Dr. Victor Rosenthal's Summarized CV:

Dr. Rosenthal is a Medical Doctor graduated from the University of Buenos Aires. He completed fellowship programs on Internal Medicine and Infectious Diseases in Buenos Aires. He is a graduate in Clinical Effectiveness, from Harvard University and the University of Buenos Aires; and obtained a certificate in Infection Control (IC) and Hospital Epidemiology from the Chilean Society of IC.

Dr. Rosenthal is the founder and chairman of the International Nosocomial Infection Control Consortium (INICC), a nonprofit international research center which focuses on Healthcare-Associated Infections collaborating with more than 1000 researchers in more than 200 cities in 49 countries. He is the chairman of an Infection Control and Hospital Epidemiology Course at the Medical College of Buenos Aires. He is a Visiting professor at University of Wisconsin, USA, and a speaker at several International Scientific Meetings worldwide (Latin America, Asia, Africa, Europe and Oceania).

He is Coauthor of JCI guidelines to prevent CLAB. He is a task force member and reviewer of the Infection Control Guidelines for the World Health Organization (WHO), and an editorial board member and scientific reviewer of several international peer reviewed journals, such as "Lancet", "American Journal of Infection Control (AJIC)"; "Infection Control and Hospital Epidemiology" (ICHE); "Critical Care Medicine"; "Emerging Infectious Diseases (CDC)"; "Epidemiology and Infection"; and several others. He has advised the governments of Colombia and Mexico, and has collaborated with edition of the Infection Control Guidelines of Argentina, Brazil, Colombia, Peru, Hong Kong, Taiwan.

Being an author of more than 350 scientific publications, Dr. Rosenthal has received several awards granted at different international scientific meetings, including APIC, IFIC, Pan American Meetings, and others.

Workshop on HAIs and Pathogens in ICUs .
Organised by Infectious Disease Control Training Centre,
Hospital Authority / Infection Control Branch,
Centre for Health Protection,
Hong Kong. 15 – 17 Apr 2013

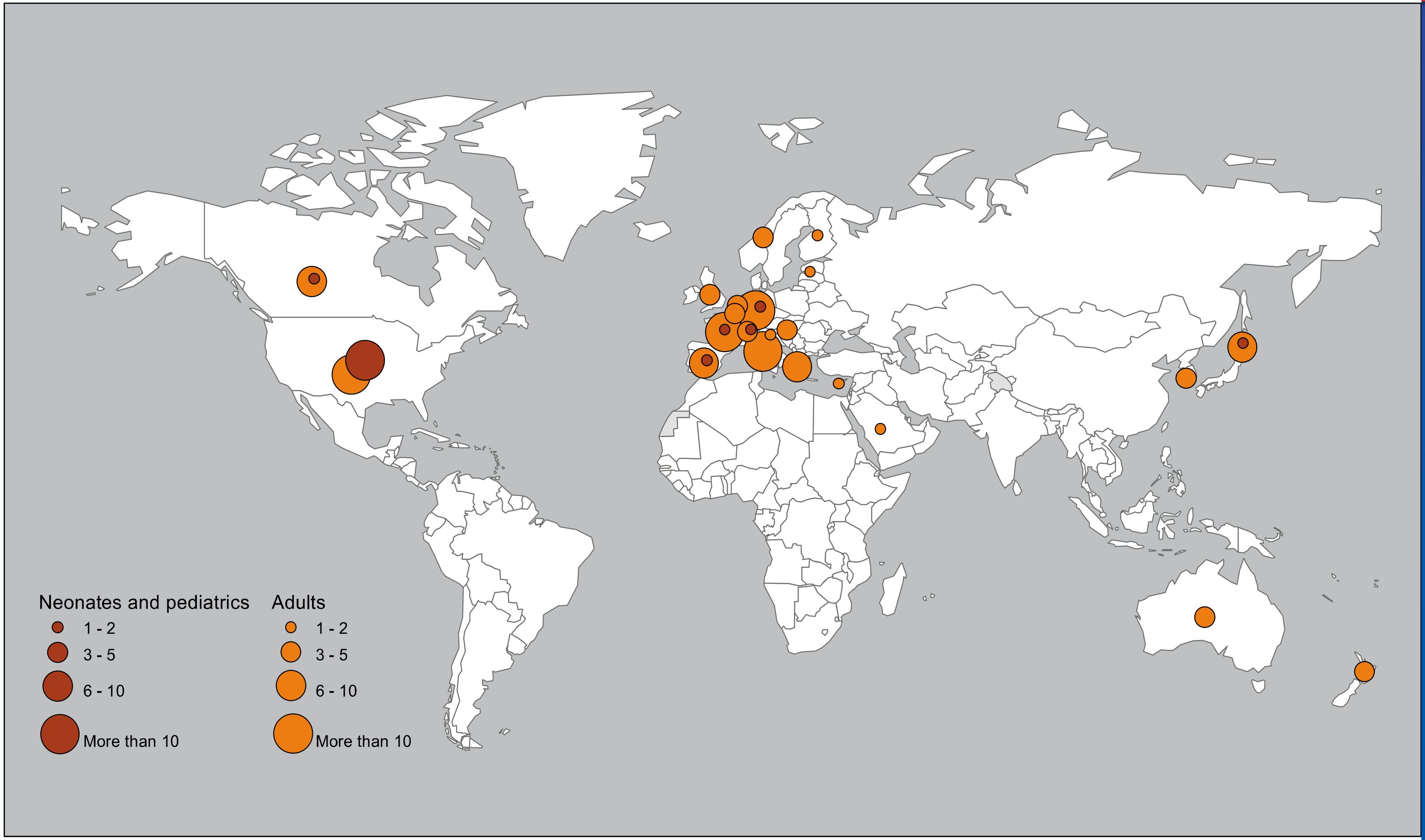
"Epidemiology and Prevention of CABSI Internationally: INICC Experience, and Review of JCI Guidelines."

Dr. Victor D. Rosenthal, MD, MSC, CIC
INICC Founder and Chairman
victor_rosenthal@inicc.org

Agenda

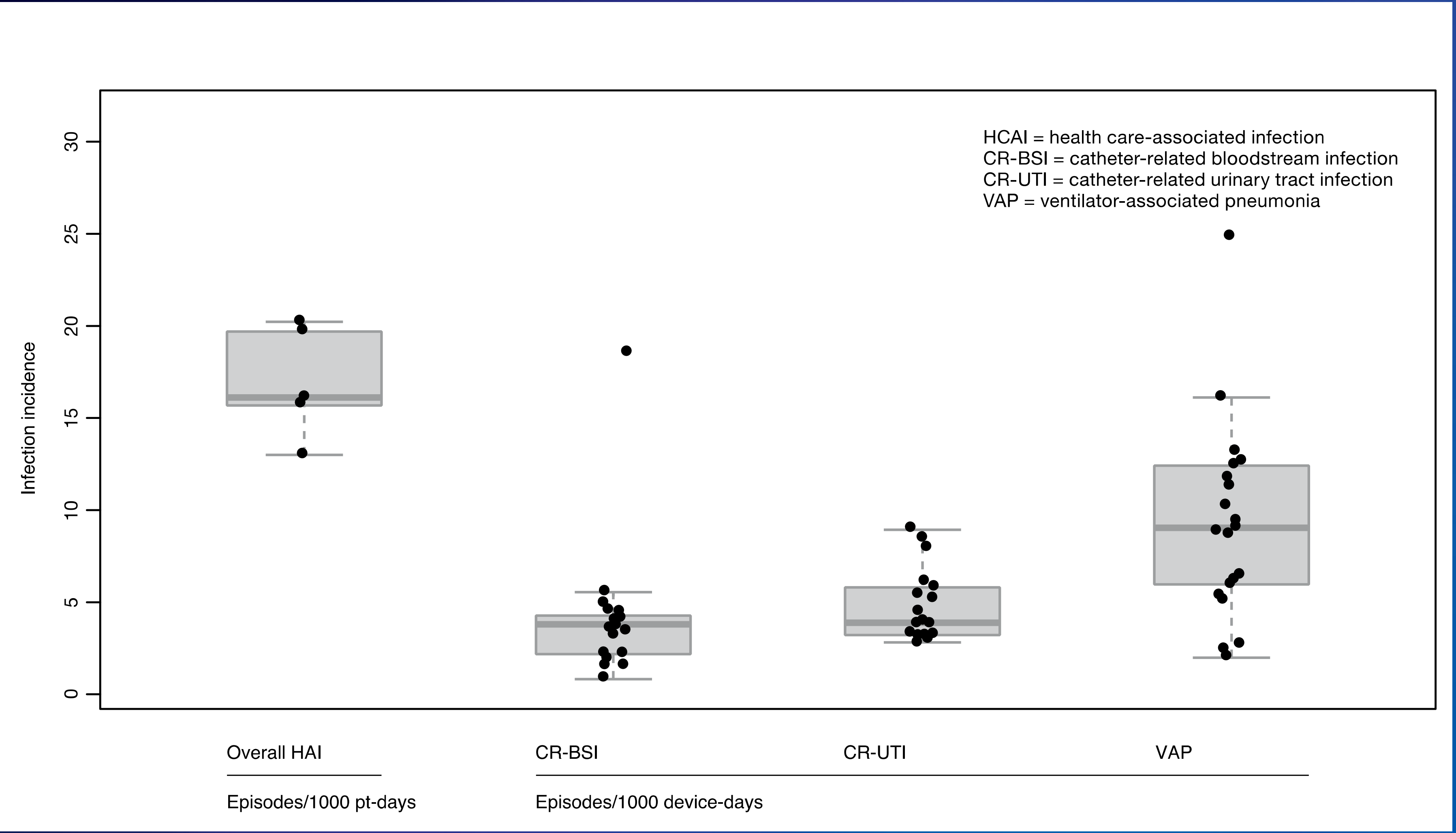
1. Introduction:
   A. CLAB rates of High Income Countries
   B. CLAB rates of Limited Resources Countries
   C. INICC review of CLAB rates.
   D. WHO paper comparing CLAB rates
2. INICC
   A. Special situation of Developing Countries
   B. Mision, Objectives, Countries Members
3. INICC Papers
   A. International Annual Reports of CLAB Rates
   B. HAI complications
4. JCI CLAB Prevention Guidelines
5. INICC Program to reduce CLAB.
   A. CLAB rate reduction in Argentina, Mexico and Turkey
   B. CLAB rate and mortality reduction in Adult ICUs
   C. CLAB rate and mortality reduction in Pediatric ICUs.
   D. CLAB rate reduction in Neonatal ICUs

The burden of endemic health care-associated infection in High-Income countries



Benedetta Allegranzi et al. Report on the Burden of Endemic Health Care-Associated Infection Worldwide. A systematic review of the literature. © World Health Organization 2011

The burden of endemic health care-associated infection in High-Income countries



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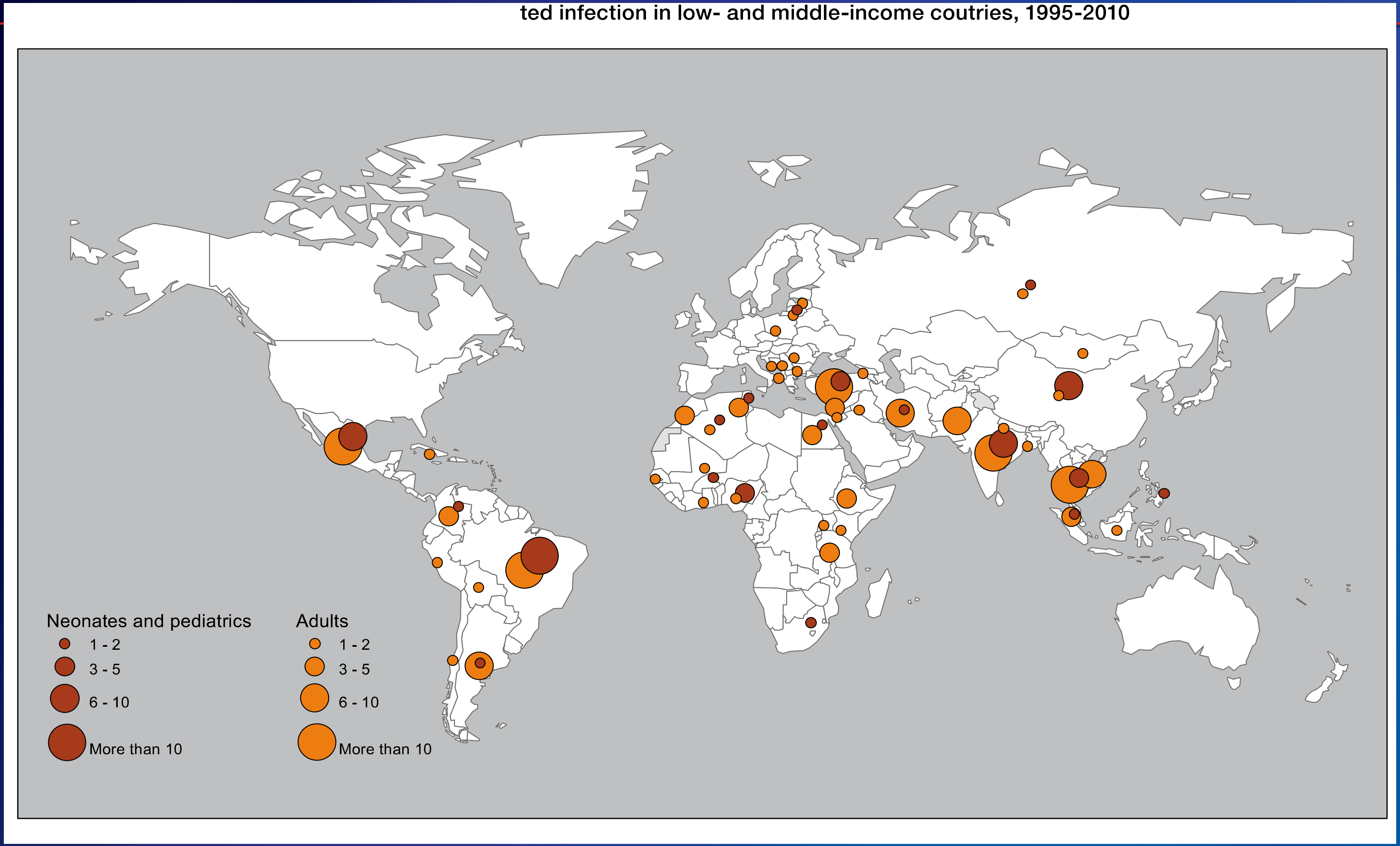
The burden of endemic health care-associated infection in low- and middle-income countries



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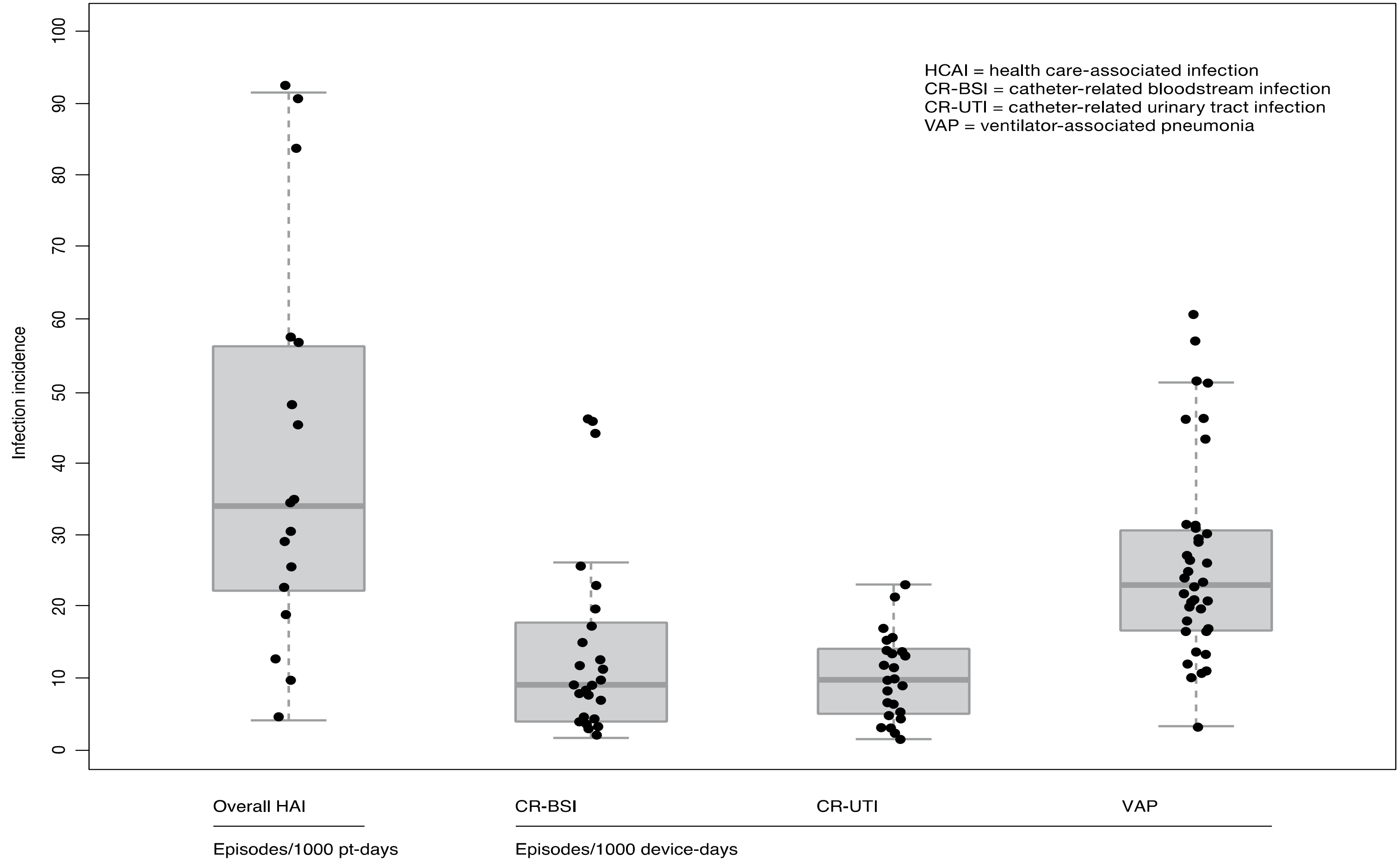
The burden of endemic health care-associated infection in low- and middle-income countries



Benedetta Allegranzi et al. Report on the Burden of Endemic Health Care-Associated Infection Worldwide. A systematic review of the literature. © World Health Organization 2011

INVITED ARTICLE HEALTHCARE EPIDEMIOLOGY
Robert A. Weinstein, Section Editor

Central Line–Associated Bloodstream Infections in Limited-Resources Countries: A Review of the Literature

Victor D. Rosenthal
Bernal Medical Center, Infection Control and Infectious Diseases Department, Buenos Aires, Argentina

Central line–associated bloodstream infections (CLABSIs) are considered a significant cause of mortality in hospitalized patients; however, the incidence of CLABSIs in limited-resources countries has not been explored analytically. Likewise, the appropriate interventions to prevent, control, and reduce CLABSIs have yet to be analyzed thoroughly. This review demonstrates that CLABSIs are associated with significant extra mortality, with an odds ratio ranging from 2.8 to 9.5. The results of 6 sequential prospective interventional studies showed that hand hygiene and educational programs were related to a significant reduction in CLABSI rates. CLABSI rates in limited-resources countries are higher than US National Healthcare Safety Network benchmark rates and have a significant impact on mortality. Studies showing successful interventions for a reduction in CLABSIs are few. Subsequently, it can be inferred that additional epidemiological studies need to be conducted to achieve an appreciation of the effects of CLABSIs and to develop more-definitive approaches for CLABSI prevention in the form of practical, low-cost, low-technology measures that are feasible to implement in limited-resources countries.

Rosenthal, V. D. (2009). "Central line-associated bloodstream infections in limited-resource countries: a review of the literature." Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 49(12): 1899-1907.

Pooled cumulative incidence densities for CLABSI in adult ICU patients, In limited resources countries- Review of the literature

Source	Country/Countries	Study Period	CLABSI per 1,000 CL days
Systematic review of the literature (1)	Limited resources countries	1995-2010	12.2

__1.__ Rosenthal, V. D. (2009). "Central line-associated bloodstream infections in limited-resource countries: a review of the literature." Clinical infectious diseases: an official publication of the Infectious Diseases Society of America __49__(12): 1899-1907.

