Outcome Surveillance and Process Surveillance
Dr. Victor Rosenthal
A Webber Training Teleclass

OUTCOME AND PROCESS SURVEILLANCE

Dr. Victor D. Rosenthal, MD, MSc, CIC
INTERNATIONAL NOSOCOMIAL INFECTION CONTROL CONSORTIUM (INICC)
www.INICC.org

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1

www.webbertraining.com

International Organizations dedicated to Infection Control

International Federation of Infection Control

International Nosocomial Infection Control Consortium

2

NICC Program

• The International Nosocomial Infection Control Consortium (INICC) (www.INICC.org) is a non-profit, open, multi-center, international, collaborative program modeled on the US National Nosocomial Infection Surveillance system (NNIS).

•It is the first international research network, formed in 1998, and is responsible for much national and global progress.

•Founded in Argentina, it is a prospective, targeted, outcome and process surveillance system designed to identify and reduce HAI rates and their consequences in the participating facilities.

INICC Program

INICC employs a multiple-approach strategy combining the following interventions:

•outcome surveillance;
•process surveillance;
•performance feedback;
•targeted interventions guided by risk factor analysis;
•cost- effective interventions guided by cost analysis;
•tutorial for surveillance;
•training in infection control guidelines application;
•secretarial and administrative support in entering data and developing charts;
•scientific data analysis and data interpretation to guide actions;
•sharing data at scientific meetings and in peer reviewed journals;
• and cooperating with hospitals and organizations worldwide.

INICC Program

• Hospitals review the protocol with their research committees and agree to full participation signing a commitment sheet, and sending it to the INICC central office in Buenos Aires, which then provides analysis and reports monthly, answers questions and augments the tutorial with personal instruction when needed.

INICC Program

• Forms and software designed to record patient data are used for both control patients without HAI and for cases with HAI.

•These patients forms include name, medical record, age, gender, underlying diseases, and severity of illness score at the time of entrance to the ICU. On a daily basis, information regarding temperature, blood pressure, devices days, cultures taken, and presence of clinical pneumonia, antibiotic use, and characteristics of any infection are collected both for cases and controls.

•Thus, by outcome surveillance it is also possible to analyze cases and controls in a prospective cohort nested study.

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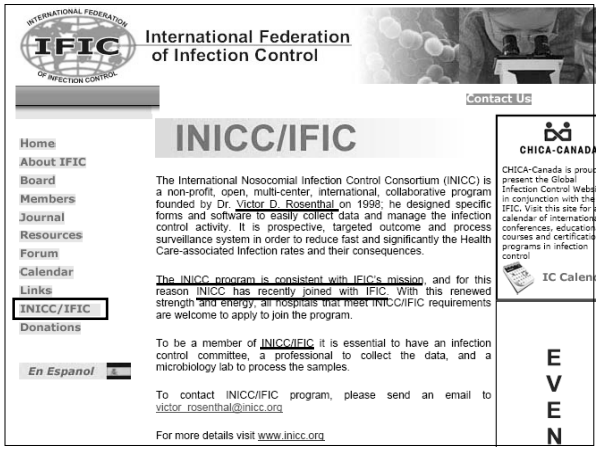
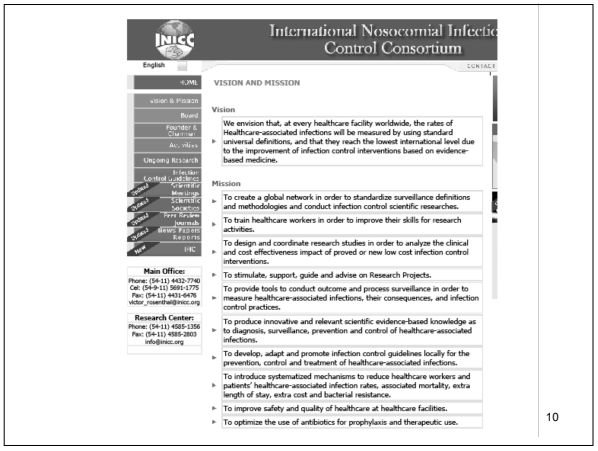
INICC Program

•At the same time, process surveillance and performance feedback is done for hand hygiene compliance, vascular and urinary catheter care, and mechanical ventilator care.

INICC Program

•In 2005 INICC has joined with the International Federation of Infection Control (IFIC) because both organizations concur on the same vision and mission.





