L, Lawrene C, et al. Prospective randomized trial of two antiseptic solution for prevention of central venous or arterial catheter colonization and infection in intensive care unit patients. *Crit Care Med* 1996;24:1818-2.
10. Maki DG, Stolz SS, Wheeler S, et al. A prospective, randomized trial of gauze and two polyurethane dressing for site care of pulmonary artery catheters: implications for catheter management unit care. *Med* 1994;22:1729-37.
11. Mermal LA, McCornick RD, Springman SR, et al. The pathogenesis and epidermology of catheter related infection with pulmonary artery Swan-Ganz catheters: a prospective study utilizing molecular subtyping. *Am J Med* 1991;91:197-205.
12. Parienti JJ, Thirion M, Megarbrane B, et al. Femoral vs. Jugular venous catheterization and risk of nosocomial events in adults requiring acute renal replacement therapy: a randomized controlled trial. *JAMA* 2008;299:2413-22.
13. Danchaivijitr S, Judaung T, Sripalakj S et al. Prevalence of Nosocomial Infection in Thailand 2006. *J Med Assoc Thai* 2007;90:1524-9.
14. O'Grady NP, Alexads M, Burns LA, et al. Guideline for the Prevention of Intravascular Catheter-Related Infections 2011.