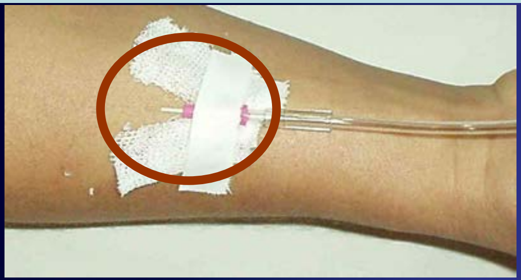
Central Line–Associated Bloodstream Infections in Limited-Resources Countries: A Review of the Literature

Victor D. Rosenthal

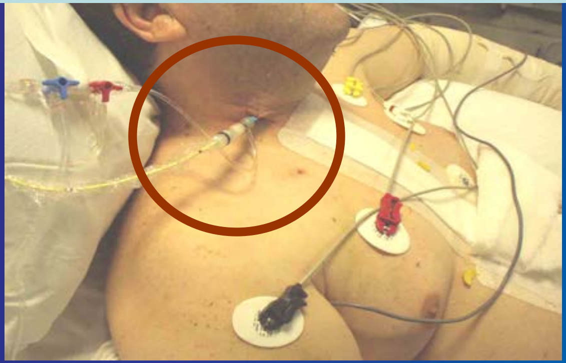
Reprints or correspondence: Dr Bernal Medical Center, Infection Control and Infectious Diseases Dept, Lavalleja 305, Floor 9, Apr B, Buenos Aires, 1414, Argentina (victor_rosenthal@inicc.org).

Clinical Infectious Diseases 2009; 49:000–000

Peripheral catheter with no sterile catheter dressing



Central line with no sterile dressing



CL insertion without maximal barriers

Three ways stop cock (open connector)

Multiple use vials with inserted needles

Single use vials, used multiple times

Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis

Benedetta Allegranzi, Sepideh Bagheri Nejad, Christophe Combescure, Wilco Graafmans, Homa Attar, Liam Donaldson, Didier Pittet

Lancet 2011; 377: 228–41
Published Online December 10, 2010
DOI:10.1016/S0140-6736(10)61458-4

See Comment page 186

First Global Patient Safety Challenge, WHO Patient Safety, Geneva, Switzerland (B Allegranzi MD, S Bagheri Nejad MD, W Graafmans PhD, H Attar PhD, L Donaldson MD, Prof D Pittet MD); Division of Clinical Epidemiology, University of Geneva Hospitals and Faculty of Medicine, Geneva, Switzerland (C Combescure PhD); Infection Control Programme, and WHO Collaborating Centre on Patient Safety (Infection Control and Improving Practices), University of Geneva Hospitals and Faculty of Medicine, Geneva, Switzerland (Prof D Pittet); and National Patient Safety Agency, London, UK (L Donaldson)

Correspondence to: Prof Didier Pittet, Infection

Summary

Background Health-care-associated infection is the most frequent result of unsafe patient care worldwide, but few data are available from the developing world. We aimed to assess the epidemiology of endemic health-care-associated infection in developing countries.

Methods We searched electronic databases and reference lists of relevant papers for articles published 1995–2008. Studies containing full or partial data from developing countries related to infection prevalence or incidence—including overall health-care-associated infection and major infection sites, and their microbiological cause—were selected. We classified studies as low-quality or high-quality according to predefined criteria. Data were pooled for analysis.

Findings Of 271 selected articles, 220 were included in the final analysis. Limited data were retrieved from some regions and many countries were not represented. 118 (54%) studies were low quality. In general, infection frequencies reported in high-quality studies were greater than those from low-quality studies. Prevalence of health-care-associated infection (pooled prevalence in high-quality studies, 15·5 per 100 patients [95% CI 12·6–18·9]) was much higher than proportions reported from Europe and the USA. Pooled overall health-care-associated infection density in adult intensive-care units was 47·9 per 1000 patient-days (95% CI 36·7–59·1), at least three times as high as densities reported from the USA. Surgical-site infection was the leading infection in hospitals (pooled cumulative incidence 5·6 per 100 surgical procedures), strikingly higher than proportions recorded in developed countries. Gram-negative bacilli represented the most common nosocomial isolates. Apart from meticillin resistance, noted in 158 of 290 (54%) *Staphylococcus aureus* isolates (in eight studies), very few articles reported antimicrobial resistance.

Interpretation The burden of health-care-associated infection in developing countries is high. Our findings indicate a need to improve surveillance and infection-control practices.

Funding World Health Organization.

	Number of ICUs	CR-BSI (95% CI)	Catheter-days	CR-UTI (95% CI)	Urinary catheter-days	VAP (95% CI)	Ventilator-days
Developed countries							
NNIS (1995–2003), USA*[98]	85–133†	5·0‡	1356 490	5·3‡	1356 490	5·8‡	115 900
NHSN (2006–2008), USA*[99]	89–182†	2·1‡	699 300	3·4‡	546 824	2·9‡	383 068
KISS (1997–2003), Germany[100]	309	1·8‡	1993 541	..	..	8·0‡	1177 137
KISS (2004–2009), Germany[101]	514–583†	1·3‡	4 002 108	2·0‡	4 757 133	5·1‡	2391381
Developing countries							
INICC (2002–2007), 18 developing countries*§[73]	60	8·9‡	132 061	6·6‡	1030	19·8‡	1802
Argentina (1998–2004; current systematic review)[60–63]	15	24·7 (7·4–42·0)	9458	17·2 (13·4–21·1)	19 013	48·0 (42·0–54·0)	5777
Turkey (1999–2005; current systematic review)[85,87,89,90]	16	11·0 (2·2–24·3)	23 503	10·8 (4·2–17·4)	36 343	26·0 (20·0–32·0)	39 504
Current systematic review (1995–2008)[60–63,65,66,68,72–74,78,79,81,83,86,87,89,90]	226	11·3 (9·0–13·6)	373 848	9·8 (7·7–11·8)	427 831	22·9 (19·1–26·6)	263 027

Data are overall (pooled mean) infection episodes per 1000 device-days. ICUs=intensive-care units. CR-BSI=catheter-related bloodstream infection. CR-UTI=catheter-related urinary-tract infection. VAP=ventilator-associated pneumonia. NNIS=National Nosocomial Infection Surveillance. NHSN=National Healthcare Safety Network. KISS=Krankenhaus Infektions Surveillance System. INICC=International Nosocomial Infection Control Consortium. *Medical or surgical ICUs in major teaching hospitals. †Range reported because number of ICUs included in data pooling varied according to the type of device-associated infection. ‡95% CI not reported. §Argentina, Brazil, Colombia, Costa Rica, Cuba, El Salvador, India, Kosovo, Lebanon, Macedonia, Mexico, Morocco, Nigeria, Peru, Philippines, Turkey, Uruguay.

Table 2: Comparison of device-associated infection densities in adult ICUs from developed and developing countries, 1995–2008

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INICC

International Nosocomial Infection Control Consortium

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INICC Infection Control Bundles

INICC Surveillance Data

INICC Infection Control Interventions

INICC Background

INICC's Scientific Publications

The following scientific research papers were designed, conducted and analyzed using INICC's protocol, forms and software.

INICC offers the community the outcome of these researches, changed into actions, services and programs aimed at fighting against nosocomial infections. (link a programa) All the researches are presented in the language they where originally published.

NOSOCOMIAL INFECTION RATES | ASSOCIATED MORTALITY | EXTRA LENGHT OF STAY | EXTRA COST | BACTERIAL RESISTANCE | RISK FACTORS | NOSOCOMIAL INFECTION RATE REDUCTION | HAND HYGIENE | SURGICAL SITE INFECTION | BOOKS AND GUIDELINES | MISCELLANEOUS

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View Page 1

288 publications found

288 - Effectiveness of a Multidimensional Approach for Prevention of Ventilator-Associated Pneumonia in 11 Adult Intensive Care Units from 10 cities of Turkey: Findings of the International Nosocomial Infection Control Consortium (INICC). Infection. In Press - 2013

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287 - Impact of a Multidimensional Infection Control Approach on Catheter-Associated Urinary Tract Infection Rates in an Adult Intensive Care Unit in Lebanon: International Nosocomial Infection Control Consortium (INICC) Findings. Int J Infect Dis, In Press. - 2013

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286 - Effectiveness of a Multidimensional Approach for Prevention of Ventilator-Associated Pneumonia in 21 Adult Intensive Care Units from 10 cities of India: Findings of the International Nosocomial Infection Control Consortium (INICC). Epidemiol Infect - 2013

Leer Resumen en Español
Read Abstract in English
Read full text

285 - Impact of a Multidimensional Infection Control Approach on Catheter-Associated

www.INICC.org

List of 50 countries participating in INICC

Latin America

1. Argentina
2. Bolivia
3. Brazil
4. Chile
5. Colombia
6. Costa Rica
7. Cuba
8. Dominican Republic
9. Ecuador
10. El Salvador
11. Guatemala.
12. México
13. Panamá
14. Peru
15. Puerto Rico
16. Venezuela
17. Uruguay

Europe

1. Bulgaria
2. Czech Republic
3. Greece
4. Kosovo
5. Lithuania
6. Macedonia
7. Poland
8. Romania
9. Serbia
10. Slovakia
11. Turkey
12. Ukraine

Asia

1. *Bahrain*
2. *China*
3. *India*
4. *Indonesia*
5. *Jordan*
6. *Lebanon*
7. *Malaysia*
8. *Mongolia*
9. *Pakistan*
10. *Philippines*
11. *Singapore*
12. *Sri Lanka*
13. *Saudi Arabia*
14. *Taiwan*
15. *Thailand*
16. *Vietnam*

África

1. *Egypt*
2. *Morocco*
3. *Niger*
4. *Tunisia*
5. *Sudan*

Four INICC Annual Reports

Publication year	2006	2008	2010	2012
Number of Countries	8	18	25	36
Peer Review Journal	Annals of Internal Medicine	American Journal of Infection Control	American Journal of Infection Control	American Journal of Infection Control

Annals of Internal Medicine | ARTICLE

Device-Associated Nosocomial Infections in 55 Intensive Care Units of 8 Developing Countries

Victor D. Rosenthal, MD; Dennis G. Maki, MD; Reinaldo Salomao, MD; Carlos Álvarez-Moreno, MD; Yatin Mehta, MD; Francisco Higuera, MD; Luis E. Cuellar, MD; Özay Akan Arikan, MD; Rédouane Abouqal, MD; and Hakan Leblebicioglu, MD, for the International Nosocomial Infection Control Consortium*

International Nosocomial Infection Control Consortium report, data summary for 2002-2007, issued January 2008

Victor D. Rosenthal,[a] Dennis G. Maki,[b] Ajita Mehta,[c] Carlos Álvarez-Moreno,[d] Hakan Leblebicioglu,[e] Francisco Higuera,[f] Luis E. Cuellar,[g] Naoufel Madani,[h] Zan Mitrev,[i] Lourdes Dueñas,[j] Josephine Anne Navoa-Ng,[k] Humberto Guanche Garcell,[l] Lul Raka,[m] Rosalía Fernández Hidalgo,[n] Eduardo A. Medeiros,[o] Souha S. Kanj,[p] Salisu Abubakar,[q] Patricio Nercelles,[r] Ricardo Diez Pratesi,[s] and International Nosocomial Infection Control Consortium Members (see Appendix for rest of the authors). Endorsed by the International Federation of Infection Control

Buenos Aires, Argentina; Madison, Wisconsin; Mumbai, India; Bogota, Colombia; Samsun, Turkey; Mexico City, Mexico; Lima, Peru; Rabat, Morocco; Skopje, Macedonia; San Salvador, El Salvador; Quezon City, Philippines; Havana, Cuba; Prishtina, Kosova; San José, Costa Rica; Sao Paulo, Brazil; Beirut, Lebanon; Kano, Nigeria; Valparaíso, Chile; and Paysandú, Uruguay

International Nosocomial Infection Control Consortium (INICC) report, data summary for 2003-2008, issued June 2009

Victor D. Rosenthal, MD,[a] Dennis G Maki, MD,[b] Silom Jamulitrat, MD,[c] Eduardo A. Medeiros, MD,[d] Subhash Kumar Todi, MD,[e] David Yepes Gomez, MD,[f] Hakan Leblebicioglu, MD,[g] Ilham Abu Khader, MD,[h] María Guadalupe Miranda Novales, MD,[i] Regina Berba, MD,[j] Fernando Martín Ramírez Wong, MD,[k] Amina Barkat, MD,[l] Osiel Requejo Pino, MD,[m] Lourdes Dueñas, MD,[n] Zan Mitrev, MD,[o] Hu Bijie, MD,[p] Vaidotas Gurskis, MD,[q] S. S. Kanj, MD,[r] Trudell Mapp, RN,[s] Rosalía Fernández Hidalgo, RN,[t] Nejla Ben Jaballah, MD,[u] Lul Raka, MD,[v] Achilleas Gikas, MD,[w] Altaf Ahmed, MD,[x] Le Thi Anh Thu, MD,[y] María Eugenia Guzmán Siritt, MD,[z] and INICC Members

Buenos Aires, Argentina; Madison, Wisconsin; Songkla, Thailand; Sao Paulo, Brazil; Kolkata, Ind
Colombia; Samsun, Turkey; Amman, Jordan; Mexico City, Mexico; Manila, Philippines; Lima, Per
Havana, Cuba; San Salvador, El Salvador; Skopje, Macedonia; Shanghai, China; Kaunas, Lithuania
Panama City, Panama; San José, Costa Rica; Tunis, Tunisia; Prishtina, Kosova; Heraklion, Greece;
Ho Chi Minh City, Vietnam; and Caracas, Venezuela

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Nosocomial Infection Control Consortium (INI
y of 36 countries, for 2004-2009

al MD, MSc, CIC[a,*], Hu Bijie[b], Dennis G. Maki[c], Yatin Meht
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ría Catalina Pirez García[q], Asma Hamdi[r], Lourdes Dueñas[s],
[u], Ossama Rasslan[v], Altaf Ahmed[w], Souha S. Kanj[x], Olber C
ul Raka[aa], Cheong Yuet Meng[bb], Le Thi Anh Thu[cc], Sameeh
, Leonardo Pazmiño Narváez[ff], Nepomuceno Mejía[gg], Nassy
ar Elanbya[ii], María Eugenia Guzmán Siritt[jj], Kushlani Jayati

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Nosocomial Infection Control Consortium (INI(
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osephine Anne Navoa-Ng[m], Rédouane Abouqal[n], Humbert
ría Catalina Pirez García[q], Asma Hamdi[r], Lourdes Dueñas[s],
[u], Ossama Rasslan[v], Altaf Ahmed[w], Souha S. Kanj[x], Olber C
ul Raka[aa], Cheong Yuet Meng[bb], Le Thi Anh Thu[cc], Sameeh
, Leonardo Pazmiño Narváez[ff], Nepomuceno Mejía[gg], Nassy
ıar Elanbya[ii], María Eugenia Guzmán Siritt[jj], Kushlani Jayati

Rosenthal, V. D., H. Bijie, et al. (2012). "International Nosocomial Infection Control Consortium (INICC) report, data summary of 36 countries, for 2004-2009." American journal of infection control 40(5): 396-407.

INICC report – 36 countries- “2004 to 2009”.

- Period: January 2004 to December 2009 (6 years)
- Countries: 36 (Argentina, Brazil, Bulgaria, China, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Egypt, Greece, India, Jordan, Kosovo, Lebanon, Lithuania, Macedonia, Malaysia, Mexico, Morocco, Pakistan, Panama, Peru, Philippines, Puerto Rico, El Salvador, Saudi Arabia, Singapore, Sri Lanka, Sudan, Thailand, Tunisia, Turkey, Venezuela, Vietnam, Uruguay)
- ICUs: 422
- Patients: 313,008
- Bed days: 2,194,897
- Central Line days: 1,078,448
- Ventilator days: 796,847
- Urinary catheter days: 1,049,541
- BSI (n): 7,603
- VAP (n): 12,395
- CAUTI (n): 6,595
- Total IAD: 26,593

Rosenthal, V. D., H. Bijie, et al. (2012). "International Nosocomial Infection Control Consortium (INICC) report, data summary of 36 countries, for 2004-2009." American journal of infection control 40(5): 396-407

HAI rates INICC vs CDC-NHSN (USA)

	INICC 2004–2009 Pooled Mean (95% CI)	U.S. NHSN 2006-2008 Pooled Mean (95% CI)
Medical Cardiac ICU		
CLAB	6.2 (5.6 – 6.9)	2.0 (1.8 – 2.1)
CAUTI	3.7 (3.2 – 4.3)	4.8 (4.6 – 5.1)
VAP	10.8 (9.5 – 12.3)	2.1 (1.9 – 2.3)
Medical-surgical ICU		
CLAB	6.8 (6.6 – 7.1)	1.5 (1.4 – 1.6)
CAUTI	7.1 (6.9 – 7.4)	3.1 (3.0 – 3.3)
VAP	18.4 (17.9 – 18.8)	1.9 (1.8 – 2.1)
Pediatric ICU		
CLAB	4.6 (3.7 – 5.6)	3.0 (2.7 – 3.1)
CAUTI	4.7 (4.1 – 5.5)	4.2 (3.8 – 4.7)
VAP	6.5 (5.9 – 7.1)	1.8 (1.6 – 2.1)
Newborn ICU		
CLAB	11.9 (10.2 – 13.9)	1.5 (1.2 – 1.9)
VAP	10.1 (7.9 – 12.8)	0.8 (0.04 – 1.5)

Rosenthal, V. D., H. Bijie, et al. (2012). "International Nosocomial Infection Control Consortium (INICC) report, data summary of 36 countries, for 2004-2009." American journal of infection control 40(5): 396-407

EXTRA MORTALITY RATES in ADULT ICUs

Table 12
Pooled means and 95% CIs of the distri
mortality* of ICU patients with DA-HA

	Death n
Crude mortality of patients without DA-HAI	11,90
Crude mortality of patients with CLABSI	41
Crude excess mortality of patients with CLABSI	41
Crude mortality rate of patients with CAUTI	29
Crude excess mortality of patients with CAUTI	29
Crude mortality rate of patients with VAP	126
Crude excess mortality of patients with VAP	126

CI, confidence interval.
*Crude excess mortality of DA-HAI 5 c
crude mortality of patients without D

American Journal of Infection Control, 2011.

Extra Length of Stay Rate of Central-Line Associated Bloodstream Infection

VAP	90,146	5020	

length of stay.

f the distribution of the length of stay and crude excess length of stay* of infants in NICUs, all birtl

	LOS, total days	Patients, n	Pooled aver
-HAI	537	5910	
I	72	204	
CLABSI	72	204	
	42	175	
VAP	42	175	

American Journal of Infection Control, 2011.

Extra Costs and Length of Stay of HAIs

Tarricone et al. Cost Effectiveness and Resource Allocation 2010, 8:8
http://www.resource-allocation.com/content/8/1/8

COST EFFEC RESOURCE

RESEARCH Open Access

Hospital costs of central line-associated bloodstream infections and cost-effectiveness of closed vs. open infusion containers. *The case of Intensive Care Units in Italy*

Rosanna Tarricone[1], Aleksandra Torbica[1*], Fabio Franzetti[2], Victor D Rosenthal[3]

Abstract

Objectives: The aim was to evaluate direct health care costs of central line-associated bloodstream infections (CLABSI) and to calculate the cost-effectiveness ratio of closed fully collapsible plastic intravenous infusion containers vs. open (glass) infusion containers.

Methods: A two-year, prospective case-control study was undertaken in four intensive care units in an Italian teaching hospital. Patients with CLABSI (cases) and patients without CLABSI (controls) were matched for admission departments, gender, age, and average severity of illness score. Costs were estimated according to micro-costing approach. In the cost effectiveness analysis, the cost component was assessed as the difference between production costs while effectiveness was measured by CLABSI rate (number of CLABSI per 1000 central line days) associated with the two infusion containers.

Results: A total of 43 cases of CLABSI were compared with 97 matched controls. The mean age of cases and controls was 62.1 and 66.6 years, respectively ($p = 0143$); 56% of the cases and 57% of the controls were females ($p = 0.922$). The mean length of stay of cases and controls was 17.41 and 8.55 days, respectively ($p < 0.001$). Overall, the mean total costs of patients with and without CLABSI were € 18,241 and € 9087, respectively ($p < 0.001$). On average, the extra cost for drugs was € 843 ($p < 0.001$), for supplies € 133 ($p = 0.116$), for lab tests € 171 ($p < 0.001$), and for specialist visits € 15 ($p = 0.019$). The mean extra cost for hospital stay (overhead) was € 7,180 ($p < 0.001$). The closed infusion container was a dominant strategy. It resulted in lower CLABSI rates (3.5 vs. 8.2 CLABSIs per 1000 central line days for closed vs. open infusion container) without any significant difference in total production costs. The higher acquisition cost of the closed infusion container was offset by savings incurred in other phases of production, especially waste management.

Conclusions: CLABSI results in considerable and significant increase in utilization of hospital resources. Use of innovative technologies such as closed infusion containers can significantly reduce the incidence of healthcare acquired infection without posing additional burden on hospital budgets.