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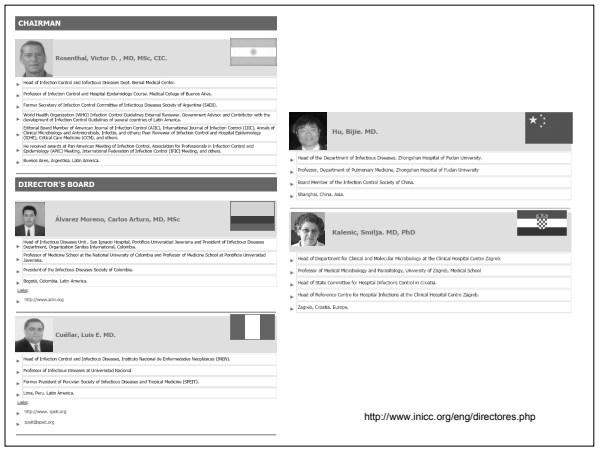

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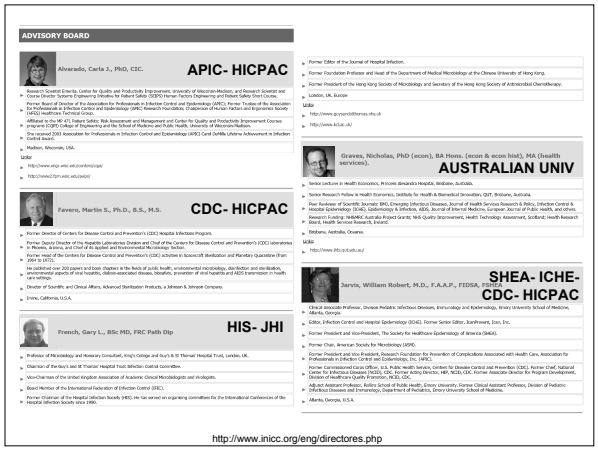

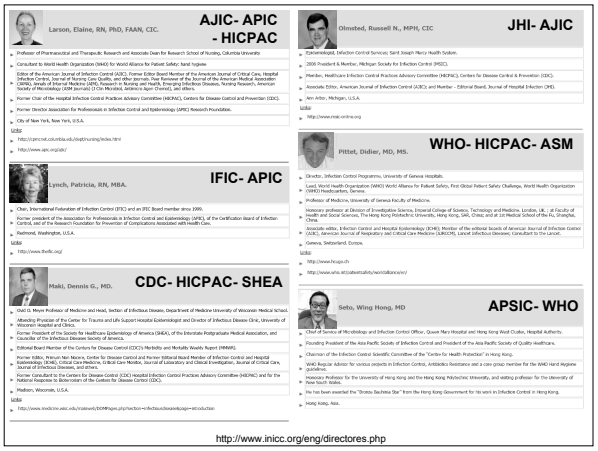

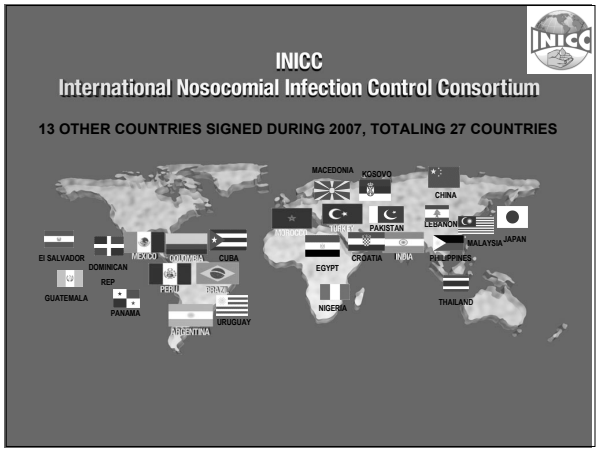

Broadly Used
Standard HAI Rates (NHSN)

17

AJIC major articles

National Healthcare Safety Network (NHSN) Report, data summary for 2006, issued June 2007

Jonathan R. Edwards, MS, Kelly D. Peterson, BBA, Mary L. Andrus, BA, RN, CIC, James S. Tolson, BS, Joy S. Goulding, Margaret A. Dudeck, MPH, Randy B. Mincey, BA, Daniel A. Pollock, MD, Teresa C. Horan, MPH, and the NHSN Facilities
Atlanta, Georgia

Am J Infect Control 2007;35:290-301.