The attributable cost and length o hospital stay because of nosocom pneumonia in intensive care units in 3 hospitals in Argentina: A prospective, matched analysis

Victor D. Rosenthal, MD, MSc, CIC,[a] Sandra Guzman, RN, ICP,[a] Oscar Migone, MS,[b] and Nasia Safdar, MD[c]
Buenos Aires, Argentina, and Madison, Wisconsin

Background: No information is available on the financial impact of nosocomial pneumonia in Argentina. To calculate the cost of nosocomial pneumonia in intensive care units, a 5-year, matched cohort study was undertaken at 3 hospitals in Argentina.

Setting: Six adult intensive care units (ICU).

Methods: Three hundred seven patients with nosocomial pneumonia (exposed) and 307 patients without nosocomial pneumonia (unexposed) were matched for hospital, ICU type, year admitted to study, length of stay more than 7 days, sex, age, antibiotic use, and average severity of illness score (ASIS). The patient's length of stay (LOS) in the ICU was obtained prospectively in daily rounds, the cost of a day was provided by the hospital's finance department, and the cost of antibiotics prescribed for nosocomial pneumonia was provided by the hospital's pharmacy department.

Results: The mean extra LOS for 307 cases (compared with controls) was 8.95 days, the mean extra antibiotic defined daily doses (DDD) was 15, the mean extra antibiotic cost was $996, the mean extra total cost was $2255, and the extra mortality was 30.3%.

Conclusions: Nosocomial pneumonia results in significant patient morbidity and consumes considerable resources. In the present study, patients with nosocomial pneumonia had significant prolongation of hospitalization, cost, and a high extra mortality. The present study illustrates the potential cost savings of introducing interventions to reduce nosocomial pneumonia. To our knowledge, this is the first study evaluating this issue in Argentina. (Am J Infect Control 2005;33:157-61.)

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY JANUARY 2007, VOL. 28, NO. 1

ORIGINAL ARTICLE

Attributable Cost and Length of Stay for Patients With Central Venous Catheter–Associated Bloodstream Infection in Mexico City Intensive Care Units: A Prospective, Matched Analysis

Francisco Higuera, MD; Manuel Sigfrido Rangel-Frausto, MD; Victor Daniel Rosenthal, MD, CIC, MSc; Jose Martinez Soto, MD; Jorge Castañon, MD; Guillermo Franco, MD; Natividad Tabal-Galan, RN, ICP; Javier Ruiz, MD; Pablo Duarte, MD; Nicholas Graves, PhD

BACKGROUND. No information is available about the financial impact of central venous catheter (CVC)–associated bloodstream infection (BSI) in Mexico.

OBJECTIVE. To calculate the costs associated with BSI in intensive care units (ICUs) in Mexico City.

DESIGN. An 18-month (June 2002 through November 2003), prospective, nested case-control study of patients with and patients without BSI.

SETTING. Adult ICUs in 3 hospitals in Mexico City.

PATIENTS AND METHODS. A total of 55 patients with BSI (case patients) and 55 patients without BSI (control patients) were compared with respect to hospital, type of ICU, year of hospital admission, length of ICU stay, sex, age, and mean severity of illness score. Information about the length of ICU stay was obtained prospectively during daily rounds. The daily cost of ICU stay was provided by the finance department of each hospital. The cost of antibiotics prescribed for BSI was provided by the hospitals' pharmacy departments.

RESULTS. For case patients, the mean extra length of stay was 6.1 days, the mean extra cost of antibiotics was $598, the mean extra hospital cost was $11,591, and the attributable extra mortality was 20%.

CONCLUSIONS. In this study, the duration of ICU stay for patients with central venous catheter–associated BSI was significantly longer than that for control patients, resulting in increased healthcare costs and a higher attributable mortality. These conclusions support the need to implement preventive measures for hospitalized patients with central venous catheters in Mexico.

Infect Control Hosp Epidemiol 2007; 28:31-35

The attributable cost, length of hosp and mortality of central line-associa bloodstream infection in intensive care departments in Argentina: A prospective, matched analysis

Victor Daniel Rosenthal, MD, MSc, CIC,[a] Sandra Guzman, RN, ICP,[a] Oscar Migone, MS,[b] and Christopher J. Crnich, MD[c]
Buenos Aires, Argentina, and Madison, Wisconsin

Background: Limited information is available on the financial impact of central venous catheter-associated bloodstream infection (BSI) in Argentina. To calculate the cost of BSIs in the intensive care department (ICU), a 5-year prospective nested case-control study was undertaken at 3 hospitals in Argentina.

Methods: We studied 6 adult ICUs from 3 hospitals. In all, 142 patients with BSI and 142 control patients without BSI were matched for hospital, type of ICU, year of admission, length of stay, sex, age, and average severity of illness score. Patients' length of stay in the ICU was obtained prospectively on daily rounds. The hospitals' finance departments provided the cost of each ICU day. The hospitals' pharmacies provided the cost of antibiotics prescribed for BSIs.

Results: The mean extra length of stay for patients with BSI compared with control patients was 11.9 days, the mean extra antibiotic defined daily dose was 22.6, the mean extra antibiotic cost was $1913, the mean extra cost was $4888.42, and the excess mortality was 24.6%.

Conclusions: In this study, patients with central venous catheter-associated BSI experienced significant prolongation of hospitalization, increased use of health care costs, and a higher attributable mortality. These findings support the need to implement preventative interventions for patients hospitalized with central venous catheters in Argentina. (Am J Infect Control 2003;31:475-80.)

The attributable cost, length of hospital stay, and mortality of central line-associated BLOODSTREAM INFECTION in intensive care departments in Argentina: A prospective, matched analysis.

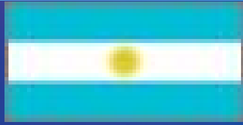


Table 1. Baseline characteristics of patients

	Case patients (N = 142)	Control patients (N = 142)
Average length of stay ≥ 7d (%)	142 (100)	142 (100)
Mean age (SD)	70.09 (±14.17)	68.88 (±13.74)*
No. males (%)	83 (58.5)	83 (58.5)*
No. admitted to medical/surgical ICU (%)	116 (81.7)	116 (81.7)*
Mean ASIS (SD)	3.30 (±1.08)	3.09 (±0.90)*
Number included in study by year (%)		
1998	25 (17.6)	27 (19.0)
1999	50 (35.2)	49 (34.5)
2000	46 (32.4)	37 (26.1)
2001	19 (13.4)	27 (19.0)
2002	2 (1.4)	2 (1.4)

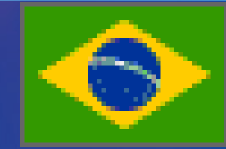
ASIS, Average severity of illness score; *ICU*, intensive care unit.
*No statistical difference found.

Rosenthal VD, et al. Am J Infect Control 2003;31(8):475-80.

The attributable cost, length of hospital stay, and mortality of central line-associated BLOODSTREAM INFECTION in intensive care departments in Argentina: A prospective, matched analysis.

	Case (N= 142)	Control (N= 142)	Extra Expenditures
Total days	3,322	1,632	1690
Average length of stay in ICU	23.39 (SE 1.49)	11.49 (SE 0.68)	11.90
Total fixed cost	$830,500	$408,000	$422,500
Mean fixed cost	$5,848 (SE 372.89)	$2,873 (SE 171.07)	$2,975
Antibiotic utilization			
Total antibiotics (in DDD*)	4,568	1,356	3,212
Mean antibiotic use per patient (DDD*)	32.16 (SE 2.81)	9.54 (SE 1.05)	22.62
Total cost of antibiotics	$301,488	$29,832	$271,656
Mean costs of antibiotics per patient	$2,123 (SE 186.06)	$210 (SE 23.09)	$1,913
Aggregate costs	$1,131,988	$437,832	$694,156
Mean aggregate costs per patient	$7,971.74	$3,083.32	$4,888.42
Average mortality	77/142 (54.2%)	42/142 (29.6%)	24.6%

Rosenthal VD, et al. Am J Infect Control 2003;31(8):475-80.



The Attributable Cost, And Length Of Hospital Stay Of Central Line Associated BLOOD STREAM INFECTION In Intensive Care Units In Brazil. A Prospective, Matched Analysis

	BSI	Controls	Extra	RR	95 % CI	P-value
Total patients (n)	70	140				
Total Antibiotic DDD, (DDD)	4243	2124				
Antibiotic DDD per patient, (DDD)	60.61	15.17	45.44			
Total Antibiotic cost (US$)	312,225.54	99,930.12				
Antibiotic cost per patient, (US$)	4,460.36	713.78	3,746.58			
Length of Stay (days)	**30.58 ± 20.41**	**6.95 ± 4.89**	**23.6**	4.40	4.08 – 4.75	0.0000
Cost (US$)	**9,843.35**	**1,937.18**	**7,906**			
Total deaths (n)	23	45				
Crude mortality (%)	32.9%	32.1%		1.02	0.62 – 1.69	0.9316

Reinaldo Salomao, Victor D. Rosenthal, et al. APIC Meeting. Tampa, USA. June 2006.

The Attributable Cost, And Length Of Hospital Stay Of Central Line Associated BLOOD STREAM INFECTION In Intensive Care Units In Mexico. A Prospective, Matched Analysis.

	Control (N= 55)	Case (N= 55)	Overall Attributable Extra Expenditures	Attributable Extra Expenditures per patient
Average length of stay in ICU (days)	406	739	333	**6.05**
Antibiotics (US$)	13,354.35	46,265.96	32,911.61	598.39
Other medicaments (US$)	128,415.14	129,832.44	1,417.30	25.77
Disposables (US$)	219,345.82	308,808.79	89,462.97	1,626.60
Cultures (US$)	1,171.40	2,111.85	940.45	17.10
Other lab tests (US$)	37,441.19	61,174.01	23,732.82	431.51
X ray, Scan, etc (US$)	15,198.40	19,556.44	4,358.04	79.24
Other costs (US$)	44,395.46	71,105.56	26,710.09	485.64
Hospitalization (fixed costs) (US$)	496,326.78	954,294.33	457,967.55	8326.68
Total cost (US$)	955,648.55	1,593,149.38	637,500.83	**11,590.92**

Higuera F, Rangel-Frausto M, Rosenthal VD, Graves N, et al.
Infection Control and Hospital Epidemiology. January 2007. In Press

Pediatr Crit Care Med 2012 Vol. 13, No. 4

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Socioeconomic impact on device-associated infections in pediatric intensive care units of 16 limited-resource countries: International Nosocomial Infection Control Consortium findings

Victor D. Rosenthal, MD, MSc, CIC; William R. Jarvis; Silom Jamulitrat; Cristiane Pavanello Rodrigues Silva; Bala Ramachandran; Lourdes Dueñas; Valdotas Gurskis; Gulden Ersoz; María Guadalupe Miranda Novales; Ilham Abu Khader; Khaldi Ammar; Naylde Barahona Guzmán; Josephine Anne Navoa-Ng; Zeinab Salah Seliem; Teodora Atencio Espinoza; Cheong Yuet Meng; Kushlani Jayatilleke; International Nosocomial Infection Control Members

Infection (2011) 39:439–450
DOI 10.1007/s15010-011-0136-2

CLINICAL AND EPIDEMIOLOGICAL STUDY

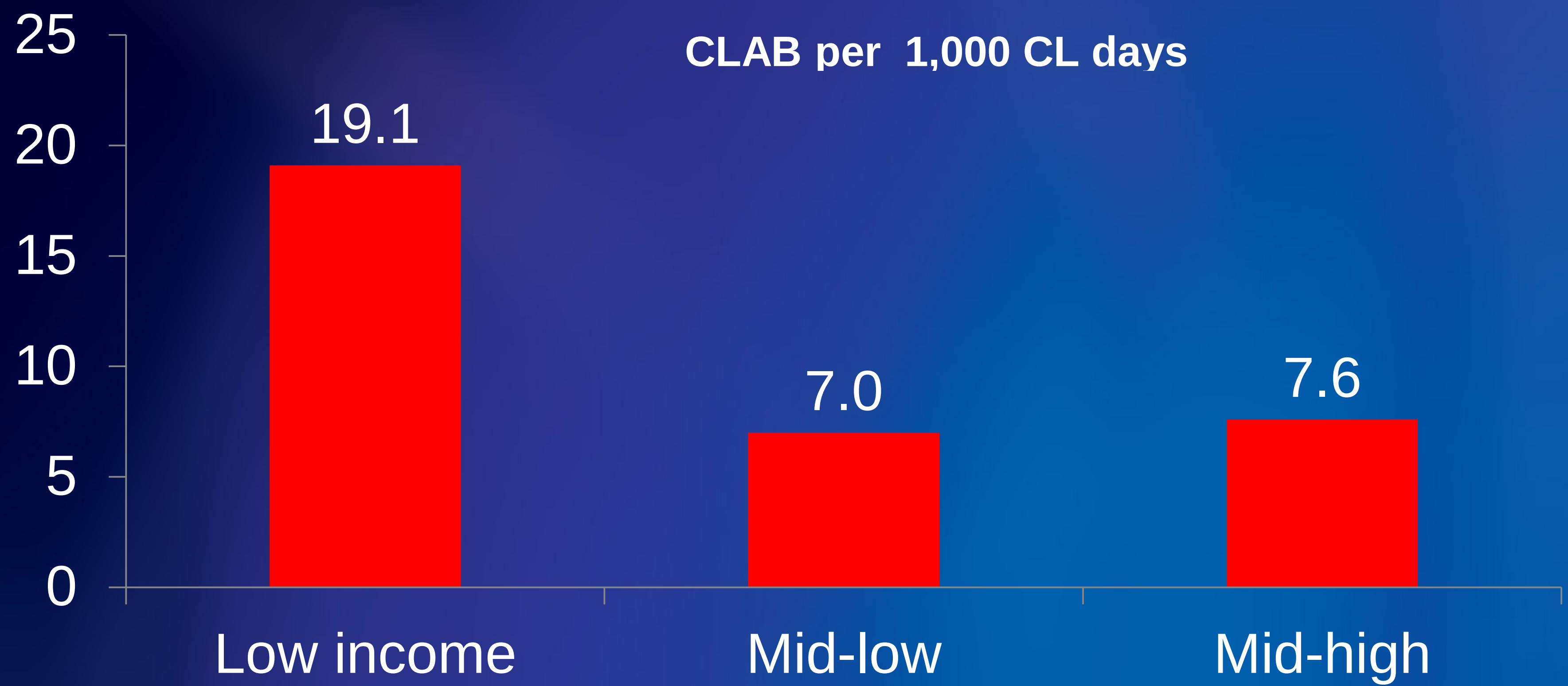
Socioeconomic impact on device-associated infections in limited-resource neonatal intensive care units: findings of the INICC

V. D. Rosenthal · P. Lynch · W. R. Jarvis · I. A. Khader · R. Richtmann · N. B. Jaballah · C. Aygun · W. Villamil-Gómez · L. Dueñas · T. Atencio-Espinoza · J. A. Navoa-Ng · M. Pawar · M. Sobreyra-Oropeza · A. Barkat · N. Mejía · C. Yuet-Meng · A. Apisarnthanarak · INICC members

World Bank classification of Countries Economic Strata. According to 2007 gross national income (GNI) per capita.

- The World Bank classifies countries into four economic strata according to 2007 gross national income (GNI) per capita.
- These groups are:
  - low income, $935 or less;
  - lower middle income, $936–3,705;
  - upper middle income, $3,706–11,455;
  - high income, $11,456 or more.
  - These economies represent 144 of 209 countries of the world (68.8%) and more than 75% of the world population.
- There is very limited information regarding association between socio economic level of the country (Low income, mid low income, and mid high income) and DAI rates, as well as association between type of hospital (Public, Academic, and Private) and DAI rates.
- The goal of this study is to show DAIs rates stratified by socio economic level of the country and type of hospital and to find statistical associations among them.

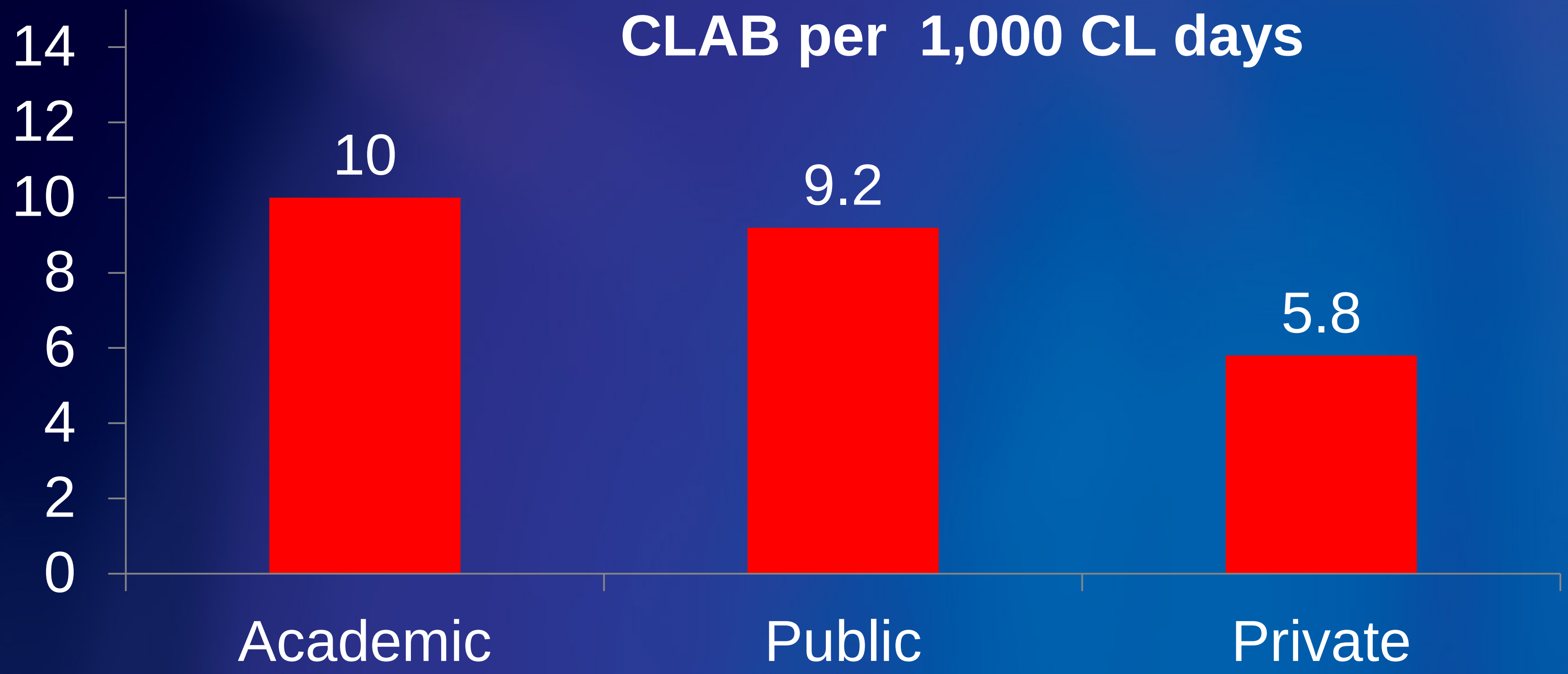
CLAB Rates Stratified Socio-Economic Level



95%CI 18.06-20.1 6.5-7.5 7.3-7.8

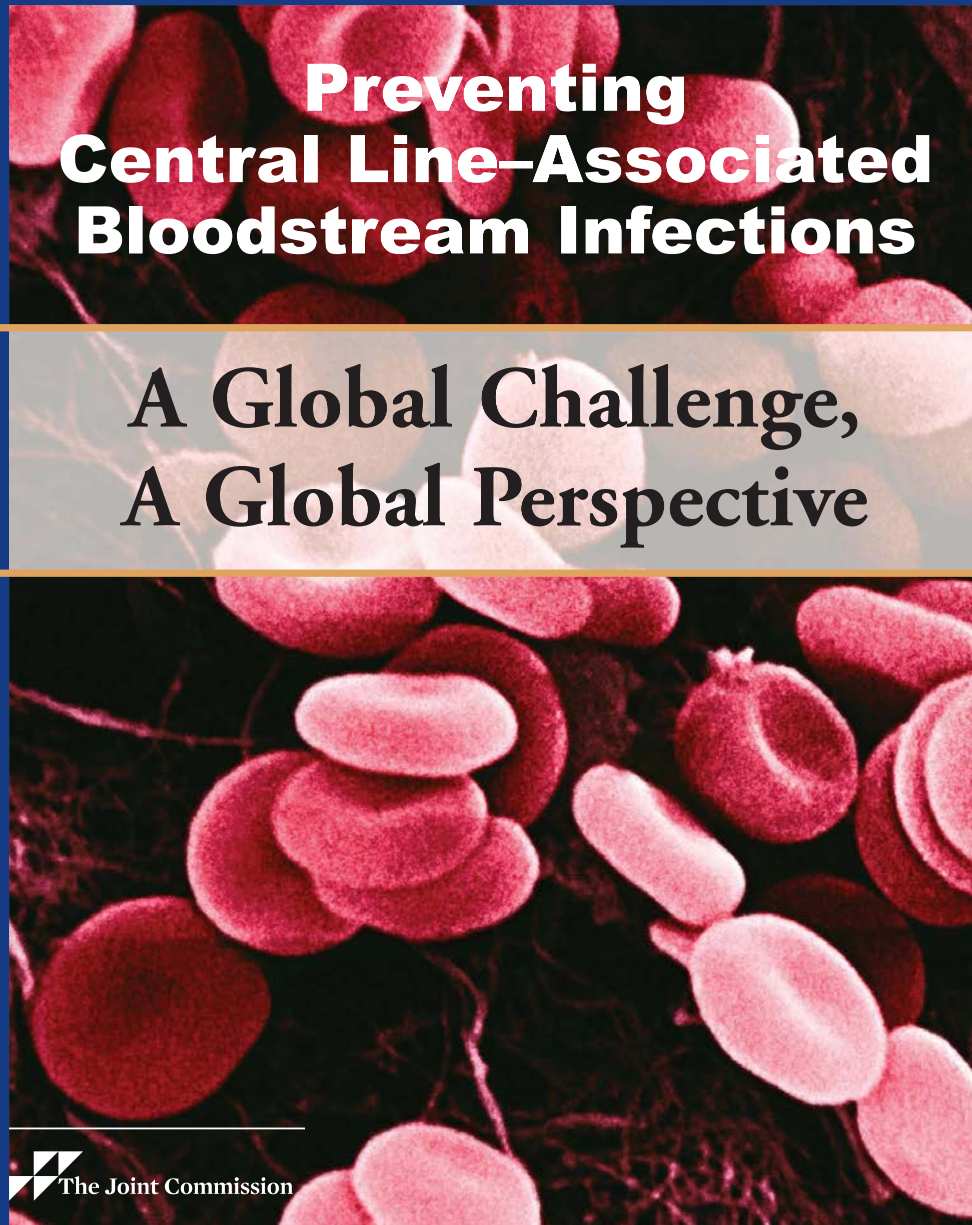
Rosenthal VD, et al. INICC data. SHEA Meeting. Atlanta, USA, March 2010

CLAB Rates Stratified By Hospital Type



95%CI ***9.6-10.3*** ***8.6-9.9*** ***5.4-6.3***

Rosenthal VD, et al. INICC data. SHEA Meeting. Atlanta, USA, March 2010



http://www.jointcommission.org/preventing_clabsi/. Accesed on August 12th 2012

This monograph was authored by The Joint Commission, Joint Commission Resources, and Joint Commission International. They partnered with infection prevention leaders from the following organizations:

- **Association for Professionals in Infection Control and Epidemiology (APIC)**
- **Association for Vascular Access (AVA)**
- **Infectious Diseases Society of America (IDSA)**
- **International Nosocomial Infection Control Consortium (INICC)**
- **National Institutes of Health (NIH)**
- **Society for Healthcare Epidemiology of America (SHEA)**

http://www.jointcommission.org/preventing_clabsi/. **Accesed on August 12th 2012**

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CLABSI Prevention Strategies, Techniques, and Technologies

1. **Education and Training of Health Care Personnel**
2. **Hand Hygiene**
3. **Aseptic Technique**
4. **CVC Insertion Preparation**
   a. Maximal Sterile Barrier Precautions
   b. Skin Preparation
   c. Catheter Selection
      - *Number of Lumens*
      - *Antimicrobial- or Antiseptic-Impregnated Catheters*
   d. Use of Catheter Kits or Carts
5. **CVC Insertion**
   a. Insertion Under Ultrasound Guidance
   b. Catheter Site Dressing Regimens
   c. Securement Devices
   d. Use of a CVC Insertion Bundle
6. **CVC Maintenance**
   a. Prophylactic Antibiotic Lock Solutions, Antimicrobial Flush Solutions, and Catheter Lock Solutions
   b. Disinfection of Catheter Hubs, Connectors, and Injection Ports
      - Needle les connectors
   c. Chlorhexidine Bathing
   d. Use of a CVC Maintenance Bundle
7. **Removal or Replacement of Catheters or System Components**
   a. Changing Administration System Components
   b. CVC Exchanges over a Guidewire
8. **Tools and Techniques**
   a. Checklists
   b. Vascular Access Teams
   c. Safe Practices for Parenteral Fluid and Medication Administration and Vial Access

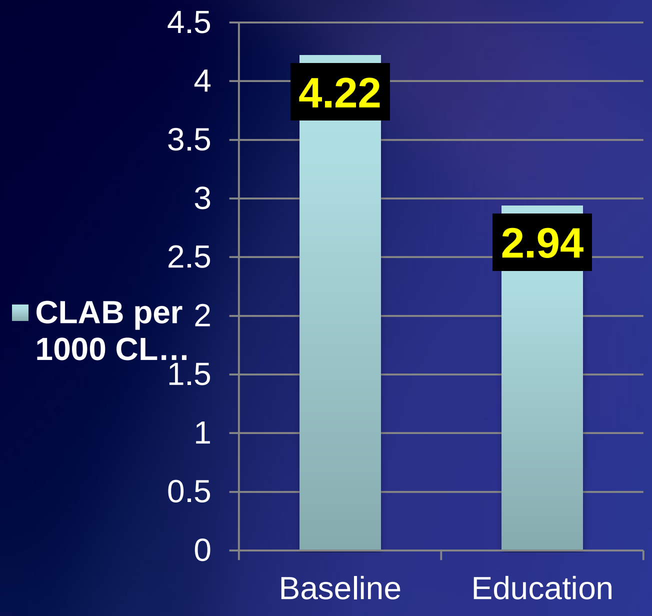
http://www.jointcommission.org/preventing_clabsi/. **Accesed on August 12th 2012**

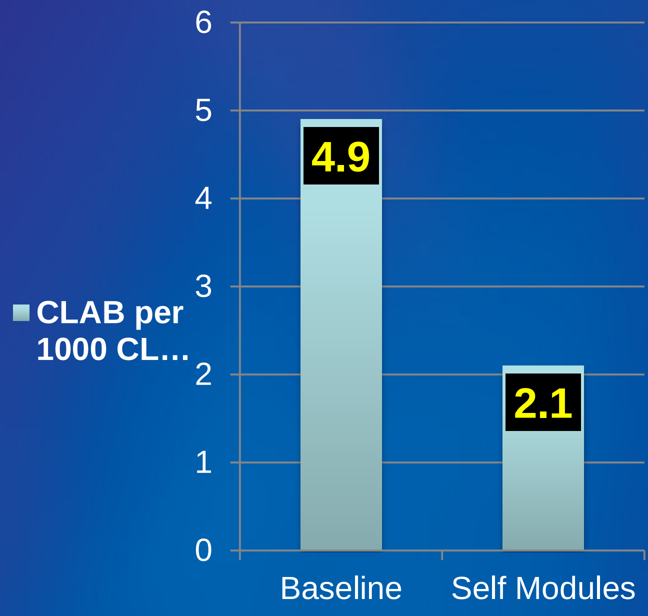
Education and Training of Health Care Personnel

- The appropriate indications for CVC insertion:
  - Administration of medications, such as chemotherapy or antibiotics
  - Administration of fluids, including blood or blood products
  - Monitoring of central venous pressure
  - Providing parenteral nutrition
  - Providing hemodialysis

http://www.jointcommission.org/preventing_clabsi/. **Accesed on August 12th 2012**

Education, Training and Staffing





Strattegy: 15-minute lecture for all ICU HCW; 10 of the evidence-based strategies in the CDC Guidlines

Strategy: Self-study modules, education, along with lectures and posters

Pérez Parra A, Cruz Menárguez M, Pérez Granda MJ, Tomey MJ, Padilla B, Bouza E. A simple educational intervention to decrease incidence of central line–associated bloodstream infection (CLABSI) in intensive care units with low baseline incidence of CLABSI. Infect Control Hosp Epidemiol. 2010 Sep;31(9):964–947.

Warren DK, et al. An educational intervention to prevent catheter- associated bloodstream infections in a nonteaching, community medical center. Crit Care Med. 2003 Jul;31(7):1959–1963.

Hand Hygiene

Hand hygiene is a key component of any effective patient safety and infection prevention program.

Hand hygiene is generally accepted as the single most important measure in preventing the spread of infection.

Both soap and water and alcohol-based hand rub products can be used to achieve proper hand hygiene.

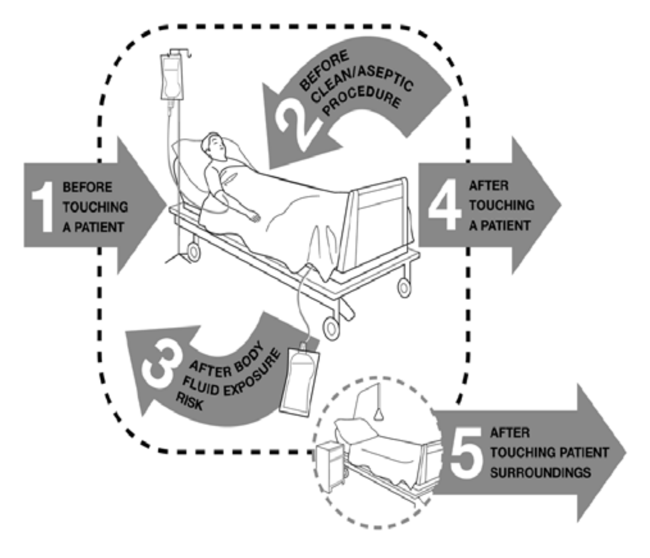


Figure 3-1. World Health Organization's "My 5 Moments for Hand Hygiene"

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- Pessoa-Silva CL, Hugonnet S, Pfister R, Touveneau S, Dharan S, Posfay-Barbe K, Pittet D. Reduction of health care associated infection risk in neonates by successful hand hygiene promotion. Pediatrics. 2007 Aug;120(2):e382–390.
- The Joint Commission. Measuring Hand Hygiene Adherence: Overcoming the Challenges. Oak Brook, IL: Joint Commission Resources, 2009.
- Rosenthal VD, Guzman S, Safdar N. Reduction in nosocomial infection with improved hand hygiene in intensive care units of a tertiary care hospital in Argentina. Am J Infect Control. 2005 Sep;33(7):392–397.

Aseptic Technique

Aseptic technique is a method used to prevent contamination with microorganisms.

Aseptic technique is applicable in all health care settings where providers perform surgery or other invasive procedures, including the insertion of CVCs or urinary catheters.

Aseptic technique is recommended by the evidence-based guidelines for all instances of CVC insertion and care.

In aseptic technique, only sterile-to-sterile contact is allowed; sterile-to-nonsterile contact must be avoided.

- Mermel LA, McCormick RD, Springman SR, Maki DG. The pathogenesis and epidemiology of catheter- related infection with pulmonary artery Swan-Ganz catheters: a prospective study utilizing molecular subtyping. Am J Med 1991; 91:197S–205.

- Abi-Said D, Raad I, Umphrey J, et al. Infusion therapy team and dressing changes of central venous catheters. Infect Control Hosp Epidemiol 1999; 20:101–5.

- Capdevila JA, Segarra A, Pahissa A. Catheter-related bacteremia in patients undergoing hemodialysis. Ann Intern Med 1998; 128:600.

- Raad II, Hohn DC, Gilbreath BJ, et al. Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. Infect Control Hosp Epidemiol 1994; 15:231–8.

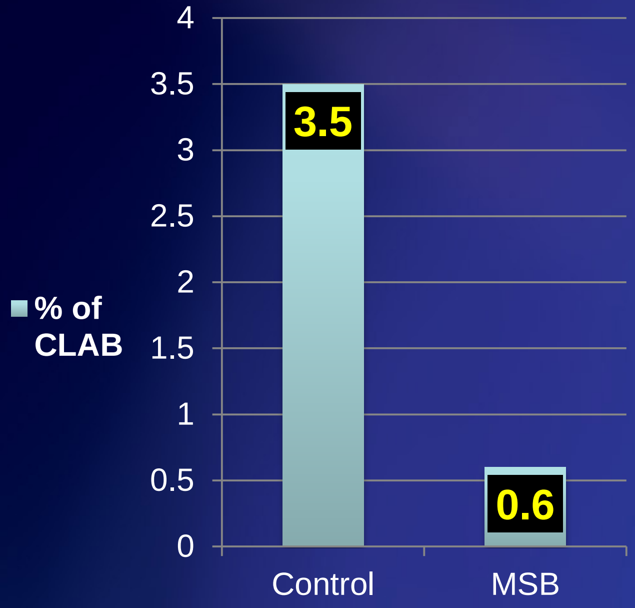
CVC Insertion Preparation: Maximal Sterile Barrier Precautions

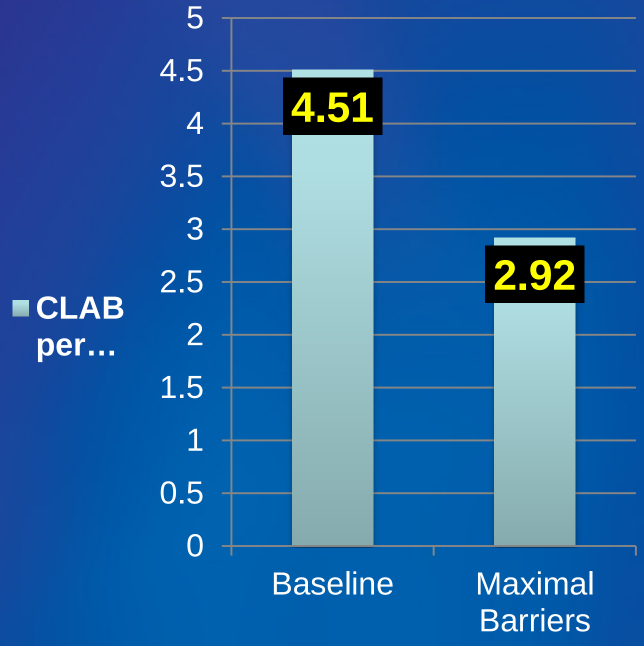
Several studies have demonstrated the benefit, either alone or as part of multimodal CLABSI prevention strategies, of using MSB precautions during CVC placement to reduce the risk of CLABSIs

Maximal sterile barrier (MSB) precautions require:

- The CVC inserter to wear
  - Mask,
  - cap,
  - sterile gown,
  - sterile gloves.
- to use a large (head-to-toe) sterile drape over the patient during the placement of a CVC or exchange of a catheter over a guidewire.

CVC Insertion Preparation: Maximal Sterile Barrier Precautions





Strattegy: Maximal Steriel Barrier Precautions

Strategy: Standardize CL insertion with MSB precautions, educational program for first postgraduate year

*Raad, II, D. C. Hohn, et al. (1994). "Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion." Infection control and hospital epidemiology : **15**(4 Pt 1): 231-238.*

Sherertz RJ, Ely EW, Westbrook DM, Gledhill KS, Streed SA, Kiger B, Flynn L, Hayes S, Strong S, Cruz J, Bowton DL, Hulgan T, Haponik EF. Education of physicians-in-training can decrease the risk for vascular catheter infection. Ann Intern Med. 2000 Apr 18;132(8):641–648.

CVC Insertion Preparation: Skin Preparation

Reducing colonization at the insertion site is a critical component of CLABSI prevention.

A number of studies have shown that chlorhexidine gluconate preparations are superior to both iodophors and alcohol for skin antisepsis.

The following summarizes current recommendations for skin antisepsis prior to CVC insertion and during dressing changes:

- *Apply antiseptics to clean skin.*
- *Apply chlorhexidine/alcohol in a concentration of at least 0.5% in alcohol.*
- *If there is a contraindication to chlorhexidine; iodophor, or alcohol as an alternative.*
- *Allow the antiseptic solution to dry before placing the catheter.*

CVC Insertion Preparation: Skin Preparation

Chlorhexidine Compared with Povidone-Iodine Solution for Vascular Catheter–Site Care: A Meta-Analysis

Nathorn Chaiyakunapruk, PharmD, PhD; David L. Veenstra, PharmD, PhD; Benjamin A. Lipsky, MD; and Sanjay Saint, MD, MPH

Purpose: Bloodstream infections related to use of catheters, particularly central-line catheters, are an important cause of patient morbidity, mortality, and increased health care costs. This study evaluated the efficacy of skin disinfection with chlorhexidine gluconate compared with povidone-iodine solution in preventing catheter-related bloodstream infection.

Data Sources: Multiple computerized databases (1966 to 2001), reference lists of identified articles, and queries of principal investigators and antiseptic manufacturers.

Study Selection: Randomized, controlled trials comparing chlorhexidine gluconate with povidone-iodine solutions for catheter-site care.

Data Extraction: Using a standardized form, two reviewers abstracted data on study design, patient population, intervention, and incidence of catheter-related bloodstream infection from all included studies.

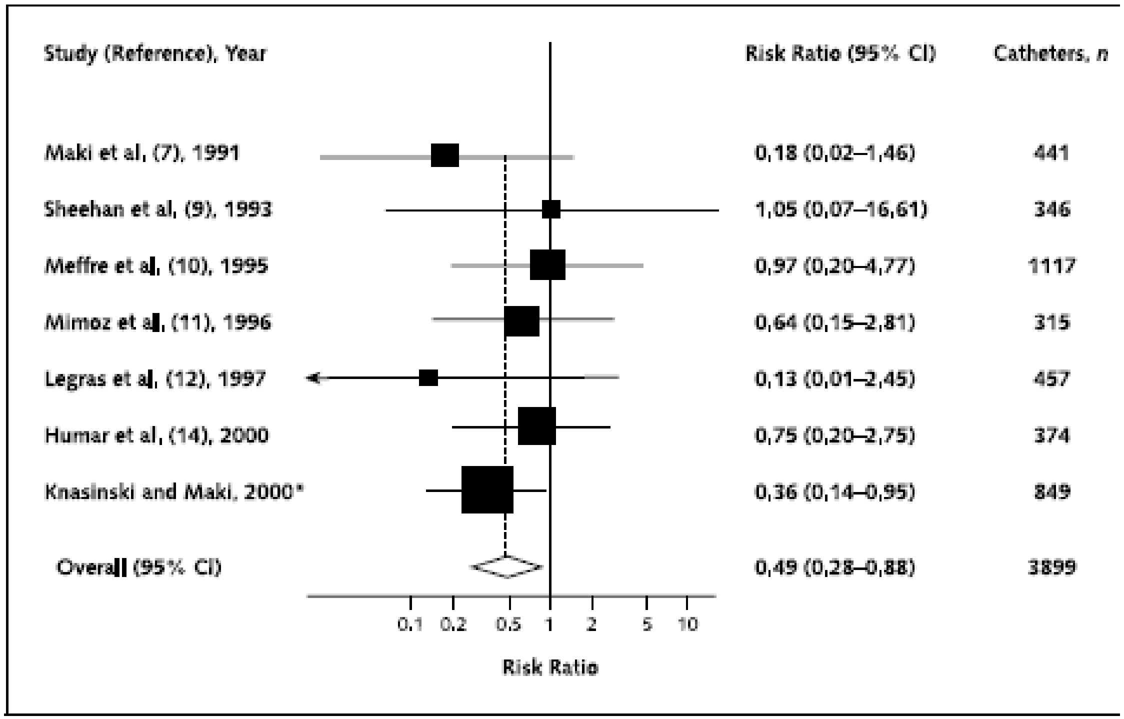
Data Synthesis: Eight studies involving a total of 4143 catheters met the inclusion criteria. All studies were conducted in a hospital setting, and various catheter types were used. The summary risk ratio for catheter-related bloodstream infection was 0.49 (95% CI, 0.28 to 0.88) in patients whose catheter sites were disinfected with chlorhexidine gluconate instead of povidone-iodine. Among patients with a central vascular catheter, chlorhexidine gluconate reduced the risk for catheter-related bloodstream infection by 49% (risk ratio, 0.51 [CI, 0.27 to 0.97]).

Conclusions: These results suggest that incidence of bloodstream infections is significantly reduced in patients with central vascular lines who receive chlorhexidine gluconate versus povidone-iodine for insertion-site skin disinfection. Use of chlorhexidine gluconate is a simple and effective means of reducing vascular catheter–related infections.

Ann Intern Med. 2002;136:792-801. www.annals.org
For author affiliations, see end of text.

CVC Insertion Preparation: Skin Preparation

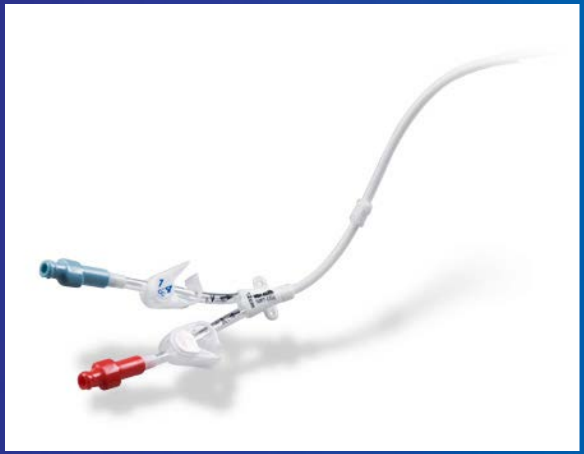
Figure 2. Analysis of catheter-related bloodstream infection in studies comparing chlorhexidine gluconate and povidone-iodine solutions for care of vascular catheter sites.



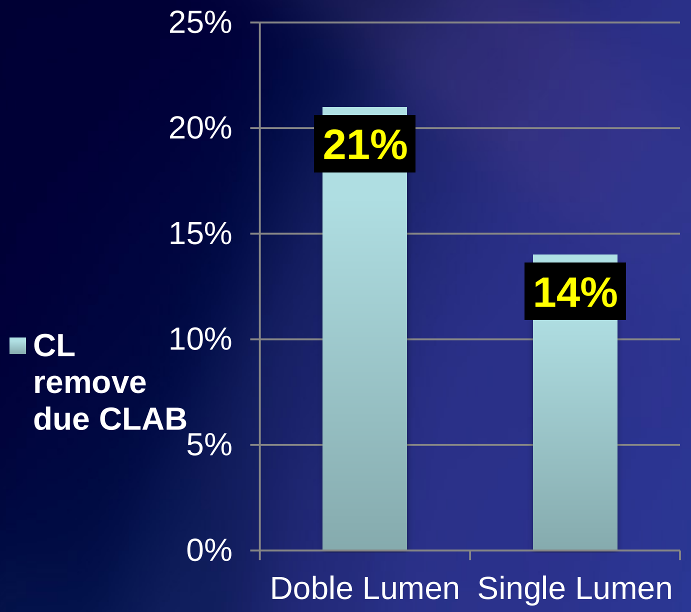
The diamond indicates the summary risk ratio and 95% CI. Studies are ordered chronologically. The size of squares is proportional to the reciprocal of the variance of the studies. For the test for heterogeneity of treatment effect, $P > 0.2$. *Knasinski V, Maki DG. A prospective, randomized, controlled trial of 1% chlorhexidine 75% alcohol vs. 10% povidone iodine for cutaneous disinfection and follow-up site care with central venous and arterial catheters [Presented paper]. San Diego: National Association of Vascular Access Network Conference; 2000.

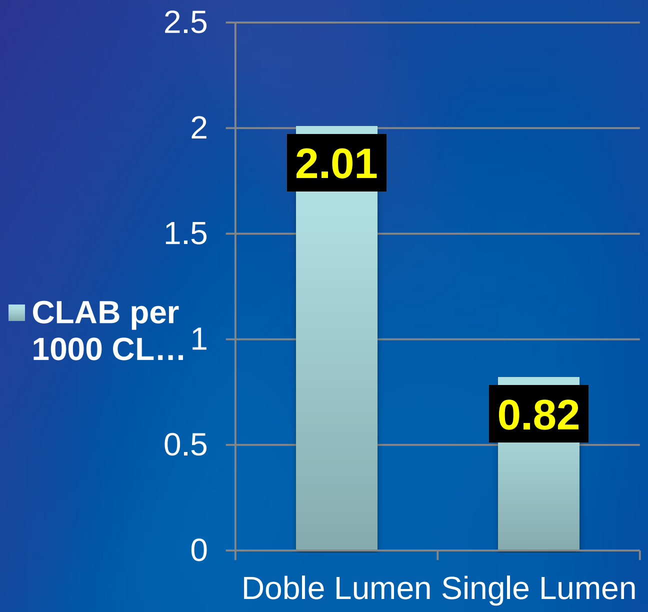
CVC Insertion Preparation: Catheter Selection: Number of Lumens

Evidence-based guidelines recommend that a CVC with the minimum number of lumens necessary for the management of the patient be used.



CVC Insertion Preparation: Catheter Selection: Number of Lumens





Strattegy: Doble Lumen vs Single Lumen

Early TF, Gregory RT, Wheeler JR, Snyder SO Jr., Gayle RG. Increased infection rate in double-lumen versus single-lumen Hickman catheters in cancer patients. South Med J 1990; 83:34–6.

CVC Insertion Preparation:
Catheter Selection:
Antimicrobial- or Antiseptic-Impregnated Catheters

Evidence-based guidelines support the use of antimicrobial- or antiseptic-impregnated catheters **if CLABSI rates are not decreasing after the implementation of a comprehensive strategy to reduce those rates.**

Such a comprehensive strategy should include, at a minimum, the following:

- Educating health care personnel who insert and maintain CVCs.
- Using maximal sterile barrier precautions.
- Using a greater than 0.5% chlorhexidine preparation with alcohol for skin preparation prior to CVC insertion.

Should CLABSI rates not be reduced with the aforementioned strategies, evidence-based guidelines recommend the use of **chlorhexidine/silver sulfadiazine or minocycline/rifampin**- impregnated CVCs for use in patients expected to have a CVC in place for an extended period of time, though the suggested time frame varies—from “more than 5 days” to “from 1 to 3 weeks.”

CVC Insertion Preparation: Use of Catheter Kits or Carts

Having standardized supply carts or kits with all the necessary CVC insertion and care supplies and equipment in “ready to go” locations

It is essential that the carts or kits are always stocked and readily accessible.

Carts and kits must contain all supplies recommended by evidence- based practices—for example:

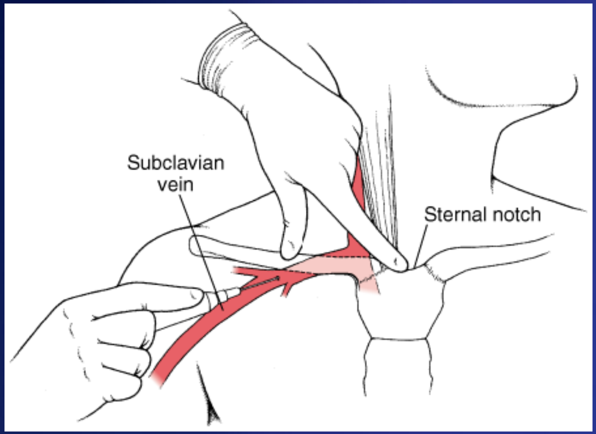
- chlorhexidine for skin antisepsis;
- cap, mask, and sterile gloves for inserters and those assisting with the procedure
- a large sterile drape for insertion procedures (rather than a small drape);

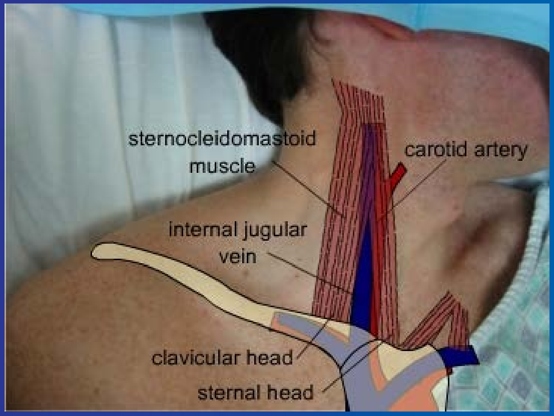
http://www.jointcommission.org/preventing_clabsi/. **Accesed on August 12th 2012**

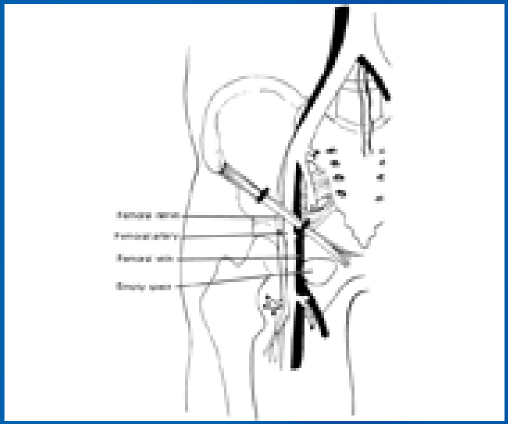
CVC Insertion: Catheter site selection

Data derived from several observational studies of CVC insertions suggest that the greatest risk of infection in adults is associated with use of the femoral vein as the insertion site, and the lowest risk is associated with subclavian site insertions, with an intermediate level of risk associated with internal jugular vein insertions for nontunneled CVCs

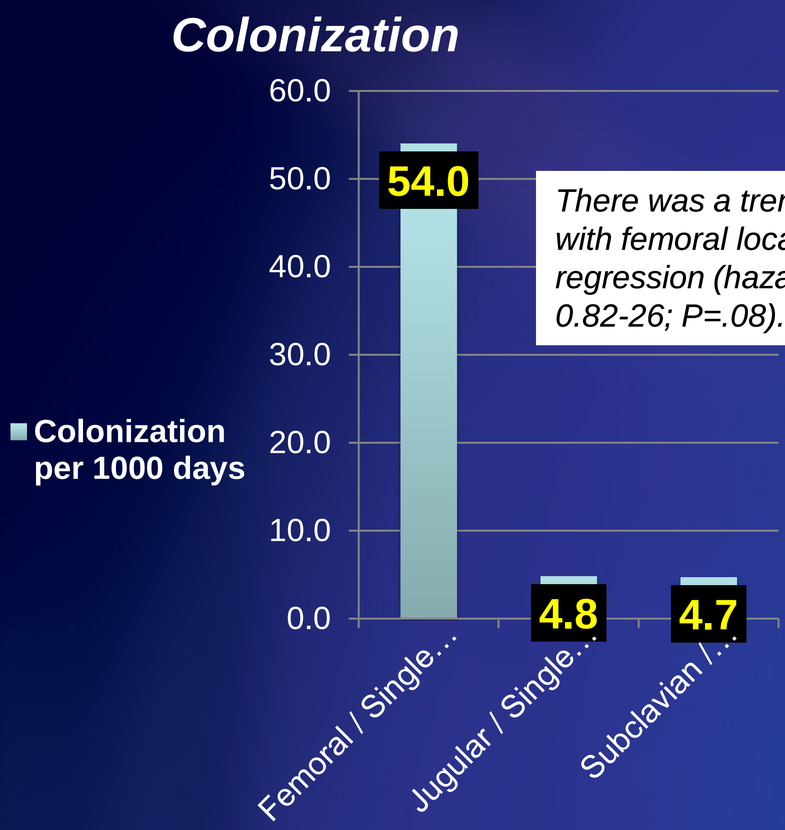
- *Avoid using the femoral site for CVC access in adult patients.*



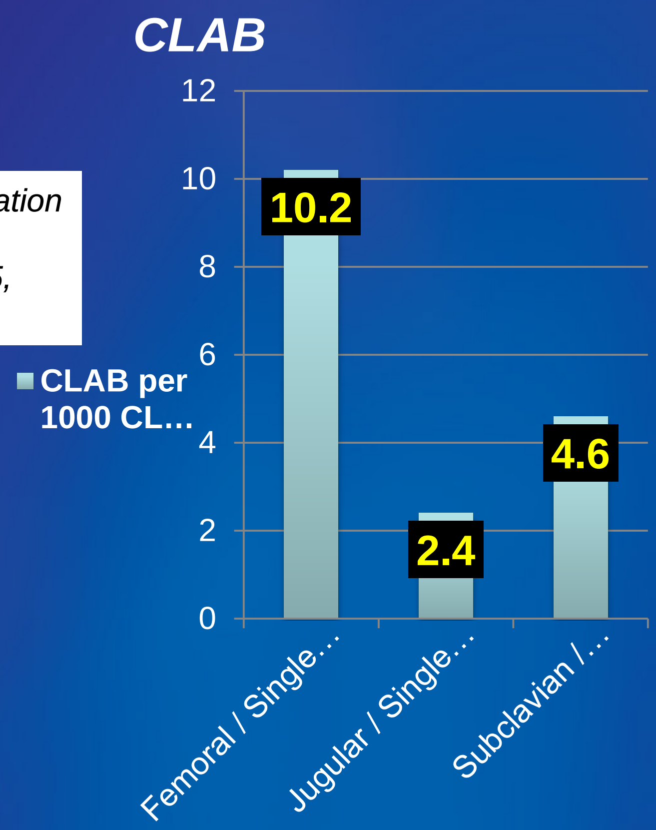




CVC Insertion: Catheter site selection



There was a trend for association with femoral location by Cox regression (hazard, 4.7; CI95, 0.82-26; P=.08).

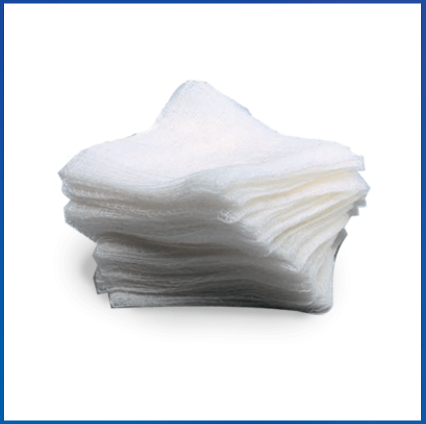


Strattegy: Femoral vs Jugular, vs Subclavian

*Goetz, A. M., M. M. Wagener, et al. (1998). "Risk of infection due to central venous catheters: effect of site of placement and catheter type." Infection Control & Hospital Epidemiology **19**(11): 842-845.*

CVC Insertion:
Catheter Site Dressing Regimens

A clean and dry dressing at the insertion site is important to protect the site and to minimize the risk of infection.



There are generally two types of dressings that can be used to cover and protect the insertion site:

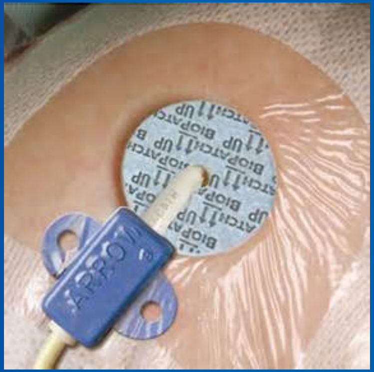
- sterile gauze and tape
- sterile, semipermeable "transparent" polyurethane dressings.

Studies have shown no clinically differences in site colonization or CLABSI rates between them.

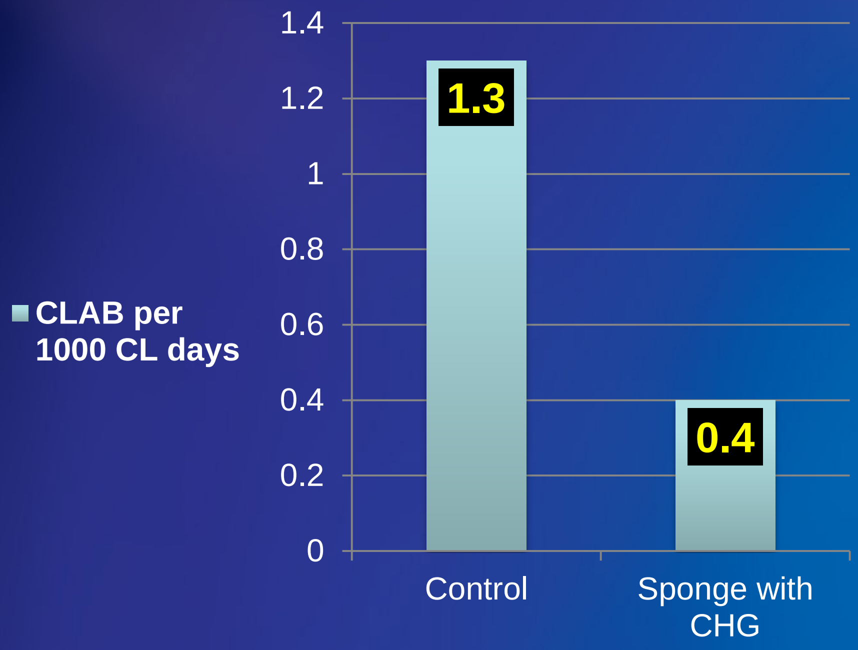
Transparent dressings permit continuous visual inspection of the insertion site, help to secure the device, and do not need to be changed as often as gauze and tape dressings.

Chlorhexidine impregnated sponge

- Chlorhexidine-impregnated dressings have been used to reduce the risk of CLABSI.
- Multicenter trial showed that patients in the chlorhexidine-impregnated dressing group had significantly fewer CLABSIs than those in the group randomized to a standard dressing.



Chlorhexidine impregnated sponge



Strattegy: *Chlorhexidine impregnated sponge*

Timsit JF, et al. Chlorhexidine-impregnated sponges and less frequent dressing changes for prevention of catheter-related infections in critically ill adults: A randomized controlled trial. JAMA. 2009 Mar 25;301(12):1231–1241.

CVC Maintenance: Disinfection of catheter hubs, connectors, and injection ports

The external surface of a catheter hub, connector, or injection port is the immediate portal of entry of microorganisms to the intraluminal surface of the catheter.

The colonizing microorganisms form within the needleless connector, catheter hub, and lumen and can be dispersed into the bloodstream, resulting in CLABSI.

It is critical, therefore, that these surfaces be thoroughly disinfected before they are accessed.

http://www.jointcommission.org/preventing_clabsi/. **Accesed on August 12th 2012**

CVC Maintenance: Disinfection of catheter hubs, connectors, and injection ports

- "Three Ways Stopcocks" should be "avoided", as they represent a potential portal of entry for microorganisms into vascular access catheters and IV fluids.
- Closed catheter access systems are associated with fewer infections than open systems and should be used preferentially

http://www.jointcommission.org/preventing_clabsi/. **Accesed on August 12th 2012**

CVC Maintenance: Needleless Intravascular Catheter Systems

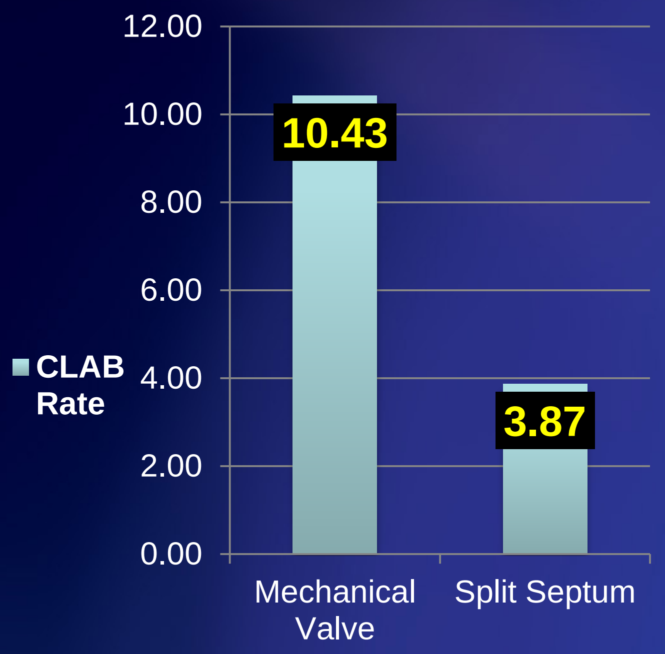
When needleless systems are used,

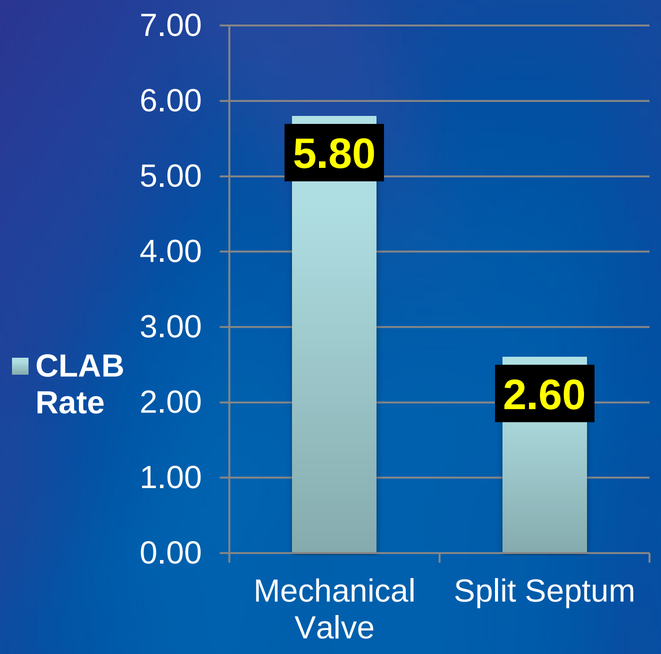
a “Split Septum” may be preferred over ”Mechanical Valves”

due to increased risk of infection with the mechanical valves [1-4]. Category II

1. *Rupp ME, Sholtz LA, Jourdan DR, et al. Outbreak of bloodstream infection temporally associated with the use of an intravascular needleless valve. Clin Infect Dis 2007; 44:1408–14.*
2. *Salgado CD, Chinnes L, Paczesny TH, Cantey JR. Increased rate of catheter-related bloodstream infection associated with use of a needleless mechanical valve device at a long-term acute care hospital. Infect Control Hosp Epidemiol 2007; 28:684–8.*
3. *Maragakis LL, Bradley KL, Song X, et al. Increased catheter-related bloodstream infection rates after the introduction of a new mechanical valve intravenous access port. Infect Control Hosp Epidemiol 2006; 27:67–70.*
4. *Field K, McFarlane C, Cheng AC, et al. Incidence of catheter-related bloodstream infection among patients with a needleless, mechanical valve-based intravenous connector in an Australian hematology-oncology unit. Infect Control Hosp Epidemiol 2007; 28:610–3.*

Background: Needleless Intravascular Catheter Systems: Split Septum vs Mechanical Valve





Strattegy: Split Septum against Mechanical Valve

- Rupp M et al. CID 2007;44:1408-14
- *Kathryn Field, MBBS et al. Infection Control and Hospital Epidemiology, May 2007, Vol. 28, No 5*

Single Use Flushing Systems

- **INS:**
  - Flushing is an important element of intermittent I.V .therapy. Flushing with preservative-free 0.9 % sodium chloride (USP) or other flush solutions shall be performed before and after the administration of incompatible medications and solutions
  - Single-use flushing systems shall be used.

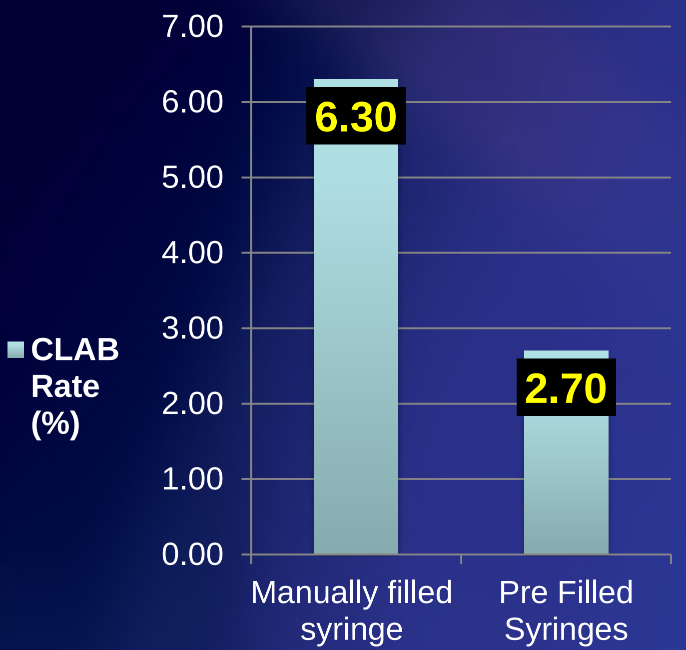
* **CDC**: Based on recent HCV outbreak,
  * CDC "strongly encourages" use of pre-fills or single dose vials.

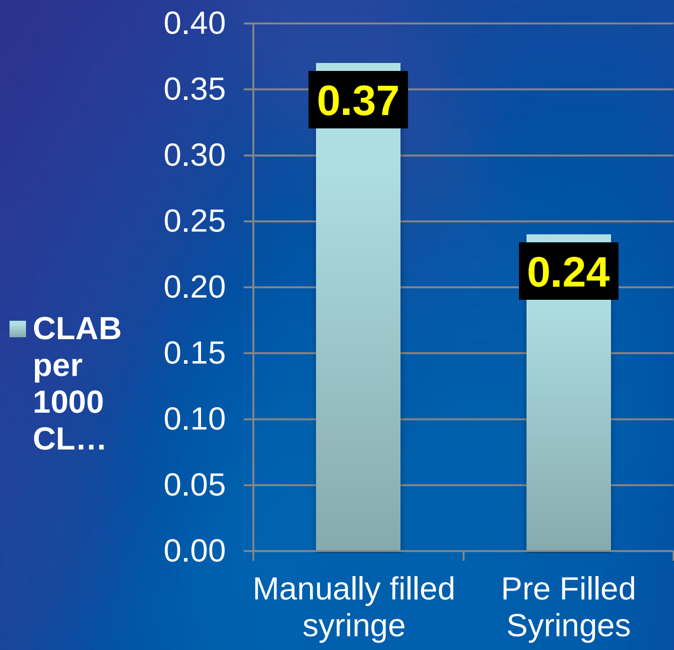
* **JCAHO**: Sentinel Events Alert identifies
  * " single-use IV flush vials" as important strategy to reduce the risk of nosocomial infections.

4- Infusion Nurse Society Standard. 2011
5- CDC
6- JCAHO Sentinel events

Background: Manually Filled Syringe vs Pre-Filled Syringe

P value: 0.01





Strattegy: *Manually filled syringe vs Pre-filled syringe*

Bertoglio et al. Pre-filled normal saline syringes to reduce totally implantable venous access device-associated bloodstream infection: a single institution pilot study. Journal of Hospital Infection 2013, in Press

CVC Maintenance: Open IV Container

Brazil

Japan

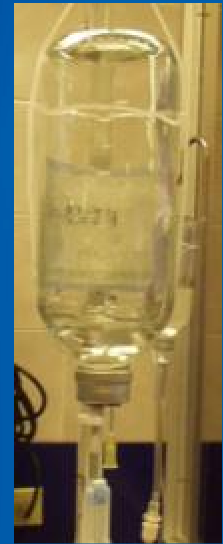
Turkey

Mexico

Argentina

South East Asia

Peru



Colombia

Czech

Open vs Closed Infusion IV Container

PROOF 1 INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY JANUARY 2011, VOL. 32, NO. 1

ORIGINAL ARTICLE

Impact of Switching from an Open to a Closed Infusion System on Rates of Central Line–Associated Bloodstream Infection: A Meta-Analysis of Time-Sequence Cohort Studies in 4 Countries

Dennis G. Maki, MD; Victor D. Rosenthal, MD, MSc, CIC; Reinaldo Salomao, MD; Fabio Franzetti, MD; Manuel Sigfrido Rangel-Frausto, MD

BACKGROUND. We report a meta-analysis of 4 identical time-series cohort studies of the impact of switching from use of open infusion containers (glass bottle, burette, or semirigid plastic bottle) to closed infusion containers (fully collapsible plastic containers) on central line–associated bloodstream infection (CLABSI) rates and all-cause intensive care unit (ICU) mortality in 15 adult ICUs in Argentina, Brazil, Italy, and Mexico.

METHODS. All ICUs used open infusion containers for 6–12 months, followed by switching to closed containers. Patient characteristics, adherence to infection control practices, CLABSI rates, and ICU mortality during the 2 periods were compared by χ^2 test for each country, and the results were combined using meta-analysis.

RESULTS. Similar numbers of patients participated in 2 periods (2,237 and 2,136). Patients in each period had comparable Average Severity of Illness Scores, risk factors for CLABSI, hand hygiene adherence, central line care, and mean duration of central line placement. CLABSI incidence dropped markedly in all 4 countries after switching from an open to a closed infusion container (pooled results, from 10.1 to 3.3 CLABSIs per 1,000 central line–days; relative risk [RR], 0.33 [95% confidence interval {CI}, 0.24–0.46]; $P < .001$). All-cause ICU mortality also decreased significantly, from 22.0 to 16.9 deaths per 100 patients (RR, 0.77 [95% CI, 0.68–0.87]; $P < .001$).

CONCLUSIONS. Switching from an open to a closed infusion container resulted in a striking reduction in the overall CLABSI incidence and all-cause ICU mortality. Data suggest that open infusion containers are associated with a greatly increased risk of infusion-related bloodstream infection and increased ICU mortality that have been unrecognized. Furthermore, data suggest CLABSIs are associated with significant attributable mortality.

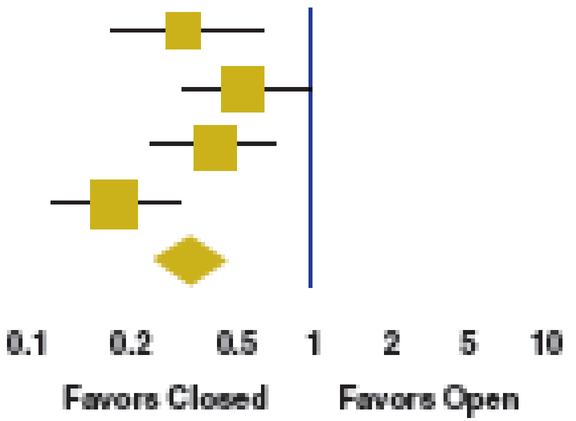
Infect Control Hosp Epidemiol 2011; 32(1):000-000

Meta Analysis–CLABSI per 1000 CL Days

Country	Risk ratio	Lower limit	Upper limit	Z-Value	p-Value
Argentina	0.346	0.153	0.784	-2.543	0.011
Brazil	0.492	0.257	0.940	-2.146	0.032
Italy	0.427	0.219	0.834	-2.490	0.013
Mexico	0.199	0.110	0.360	-5.338	0.000
Pooled	0.336	0.240	0.469	-6.398	0.000

(Statistics for each study)

Risk ratio and 95% CI



Heterogeneity: Q value = 4.827, df(Q) = 3 (P = 0.185), I squared = 37.848

For CLABSI per 1000 CL days, both the pooled (P<.001) and all four individual by-country analyses favored the closed infusion container. All of the analyses achieved statistical significance.

Maki DG, Rosenthal VD, et al. Infection Control and Hospital Epidemiology (ICHE) 2010, in press

Removal or Replacement of Catheters or System Components: Daily review of line necessity

- Risk of CLABSI increases with the duration of time the catheter is left in place,
- So daily evaluation of the continued need for a catheter is an important aspect of CLABSI prevention; catheters that are no longer needed should be promptly removed.

Removal or Replacement of Catheters or System Components: Changing administration system components

- The administration system, which includes the primary and any secondary sets and add- on devices, be changed on a regular basis.
  - The most appropriate interval for routine replacement of IV administration sets is every 96 hours.
  - For fat emulsions, nutrition, and blood products, tubing and add-on devices should be changed within 24 hours.

Tools and Techniques: Vascular access teams

Studies have shown that the use of IV teams, consisting of trained nurses or technicians who use strict aseptic technique during catheter insertion and follow-up care, can reduce the risk of phlebitis, bloodstream infections, and costs.

Few studies have been performed regarding the specific impact of such teams on CLABSI rates, categorizing the use of IV teams as an unresolved issue.

***http://www.jointcommission.org/preventing_clabsi/.* Accesed on August 12th 2012**

CVC Insertion:
Use of a CVC insertion bundle

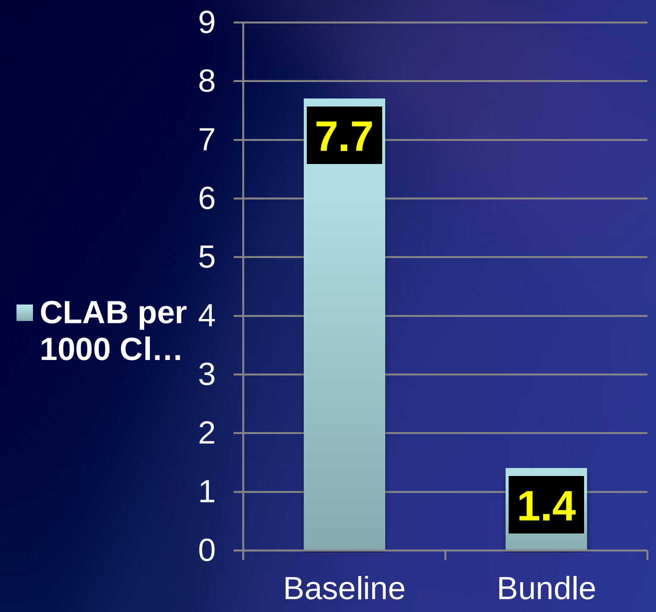
Bundles facilitate the use of evidence-based practices, and their use is recommended in CLABSI guidelines

Studies have shown that can lead to significant, sustained reductions in CLABSI rates.

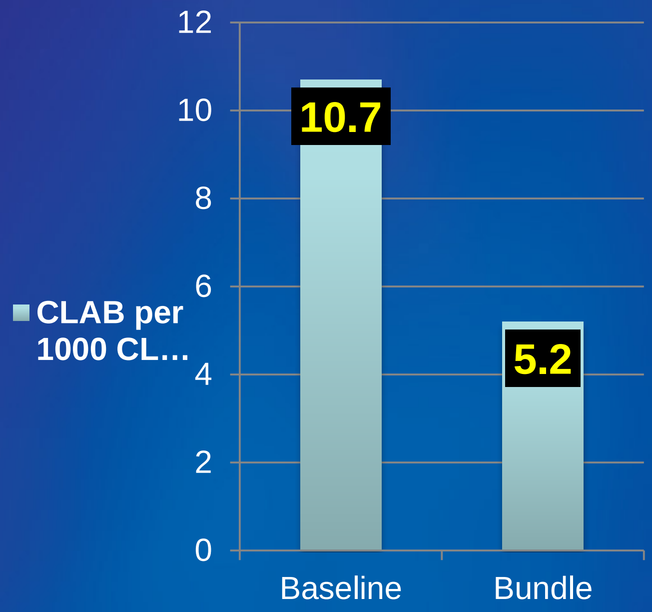
The Institute for Healthcare Improvement (IHI) describes a “bundle” as “group of best practices that individually improve care, but when applied together result in substantially greater improvement.”

http://www.jointcommission.org/preventing_clabsi/. **Accesed on August 12th 2012**

CVC Insertion:
Use of a CVC insertion bundle



INICC PICUs of 5 Countries



Strattegy: Bundle

Strategy: Bundle

*Pronovost, P., D. Needham, et al. (2006). "An intervention to decrease catheter-related bloodstream infections in the ICU." The New England journal of medicine **355**(26): 2725-2732.*

*Rosenthal, V. D., B. Ramachandran, et al. (2012). "Impact of a multidimensional infection control strategy on central line-associated bloodstream infection rates in pediatric intensive care units of five developing countries: findings of the International Nosocomial Infection Control Consortium (INICC)." Infection **40**(4): 415-423.*

Tools and Techniques: Checklists

A checklist is a list of criteria or action items that are arranged in a systematic order.

Standardized CVC checklists reflect the elements based on evidence-based practices, included in the bundle and serve to remind health care personnel of key steps and procedures that need to be done with each CVC insertion or maintenance episode that can help prevent CLABSI, thereby reducing ambiguity about what should be done.

Using a checklist requires at least two staff members: the inserter, who performs the procedure, and the observer, who records the information on the checklist.

http://www.jointcommission.org/preventing_clabsi/. **Accesed on August 12th 2012**

Sample CVC Insertion Checklist

CENTRAL LINE INSERTION STANDARD WORK & SAFETY (BUNDLE) CHECKLIST for CCU & IV RNs

Date: ____________ **Start Time:** ____________ **End Time:** ____________

Procedure Location: ☐ Radiology ☐ OR ☐ CCU ☐ Induction Room ☐ Dialysis ☐ Other________

Procedure Operator: ☐ Attending ☐ Resident ☐ IV RN ☐ PA

Person Filling Out Form: ____________ ☐ IV RN ☐ CCU RN ☐ Other, title________

Catheter Type: ☐ Dialysis ☐ Central Venous ☐ PICC (type) ☐ PA/Swan Ganz ☐ Port

Number of Lumens: ☐ 1 ☐ 2 ☐ 3 ☐ 4 Catheter lot number: ____________

Insertion Site: ☐ Jugular ☐ Upper Arm ☐ Subclavian ☐ Femoral **Side of Body:** ☐ Left ☐ Right ☐ Bilateral

Reason for Insertion (*NO Routine Replacement!*) ☐ Elective ☐ Malfunction ☐ Emergent

	Central Line Standard Work	YES
BEFORE	**Patient's Allergy Assessed** (especially to Lidocaine or Heparin)	☐
	Patient's Latex Allergy Assessed (modify supplies)	☐
	Consent form complete & in chart Exception: Emergent Procedure	☐
	Bundle Element = Hand Hygiene	
	Operator and Assistant cleanse hands (ASK, if not witnessed)	☐
	Bundle Element = Optimal Catheter Site Selection	
	Subclavian is the preferred site for central lines **Check / Explain why alternate site used:** ____________ ☐ Anatomy – distorted, prior surgery/rad. Sac ☐ Anesthesiologist placed ☐ Chest wall infection ☐ Coagulopathy ☐ COPD severe/ lung dx ☐ Dialysis line placed ☐ Emergency / CPR ☐ Operator training ☐ PICC Placed	☐ **OR** Exception(s) Checked to left
	Procedural Time - Out Performed Patient ID X 2	☐
	Announce the procedure to be performed	☐
	Mark/ assess site	☐
	Position patient correctly for procedure (Supine or Trendelenburg)	☐
	Assemble equipment/ verify supplies; **including venous confirmation method**	☐
	Verify that all medication & syringes are labeled	☐
	Bundle Element = Skin Antisepsis	
	Skin Prep Performed Chlorhexidine/alcohol applicator used; Dry technique: 30 second scrub + 30 second dry time **OR** Chlorhexidine/alcohol applicator used; Wet technique: 2 minute scrub + 1 minute dry time	☐ DRY **OR** ☐ WET
	Bundle Element = MAXIMUM Sterile Barriers	
	Patient's body covered by sterile drape	☐
	Operator and Assistant in PPE (sterile gloves, hat, mask and sterile gown)	☐
	Others (in room, except patient) **wearing Mask**	☐
DURING	**VMMC Bundle Element = Ultrasound Guidance**	
	Ultrasound Guidance Used for PICC, Internal Jugular & Femoral Insertions	☐ Device OR ☐ Subclavian
	VMMC Bundle Element = Venous Confirmation	
	Confirmation of Venous Placement PRIOR TO DILATION OF VEIN by: **Approved methods: 1) TEE OR 2) Pressure Transducer OR 3) Manometry Method OR 4) Fluroscopy**	☐ Method OR ☐ PICC
	Type and Dosage (mL / units) of Flush: ____________	☐
	Catheter Caps Placed on Lumens	☐
	Catheter Secured / Sutured in place	☐
	Tip position confirmation via: Fluroscopy OR Chest X-ray ordered	☐
AFTER	**Sterile Technique Maintained when applying dressing**	
	Dressing Dated	
	Chest Xray / Fluroscopy Findings Confirm Catheter Position	
	Repositioning Required because of Xray Findings	
	"Approved for use" Writing on Dressing After Confirmation	
	If placed in CCU, CCU RN Notified IV RN Dept. X of Central Line Placement	
	If a Femoral line placed, Elective PICC Placement Ordered (NOW).	
	Central line (maintenance) Order Placed	

Procedure Note:

Tip location: | Catheter Measurements: (Cut catheter, external length, internal length)

PATIENT NAME & ID #

VIRGINIA MASON MEDICAL CENTER – Seattle WA
Central Line Insertion Standard Work & Safety (Bundle) Checklist for CCU & IV RNs

INICC Multidimensional Approach to reduce CLABSI rates

The INICC HAI Multi Faceted Prevention Model Included the Following Measures:

1- Bundle of infection control interventions,

2- Education,

3- Outcome surveillance,

4- Feedback of HAI rates,

5- Process surveillance,

6- Performance feedback of infection control practices

Reducing CLAB rate in ICUs of Argentina

Effect of an infection control program using education and performance feedback on rates of intravascular device-associated bloodstream infections in intensive care units in Argentina

Victor Daniel Rosenthal, MD, MS, CIC,[a] Sandra Guzman, RN, ICP,[a] Stella Maris Pezzotto, MS,[b] and Christopher J. Crnich, MD[c]
Buenos Aires, Argentina, and Madison, Wisconsin

Objective: Our aim was to ascertain the effect of an infection control program, using education and performance feedback on intensive care units, for intravascular device (IVD)-associated bloodstream infection (BSI).

Methods: Within 4 level III, adult, intensive care units in Argentina, all admitted, adult patients with a central vascular catheter in place for at least 24 hours were included. This was a prospective before-and-after trial in which rates of IVD-associated BSI determined during a period of active surveillance without education or performance feedback (phase 1) were compared after sequential implementation of an infection control program using education (phase 2) and performance feedback (phase 3).

Results: A total of 1219 IVD days were accumulated in phase 1; 586 during phase 2; and 4140 during phase 3. Compliance with central vascular catheter—site care improved significantly from baseline during the study period. Overall rates of IVD-associated BSI were lowered significantly from baseline after sequential implementation of education and performance feedback (11.10 vs 46.63 BSI/1000 IVD days; relative risk = 0.25; 95% confidence interval = 0.17-0.36; $P < .0001$). Rates of IVD-associated BSI decreased significantly after implementation of an educational program (phase 1 to phase 2) (relative risk 0.57; confidence interval 0.19-0.73; P = .0026) and further reductions were seen after implementation of a performance feedback program (phase 2 to phase 3), although the reduction did not reach statistical significance (9.9 vs 17.06 BSI/1000 IVD days; relative risk 0.58; confidence interval 0.29-1.18; P = .11). Additional analysis of the data using χ^2 for trends demonstrated that sequential implementation of an education and performance feedback program resulted in a significant trend toward reduced rates of IVD-associated BSI ($P < .001$).

Conclusion: Implementation of an infection control program, using education and performance feedback, resulted in significant reductions in rates of IVD-associated BSI. (Am J Infect Control 2003;31:405-9.)

Characteristics of Patients in both Periods

Table 2. Baseline characteristics of patients at study entry

	Preintervention (%)	Intervention (%)	*P*
Male sex, %	84 (48.8)	358 (53.6)	.265
Age (y), mean ± SD	71.98 ± 13.45	71.91 ± 12.19	.944
Diabetes, %	32 (18.6)	103 (15.4)	.314
Cancer, %	9 (4.8)	33 (4.9)	.925
HIV, %	1 (0.6)	0 (0.0)	.205*

Process Surveillance

Table 3. Compliance with intravascular device site care

	Phase 1	Phase 2	Phase 3
Presence of gauze on IVD site	53.02% (184/347)	56.21% (95/169)	96.53% (4986/5165)
	—	RR = 1.06*	RR = 1.72†
	—	95% CI = 0.86–1.30	95% CI = 1.40–2.10
	—	*P* = .64*	*P* < .001†
Date on IV administration set	0.57% (2/347)	0.00% (0/169)	74.00% (3839/5165)
	—	—	—
	—	*P* = .32*	*P* < .001†
Good gauze condition	48.70% (169/347)	43.19% (73/169)	89.56% (4626/5165)
	—	RR = 0.89*	RR = 2.07†
	—	95% CI = 0.67–1.17	95% CI = 1.65–2.62
	—	*P* = .39*	*P* < .001†

Rates of CLAB

	BSIs per 1000 IVD-days	RR	*P*- value
Phase 1	45.94 (56/1219)		
Phase 2	17.06 (10/586)	0.37**	<0.001
Phase 3	9.90 (41/4140)	0.58***	0.11

*Rosenthal, V. D., S. Guzman, et al. (2003). "Effect of an infection control program using education and performance feedback on rates of intravascular device-associated bloodstream infections in intensive care units in Argentina." American Journal of Infection Control **31**(7): 405-409.*

Reducing CLAB rate and Mortality rate in ICUs in Mexico

The effect of process control on the incidence of central venous catheter–associated bloodstream infections and mortality in intensive care units in Mexico*

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Purpose: To ascertain the effect of an infection control program including process control on intensive care unit (ICU) rates of intravascular device (IVD)–associated bloodstream infection (BSI).

Setting: Two level III adult ICUs in one public university hospital in Mexico: one medical surgical ICU and one neurosurgical ICU.

Population Study: All adult patients admitted to study units who had a central venous catheter (CVC) in place for at least 24 hrs.

Methods: A prospective before/after trial in which rates of IVD-associated BSI are determined during a period of active surveillance without process control (phase 1) were compared with rates of IVD-associated BSI after implementing an infection control program applying process control (phase 2).

Results: Six hundred five IVD-days were accumulated in phase 1, and 2824 IVD-days were accumulated during phase 2. Compliance with CVC site care and hand hygiene improved significantly from baseline during the study period: placing a gauze dressing over the catheter insertion site (99.24% vs. 86.69%, respectively; relative risk [RR] = 1.14; 95% confidence interval [CI] = 1.07–1.22; p = .0000), proper use of gauze for vascular catheter insertion site (97.87% vs. 84.21%, respectively; RR = 1.16; 95% CI = 1.09–1.24; p = .0000), documentation of the duration of the administration set of the vascular catheter (93.85% vs. 40.69%, respectively; RR = 2.34; 95% CI = 2.14–2.56; p = .0000), and hand hygiene before contact with the patient (84.9% vs. 62%, respectively; RR = 1.37; 95% CI = 1.21–1.51; p = .0000). Overall rates of IVD-associated BSI were lowered significantly from baseline rates after implementation of process control (19.5 vs. 46.3 BSIs per 1000 IVD-days, respectively; RR = 0.42; 95% CI = 0.27–0.66; p = .0001). Overall rates of crude unadjusted mortality were lowered significantly from baseline rates (48.5% vs. 32.8% per 100 discharges, respectively; RR = 0.68; 95% CI = 0.50–0.31; p = .01).

Conclusion: Implementation of an infection control program utilizing education, process control, and performance feedback was associated with significant reductions in rates of IVD-associated BSI and mortality. (Crit Care Med 2005; 33:2022–2027)

KEY WORDS: bacteremia; bloodstream infection; catheter-related bloodstream infection; central catheter–associated bloodstream infection; central venous catheter; vascular catheter; nosocomial infection; hospital infection; infection control program; process control; Mexico; developing country; intensive care unit; adults

Hospitalized critically ill patients have a significant risk of developing nosocomial infections. Most nosocomial bloodstream infections (BSIs) are primary, mainly originating in intravascular devices (IVDs) (1–4). IVD-associated BSIs significantly increase attributable mortality (5, 6), the length of hospitalization, and the cost of health care (5, 7, 8).

Infection control programs in Latin America are not mandatory in many countries. This lack of governmental oversight has resulted in a low awareness of the need for infection control programs. As a result, the rates of IVD-associated BSIs are higher than in indus-
trialized countr
international pr
(VDR) to determ
vice-associated
countries, we p
rates of device-a
fection in countr
Europe (10–16)
IVD-associated
three to five tim

National Nosocomial Infection Surveillance (NNIS) System rates.

We report the results of a prospective, before/after trial that assessed the effectiveness of implementing an infection control program utilizing process control for reducing the rates of IVD-associated BSI among patients from two level III neurosurgical and medical surgical intensive care units (ICUs) in one Mexican

*See also p. 2133.

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Higuera, F., V. D. Rosenthal, et al. (2005). "The effect of process control on the incidence of central venous catheter-associated bloodstream infections and mortality in intensive care units in Mexico." Critical Care Medicine **33**(9): 2022-2027.

Characteristics of Patients in both Periods

Table 1. Baseline characteristics of patients at study entry

Characteristic	Phase 1 (n = 132)	Phase 2 (n = 338)	*p*
Males	60 (45.5)	163 (48.2)	.588
Mean age (yr) ± SD	44.32 ± 18.3	45.91 ± 17.88	.422
Diabetes	26 (19.7)	72 (21.3)	.700
Cancer	1 (0.8)	7 (2.1)	.322
Hypertension[a]	22 (16.7)	75 (22.2)	.183
Cardiac failure	3 (2.3)	16 (4.7)	.223
COPD	3 (2.3)	16 (4.7)	.223
Smoker	17 (12.9)	55 (16.3)	.358
Alcoholism	24 (18.2)	65 (19.2)	.794
Renal impairment	3 (2.3)	19 (5.6)	.722

Process Surveillance

Table 5. Compliance with intravascular device (IVD) site care and hand hygiene

Finding	Phase 1	Phase 2	RR	95% CI	*p*
Presence of gauze on IVD site, %	86.69 (n = 1413)	99.24 (n = 2912)	1.14	1.07 – 1.22	.0000
Proper placement of gauze at IVD site, %	84.21 (n = 1413)	97.87 (n = 2912)	1.16	1.09 – 1.24	.0000
Date on IV administration set, %	40.69 (n = 1413)	93.85 (n = 2912)	2.34	2.14 – 2.56	.0000
Hand hygiene compliance, %	62 (n = 584)	84.9 (n = 1122)	1.37	1.21 – 1.51	.0000

Rates of intravascular device-associated bloodstream infection and mortality

	Phase 1	Phase 2	RR (P value)
BSI (n)	28	55	
IVD days (n)	605	2,824	
BSI per 1000 IVD days	46.3	19.5	0.42 (p 0.001)
Total patients (n= 470)	132	338	
Total deaths (n=175)	64	111	
Crude mortality	48.5%	32.8%	0.68 (p 0.0001)

Higuera, F., V. D. Rosenthal, et al. (2005). "The effect of process control on the incidence of central venous catheter-associated bloodstream infections and mortality in intensive care units in Mexico." Critical Care Medicine ***33****(9): 2022-2027.*

Reducing CLAB rate in Turkey

Impact of a Multidimensional Infection Control Approach on Central Line-Associated Bloodstream Infections Rates in Adult Intensive Care Units of 8 Cities of Turkey: Findings of the International Nosocomial Infection Control Consortium (INICC)

Hakan Leblebicioglu,[1] Recep Öztürk,[2] Victor Daniel Rosenthal,[3] Özay Arıkan Akan,[4] Fatma Sirmatel,[5] Davut Ozdemir,[6] Cengiz Uzun,[7] Huseyin Turgut,[8] Gulden Ersoz,[9] Iftíhar Koksal,[10] Asu Özgültekin,[11] Saban Esen, [1] Fatma Ulger,[1] Ahmet Dilek,[1] Hava Yilmaz,[1] Yalim Dikmen,[2] Gökhan Aygún,[2] Melek Tulunay,[4] Mehmet Oral,[4] Necmettin Ünal,[4] Mustafa Cengiz,[5] Leyla Yilmaz,[5] Mehmet Faruk Geyik,[6] Ahmet Şahin,[6] Selvi Erdogan,[6] Suzan Sacar,[8] Hülya Sungurtekin,[8] Doğaç Uğurcan,[8] Ali Kaya,[9] Necdet Kuyucu,[9] Gürdal Yýlmaz,[10] Selçuk Kaya,[10] Hülya Ulusoy,[10] Asuman İnan.[11]

ACMA 2013, Accepted and In press

Characteristics of the Participating Intensive Care Units, and Hospitals (from September 2003 to January 2011).

Data	ICUs, n	ICU Patients, n
Type of ICU, n (%)		
Cardiac Surgical	1 (8%)	172
Surgical	1 (8%)	222
Medical	2 (15%)	452
Adult Stepdown	2 (15%)	828
Medical Surgical	7 (54%)	2,343
All ICUs	13 (100%)	4,017
Type of hospital, n (%)		
Private Community	12 (92%)	3,996
Academic Teaching	1 (8%)	21
All hospitals	13 (100%)	4,017

H Leblebicioglu, R Öztürk, VD Rosenthal, et al. Impact of a Multidimensional Infection Control Approach on Central Line-Associated Bloodstream Infections Rates in Adult Intensive Care Units of 8 Cities of Turkey: Findings of the International Nosocomial Infection Control Consortium (INICC). ACMA 2013, Accepted and In press

Characteristics of Patients in the Baseline Period and Intervention Period

Patients' Characteristics	Baseline	Intervention	RR*	95% CI	P- Value
Study period by hospital in months, mean ± SD (range)	3	15.6 ± 9.2 (4 – 36)			
Number of Patients	560	3457			
*Bed days, n	5517	37232			
**No. of CL days, n	3129	23463			
***CL use, mean	0.57	0.63	1.1	1.07 – 1.15	0.0001
CL duration, mean ± SD	5.6 ± 9.0	6.8 ± 11.0	-	-	0.014
Age, mean ± SD	54.1 ± 22.0	52.3 ± 21.4	-	-	0.08
ASIS score, mean ± SD	3.2 ± 1.1	3.6 ± 1.14	-	-	0.0001
Male	305 (57%)	2,048 (60%)	1.05	0.91 – 1.21	0.5
Female	230 (43%)	1379 (40%)	-	-	-
Abdominal Surgery, n (%)	58 (10%)	349 (10%)	0.97	0.74 – 1.3	0.84
Cardiac Surgery, n (%)	11 (2%)	72 (2%)	1.1	0.56 – 2.22	0.9
Trauma, n (%)	58 (10%)	357 (10%)	0.99	0.75 – 1.34	0.97
Previous Infections, n (%)	81 (14%)	415 (12%)	0.83	0.653 – 1.1	0.13
Endocrine diseases, n (%)	43 (8%)	250 (7%)	0.94	0.68 – 1.33	0.7
Chronic Obstructive, n (%)	150 (27%)	904 (26%)	0.98	0.82 – 1.17	0.8
Renal Impairment, n (%)	33 (6%)	180 (5%)	0.9	0.61 – 1.3	0.5
Hepatic Failure, n (%)	13 (2%)	50 (1%)	0.62	0.33 – 1.25	0.14
Thoracic Surgery, n (%)	27 (5%)	151 (4%)	0.91	0.6 – 1.42	0.62
Stroke, n (%)	14 (3%)	64 (2%)	0.74	0.4 – 1.43	0.3

H Leblebicioglu, R Öztürk, VD Rosenthal, et al. Impact of a Multidimensional Infection Control Approach on Central Line-Associated Bloodstream Infections Rates in Adult Intensive Care Units of 8 Cities of Turkey: Findings of the International Nosocomial Infection Control Consortium (INICC). ACMA 2013, Accepted and In press

Process Surveillance

Patients' Characteristics	Baseline	Intervention	RR*	95% CI	P- Value
Study period by hospital in months, mean ± SD (range)	3	15.6 ± 9.2 (4 – 36)			
Hand Hygiene compliance % (n/n)	32% (427/1328)	49% (5260/10786)	1.52	1.4 – 1.7	0.0001
Date on administration set % (n/n)	33% (1544/4656)	39% (14159/36472)	1.17	1.11 – 1.2	0.0001
Placed sterile dressing % (n/n)	78% (3617/4656)	90% (32895/36472)	1.2	1.12 – 1.2	0.0001
Correct condition of dressing % (n/n)	76% (3537/4656)	73% (26699/36472)	0.96	0.93 – 0.99	0.04

H Leblebicioglu, R Öztürk, VD Rosenthal, et al. Impact of a Multidimensional Infection Control Approach on Central Line-Associated Bloodstream Infections Rates in Adult Intensive Care Units of 8 Cities of Turkey: Findings of the International Nosocomial Infection Control Consortium (INICC). ACMA 2013, Accepted and In press

Central Line Associated Blood Stream Infection Rates Stratified By The Length Of Time That Each Intensive Care Unit Has Participated In The International Nosocomial Infection Control Consortium. Poisson regression

Time since joining INICC	Nº of ICUs, n	Central line days, n	CLAB, n	Crude CLAB rate/1000 CL days	IRR accounting for clustering by ICU	P value
1-3 months (baseline)	13	3,129	62	19.81	1	-
4-12 months	13	9,751	160	16.41	0.864 (0.637 – 1.17)	0.347
Second year	11	7,287	109	15.0	0.643 (0.46 – 0.9)	0.01
Third year	6	6,425	77	12.0	0.613 (0.43 – 0.87)	0.007

H Leblebicioglu, R Öztürk, VD Rosenthal, et al. Impact of a Multidimensional Infection Control Approach on Central Line-Associated Bloodstream Infections Rates in Adult Intensive Care Units of 8 Cities of Turkey: Findings of the International Nosocomial Infection Control Consortium (INICC). ACMA 2013, Accepted and In press

CLAB Rate and Mortality Rate Reduction in Adult ICUs of 15 Countries of 4 Continents

PROOF 1 INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY DECEMBER 2010, VOL. 31, NO. 12

ORIGINAL ARTICLE

Impact of International Nosocomial Infection Control Consortium (INICC) Strategy on Central Line–Associated Bloodstream Infection Rates in the Intensive Care Units of 15 Developing Countries

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Regina Berba, MD; Naoufel Madani, MD; Eduardo A. Medeiros, MD, PhD; Luis E. Cuéllar, MD;
Zan Mitrev, MD, FETCS; Lourdes Dueñas, MD; Humberto Guanche Garcell, MD; Trudell Mapp, RN;
Souha S. Kanj, MD, FACP, FIDSA; Rosalía Fernández Hidalgo, RN, MSc; International Nosocomial Infection Control Consortium Investigators

BACKGROUND. The International Nosocomial Infection Control Consortium (INICC) was established in 15 developing countries to reduce infection rates in resource-limited hospitals by focusing on education and feedback of outcome surveillance (infection rates) and process surveillance (adherence to infection control measures). We report a time-sequence analysis of the effectiveness of this approach in reducing rates of central line–associated bloodstream infection (CLABSI) and associated deaths in 86 intensive care units with a minimum of 6-month INICC membership.

METHODS. Pooled CLABSI rates during the first 3 months (baseline) were compared with rates at 6-month intervals during the first 24 months in 53,719 patients (190,905 central line–days). Process surveillance results at baseline were compared with intervention period data.

RESULTS. During the first 6 months, CLABSI incidence decreased by 33% (from 14.5% to 9.7%). Over the first 24 months there was a cumulative reduction from baseline of 54% (from 16.0 to 7.4 CLABSIs per 1,000 central line–days; relative risk, 0.46 [95% confidence interval, 0.33–0.63]; $P < .001$). The number of deaths in patients with CLABSI decreased by 58%. During the intervention period, hand hygiene adherence improved from 50% to 60% ($P < .001$); the percentage of intensive care units that used maximal sterile barriers at insertion increased from 45% to 85% ($P < .001$), that adopted chlorhexidine for antisepsis increased from 7% to 27% ($P = .018$), and that sought to remove unneeded catheters increased from 37% to 83% ($P = .004$); and the duration of central line placement decreased from 4.1 to 3.5 days ($P < .001$).

CONCLUSIONS. Education, performance feedback, and outcome and process surveillance of CLABSI rates significantly improved infection control adherence, reducing the CLABSI incidence by 54% and the number of CLABSI-associated deaths by 58% in INICC hospitals during the first 2 years.

Infect Control Hosp Epidemiol 2010; 31(12):000-000

Characteristics of Patients in both Periods

TABLE 2. Characteristics of Patients at Baseline and During the Intervention Period

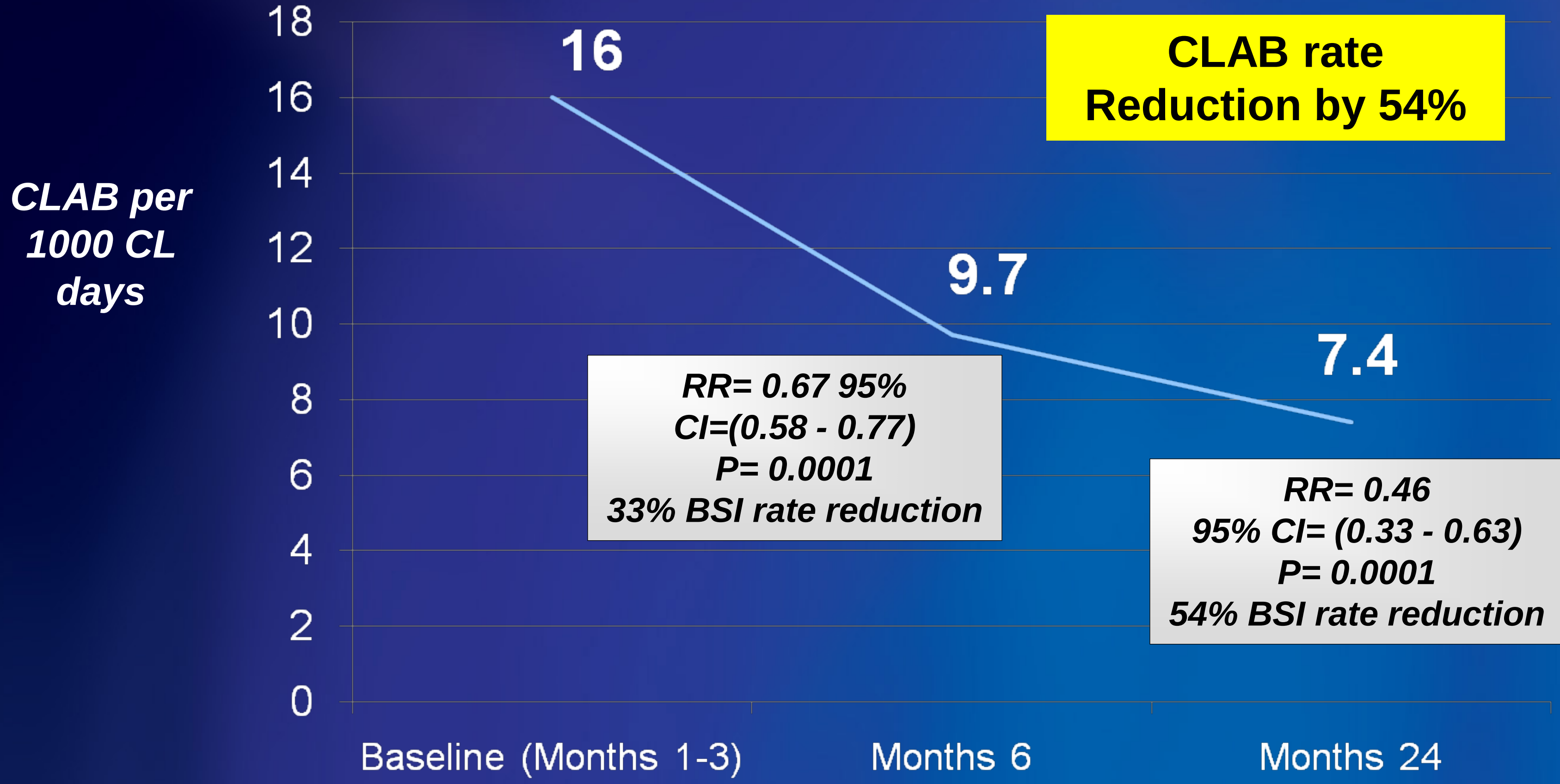
Characteristic	Baseline	Intervention	RR (95% CI)	*P*
No. of patients	7,751	45,968	…	
No. of central line–days	30,889	160,016	…	
Age, mean (IQR), years	53.6 (40– 70)	55.7 (42– 72)	…	
Sex, no. (%) of patients				
Male	4,756 (61)	27,603 (60)	0.98 (0.95–1.01)	.169
Female	2,995 (39)	18,365 (40)	1.03 (0.99–1.07)	.090
Service, no. (%) of patients				
Adult	6,247 (81)	41,540 (90)	…	
Pediatric	430 (6)	1,459 (3)	…	
Neonatal	874 (11)	2,966 (6)	…	
ASIS, mean (IQR)	2.96 (2–4)	2.91 (2–4)	…	.806
Underlying diseases, no. (%) of patients				
Cardiac surgery	228 (3)	1,464 (3)	1.00 (0.87–1.15)	.967
Cancer	205 (3)	1,320 (3)	1.00 (0.86–1.16)	.999
Abdominal surgery	323 (4)	1,882 (4)	0.90 (0.80–1.02)	.096
Thoracic surgery	43 (1)	212 (0.5)	0.77 (0.55–1.106)	.109
Trauma	188 (2)	1,111 (2)	0.92 (0.79–1.07)	.276

Process Surveillance

TABLE 3. Representative Infection Control Practices and the Results of Process Surveillance

Variable	Baseline	Intervention	RR (95% CI)	P
Representative infection control practice, %				
Hand hygiene practices				
Hand washing with soap and water	76	44	0.58 (0.34–0.99)	.043
Alcohol-based hand rub	20	66	3.37 (1.60–7.08)	.001
Hand washing with povidone-iodine	20	39	1.96 (0.88–4.36)	.094
Hand washing with CHG	23	53	2.27 (1.12–4.62)	.020
Hospital intravenous team	13	26	2.00 (0.75–5.33)	.157
Femoral lines frequent	9	9	1.00 (0.25–4.00)	>.99
Use of maximal sterile barriers at insertion	46	85	1.86 (1.11–3.13)	.017
Cutaneous antisepsis with CHG	7	27	4.09 (1.15–4.49)	.018
Insertion site dressing				
None	32	12	0.37 (0.13–1.04)	.050
Nonsterile dressing	37	5	0.13 (0.03–0.57)	.001
Sterile gauze	57	76	1.32 (0.79–3.63)	.071
Sterile transparent dressing	28	52	1.85 (0.94–3.63)	.071
Topical antibiotic on insertion sites	2	0	...	.322
Intravenous container vented with a needle	63	36	0.58 (0.32–1.05)	.068
Scheduled replacement of central lines	69	29	0.43 (0.41–0.45)	<.001
Proactive efforts to promptly remove unneeded catheters	37	83	2.25 (1.27–3.97)	.004
3-way stopcocks used widely	94	88	0.94 (0.62–1.41)	.756
Special technologies				
Antimicrobial-coated central catheters	6	4	0.68 (0.11–4.07)	.671
CHG sponge dressings	2	8	4.08 (0.46–6.52)	.172
Results of process surveillance				
Adherence to hand hygiene,[a] %	50[b]	60[c]	1.21 (1.18–1.24)	.001
Central line usage,[d] %	53[e]	52[f]	0.99 (0.98–1.01)	.120
Duration central line, mean (IQR), days	4.1 (0–5)	3.5 (0–4)	0.85 (...)	.001
Sterile dressing, in good condition	81	82	1.01 (0.99–1.00)	.669
Administration set replaced every 72–96 hours, %	18	50	2.73 (2.52–2.96)	.001

REDUCTION OF CLAB
86 ICUs of 15 Countries



*Rosenthal, V. D., D. G. Maki, et al. (2010). "Impact of International Nosocomial Infection Control Consortium (INICC) strategy on central line-associated bloodstream infection rates in the intensive care units of 15 developing countries." Infection control and hospital epidemiology : the official journal of the Society of Hospital Epidemiologists of America **31**(12): 1264-1272.*

Deaths in patients with central line-associated bloodstream infection during baseline and intervention periods.

Cohort	ICUs, n	No. patients at risk	Deaths of patients with CLAB, n	CLAB-associated deaths per 100 patients (%)	RR* (95% CI)	P-value
Months 1-3 (Baseline)	86	7,376	77	1.04	-	-
Months 5-7	86	7,522	46	0.61	0.59 (0.41-0.84)	0.004
Months 11-13	68	4,718	22	0.47	0.45 (0.28-0.72)	0.001
Months 17-19	43	3,527	16	0.45	0.43 (0.25-0.74)	0.002
Months 23-25	28	2,264	10	0.44	0.42 (0.22-0.82)	0.008

Mortality reduction by 58%

Rosenthal, V. D., D. G. Maki, et al. (2010). "Impact of International Nosocomial Infection Control Consortium (INICC) strategy on central line-associated bloodstream infection rates in the intensive care units of 15 developing countries." Infection control and hospital epidemiology 31(12): 1264-1272.

Infection
DOI 10.1007/s15010-012-0246-5

CLINICAL AND EPIDEMIOLOGICAL STUDY

Impact of a multidimensional infection control strategy on central line-associated bloodstream infection rates in pediatric intensive care units of five developing countries: findings of the International Nosocomial Infection Control Consortium (INICC)

V. D. Rosenthal · B. Ramachandran · W. Villamil-Gómez · A. A. Ruiz · J. A. Navoa-Ng · L. Matta-Cortés · M. Pawar · A. Nevzat-Yalcin · M. Rodríguez-Ferrer · R. D. Yıldızdaş · A. Menco · R. Campuzano · V. D. Villanueva · L. F. Rendon-Campo · A. Gupta · O. Turhan · N. Barahona-Guzmán · O. O. Horoz · P. Arrieta · J. M. Brito · M. C. V. Tolentino · Y. Astudillo · N. Saini · N. Gunay · G. Sarmiento-Villa · E. Gumus · A. Lagares-Guzmán · O. Dursun

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Rosenthal, V. D., B. Ramachandran, et al. (2012). "Impact of a multidimensional infection control strategy on central line-associated bloodstream infection rates in pediatric intensive care units of five developing countries: findings of the International Nosocomial Infection Control Consortium (INICC)." Infection 40(4): 415-423.

Characteristics of Patients in both Periods

	Baseline	Intervention	RR	95% CI	*P*-value
No. of patients	378	1,608			
Study period by hospital (months), mean ± SD (range)	3	12.8 ± 8.8 (3–24)			
Central line duration, mean ± SD	2.73 ± 5.3	2.40 ± 5.7			0.312
Sex, *n* (%)					
Male	220 (58)	923 (57)	0.98	0.86–1.12	0.7446
Female	156 (42)	683 (42)			
Age, mean ± SD	5.6 ± 4.6	6.5 ± 7.1			0.046
Abdominal surgery, *n* (%)	4 (1)	8 (0.5)	0.47	0.14–1.56	0.2069
Thoracic surgery, *n* (%)	1 (0.3)	12 (1)	2.82	0.37–21.70	0.8775
Previous infection, *n* (%)	23 (6)	29 (2)	0.30	0.17–0.51	0.3851

Process Surveillance

Table 4 Hand hygiene, CL use, and CL care improvement in PICUs in Phase 1 (baseline period) and in Phase 2 (intervention period)

	Phase 1 (1–3 months)	Phase 2	RR (95% CI)	*P*-value
No. of hand hygiene observations	512	2,180		
Hand hygiene compliance, % (*n*)	56 (285)	79 (1,721)	1.42 (1.25–1.61)	0.0001
No. of inserted CLs	887	2,686		
CLs with sterile gauze (%)	84.0 (745)	97.2 (2,610)	1.16 (1.07–1.26)	0.0004
CLs with sterile gauze in good condition (%)	83.9 (744)	93.9 (2,522)	1.12 (1.03–1.21)	0.0068
No. of CL days	1,029	3,861		
CL use, mean	0.41	0.38	0.93 (0.87–0.99)	0.01

CLAB Rates in Phase 1 (Baseline Period) and in Phase 2 (Intervention Period)

CLAB rate Reduction by 47%

	Phase 1 (months 1-3)	Phase 2	RR (95% CI)	P Value
No. of CLAB	16	40		
No. of CL days	1,229	5,841		
CL use, mean	0.39	0.36	0.93 (0.87 – 0.99)	0.0198
CLAB Rate per 1000 CL days	13.0	6.9	0.53 (0.29 – 0.94)	0.0271

Rosenthal, V. D., B. Ramachandran, et al. (2012). "Impact of a multidimensional infection control strategy on central line-associated bloodstream infection rates in pediatric intensive care units of five developing countries: findings of the International Nosocomial Infection Control Consortium (INICC)." Infection 40(4): 415-423.

Overall Mortality Reduction comparing Phase 1 (Baseline Period) and Phase 2 (Intervention Period)

Mortality reduction by 31%

	Baseline period (months 1-3)	Intervention period	RR (95% CI)	P Value
No. of Patients	1,272	3,067		
No. of deaths	145	253		
Percentage of deaths	10.3%	7.0%	0.69 (0.49 – 0.95)	0.0234

Rosenthal, V. D., B. Ramachandran, et al. (2012). "Impact of a multidimensional infection control strategy on central line-associated bloodstream infection rates in pediatric intensive care units of five developing countries: findings of the International Nosocomial Infection Control Consortium (INICC)." Infection 40(4): 415-423.

ORIGINAL ARTICLE

Findings of the International Nosocomial Infection Control Consortium (INICC), Part III: Effectiveness of a Multidimensional Infection Control Approach to Reduce Central Line–Associated Bloodstream Infections in the Neonatal Intensive Care Units of 4 Developing Countries

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OBJECTIVE. To analyze the impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional infection control approach to reduce central line–associated bloodstream infection (CLABSI) rates.

SETTING. Four neonatal intensive care units (NICUs) of INICC member hospitals from El Salvador, Mexico, Philippines, and Tunisia.

PATIENTS. A total of 2,241 patients hospitalized in 4 NICUs for 40,045 bed-days.

METHODS. We conducted a before-after prospective surveillance study. During Phase 1 we performed active surveillance, and during phase 2 the INICC multidimensional infection control approach was implemented, including the following practices: (1) central line care bundle, (2) education, (3) outcome surveillance, (4) process surveillance, (5) feedback of CLABSI rates, and (6) performance feedback of infection control practices. We compared CLABSI rates obtained during the 2 phases. We calculated crude stratified rates, and, using random-effects Poisson regression to allow for clustering by ICU, we calculated the incidence rate ratio (IRR) for each follow-up time period compared with the 3-month baseline.

RESULTS. During phase 1 we recorded 2,105 CL-days, and during phase 2 we recorded 17,117 CL-days. After implementation of the multidimensional approach, the CLABSI rate decreased by 55%, from 21.4 per 1,000 CL-days during phase 1 to 9.7 per 1,000 CL-days during phase 2 (rate ratio, 0.45 [95% confidence interval, 0.33–0.63]). The IRR was 0.53 during the 4–12-month period and 0.07 during the final period of the study (more than 45 months).

CONCLUSIONS. Implementation of a multidimensional infection control approach was associated with a significant reduction in CLABSI rates in NICUs.

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Characteristics of Patients in both Periods

TABLE 2. Characteristics of Patients Hospitalized in Neonatal Intensive Care Units during Phase 1 (Baseline Period) and Phase 2 (Intervention Period)

	Baseline	Intervention	*P*
No. of months	3	23.5[a]	
No. of patients	374	1,867	
No. of bed-days	5,654	34,391	
No. of CL-days	2,105	17,117	
CL use ratio, mean (95% CI)	0.37 (0.19–0.21)	0.50 (0.49–0.50)	.0001
CL duration, mean ± SD, days	5.63 ± 12.0	9.18 ± 20.2	.0001
Sex, no. (%)			
Male	241 (64)	1,117 (60)	.2587
Female	133 (36)	748 (40)	.3983
Weight, mean ± SD, kg	2.37 ± 0.87	2.31 ± 0.84	.0001

Process Surveillance

TABLE 3. Hand Hygiene (HH) and Central Line (CL) Care Improvement during Phase 1 (Baseline Period) and Phase 2 (Intervention Period)

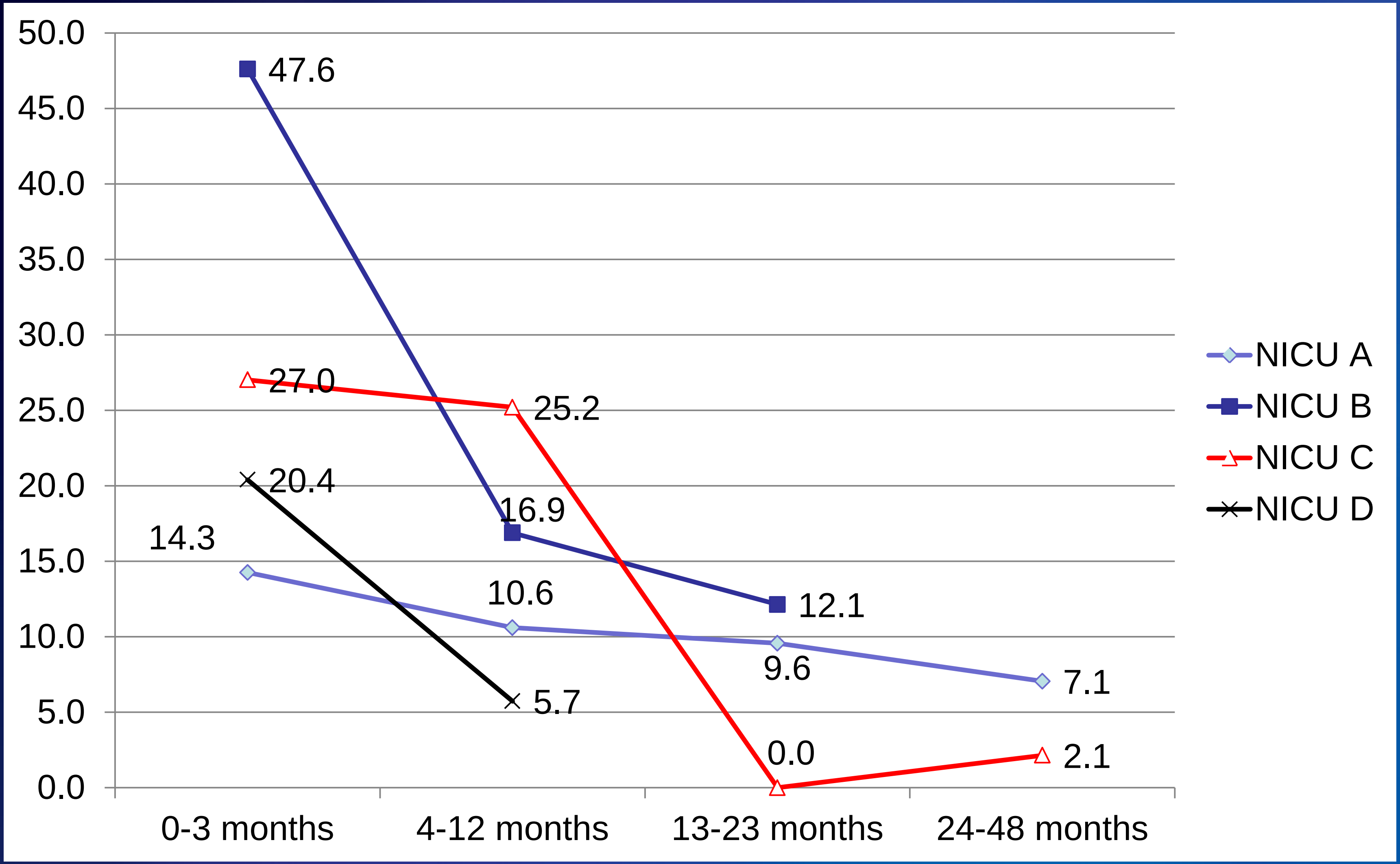
	Phase 1	Phase 2	RR (95% CI)	*P*
No. of HH opportunities				
All	669	2,262	...	
NICU A	121	318	...	
NICU B	505	1,090	...	
NICU C	43	854	...	
HH compliance, % (no.)				
All	51.4 (344)	71.5 (1,618)	1.39 (1.24–1.56)	.0001
NICU A	60.3 (73)	60.7 (193)	1.01 (0.77–1.32)	.9653
NICU B	45.9 (232)	57.8 (630)	1.26 (1.08–1.46)	.0027
NICU C	90.7 (39)	93.1 (795)	1.03 (0.74–1.42)	.8738
No. of observed CL				
All	2,009	20,031	...	
NICU A	1,632	18,652	...	
NICU B	325	787	...	
NICU C	52	592	...	
CL with sterile gauze, % (no.)				
All	70.1 (1,409)	83.7 (16,771)	1.19 (1.13–1.26)	.0001
NICU A	68.6 (1,120)	83.3 (15,545)	1.39 (1.31–1.48)	.0001
NICU B	72.9 (237)	98.1 (772)	1.35 (1.16–1.56)	.0001
NICU C	100.0 (52)	76.7 (454)	0.77 (0.58–1.02)	.0690
CL with sterile gauze in good condition, % (no.)				
All	91.8 (1,845)	95.7 (19,176)	1.04 (0.99–1.09)	.0883
NICU A	95.6 (1,561)	96.0 (17,902)	1.15 (1.09–1.21)	.0001
NICU B	71.4 (232)	86.9 (684)	1.22 (1.05–1.41)	.0094
NICU C	100.0 (52)	99.7 (590)	1.00 (0.75–1.32)	.9813

Central Line-Associated Bloodstream Infection Stratified by the Length of Time that each unit has participated in INICC. Crude stratified rates, using random effects Poisson regression.

CLAB rate Reduction by 91%

Months since joining INICC	ICUs, n	CL days	CLABSI	Crude CLABSI rate/ 1000 CL days	IRR accounting for clustering by ICU (95% CI)
0-3 months (baseline)	4	2105	46	21.8	-
4-12 months	4	6514	72	11.1	0.53 (0.36 – 0.78)
13-23 months	2	7445	73	9.8	0.46 (0.31 – 0.68)
24-35 months	2	2692	19	7.1	0.43 (0.23 – 0.81)
36-48 months	1	466	1	2.1	0.07 (0.01 – 1.26) **

Evolution of Central Line-Associated Bloodstream Infection in each Neonatal Intensive Care Unit



Conclusions I

- According with WHO paper, based on INICC peer review publications, CLAB rates in ICUs in limited resources countries are higher than in USA and Europe.
- CLAB rates are higher in public than in private hospitals.
- CLAB rates are higher in low income than in middle income countries.
- INICC was successful to measure adverse consequences of CLAB (mortality, extra length of stay, cost, bacterial resistance)
- There are new recommendations on JCI guidelines compared with CDC Guidelines.

Conclusions II

- Six Components of INICC strategy:
  1. Bundles,
  2. Education,
  3. Outcome Surveillance (CLAB rates, extra mortality, extra LOS, extra cost, bacterial resistance, etc.)
  4. Process Surveillance (Compliance with hand hygiene, with invasive device care)
  5. Feedback of CLAB rates and consequences
  6. Performance Feedback
- It was effective to:
  - Increase compliance with:
    - Hand hygiene
    - Vascular catheter care.
  - Reduce rates of:
    - CLAB in ICUs of Argentina, Mexico, Turkey, and worldwide in Adults ICUs (54%), pediatric ICUs (47%) and neonatal ICUs (90%)
    - Mortality (58%)

Thank you very much

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