Table 2. Pooled means and key percentiles of the distribution of central line-associated BSI rates and central line utilization ratios, by type of location, DA module, 2006

Central line-associated BSI rate*	No. of locations	No. of CLAB	Central line-days	Pooled mean	Percentile 10%	25%	50% (median)	75%	90%
Type of location									
Burn ICU	14	127	18,612	6.8					
Coronary ICU	53	181	63,941	2.8	0.0	0.0	2.0	4.2	6.5
Surgical cardiothoracic ICU	51	150	92,484	1.6	0.0	0.0	1.2	2.8	4.1
Medical ICU	73	489	170,719	2.9	0.0	0.8	2.2	4.2	6.2
Medical/surgical ICU									
Major teaching	63	304	128,502	2.4	0.0	0.6	1.9	3.1	5.5
All others	102	431	198,551	2.2	0.0	0.0	1.0	2.3	4.5
Pediatric medical/surgical ICU	36	255	48,144	5.3	0.0	1.1	3.5	6.5	9.4
Neurosurgical ICU	19	75	21,412	3.5					
Surgical ICU	72	378	137,484	2.7	0.0	0.9	2.0	4.4	7.4
Trauma ICU	21	182	39,635	4.6	0.0	0.4	3.3	6.5	8.5
Inpatient medical ward	18	51	24,218	2.1					
Inpatient medical/surgical ward	26	58	38,340	1.5	0.0	0.0	0.0	1.8	3.6

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Table 3. Pooled means and key percentiles of the distribution of urinary catheter-associated UTI rates and urinary catheter utilization ratios, by type of location, DA module, 2006

Urinary catheter-associated UTI rate*	No. of locations	No. of CAU	Urinary catheter-days	Pooled mean	Percentile				
					10%	25%	50% (median)	75%	90%
Type of location									
Burn ICU	12	96	12,860	7.5					
Coronary ICU	41	301	65,277	4.6	0.9	2.8	4.0	5.5	8.1
Surgical cardiothoracic ICU	41	262	70,221	3.7	0.0	1.8	3.4	4.3	7.2
Medical ICU	55	680	156,261	4.4	0.7	1.8	3.8	5.6	8.3
Medical/surgical ICU									
Major teaching	51	450	132,096	3.4	0.4	1.9	3.0	4.5	6.4
All others	83	697	221,435	3.1	0.0	0.8	2.4	4.2	6.5
Pediatric medical/surgical ICU	27	113	21,686	5.2	0.0	0.0	2.8	6.0	9.3
Neurosurgical ICU	14	171	26,253	6.5					
Surgical ICU	54	509	126,887	4.0	0.0	1.2	3.0	6.1	9.9
Trauma ICU	19	283	51,027	5.5					
Inpatient medical ward	11	110	15,448	7.1					
Inpatient medical/surgical ward	25	87	23,416	3.7	0.0	1.5	2.9	5.0	7.7

Table 4. Pooled means and key percentiles of the distribution of ventilator-associated PNEU rates and ventilator utilization ratios, by type of location, DA module, 2006

Ventilator-associated PNEU rate*	No. of units	No. of VAP	Ventilator days	Pooled mean	Percentile				
					10%	25%	50% (median)	75%	90%
Type of location									
Burn ICU	12	124	10,098	12.3					
Coronary ICU	48	100	35,727	2.8	0.0	0.0	1.3	4.5	6.6
Surgical cardiothoracic ICU	48	265	46,710	5.7	0.0	1.4	4.0	8.1	19.4
Medical ICU	64	339	109,277	3.1	0.0	0.9	2.8	4.6	7.2
Medical/surgical ICU									
Major teaching	58	302	84,530	3.6	0.0	1.3	2.5	5.1	7.3
All others	99	372	135,546	2.7	0.0	0.0	1.6	3.8	6.2
Pediatric medical/surgical ICU	32	81	32,936	2.5	0.0	0.0	1.0	2.8	6.1
Neurosurgical ICU	15	97	13,799	7.0					
Surgical ICU	61	384	73,205	5.2	0.0	1.8	4.1	6.4	10.0
Trauma ICU	19	329	32,297	10.2					

Surveillance
Outcome surveillance

• Outcome surveillance is the measurement of the rates and consequences of health care-associated infections (HAI), including but not limited to the following few variables: HAI rates, mortality, extra length of stay, attributable cost, and bacterial resistance.

•Development of infection control programs in industrialized countries has been supported by outcome surveillance data. Baseline epidemiology should include the above-mentioned items in order to plan specific targeted interventions, the most relevant one being the HAI rate.

Surveillance
Outcome surveillance

• Outcome surveillance allows evaluation of the cost-effectiveness of specific infection control interventions.

• It is also used to analyze case control studies in order to establish risk factors, and match patients to find extra cost and mortality. In summary, outcome surveillance is often the infrastructure for management of HAI.

Surveillance
Outcome surveillance

• Outcome surveillance of device-associated infections (DAI) has become an integral feature of infection control and quality assurance in the industrialized countries since more precise assignment of risk is possible.

•Standards for institutional surveillance have been adopted in the United States, UK, Australia, Canada, Germany, among other countries.

Surveillance
Outcome surveillance

• These industrialized countries report infection rates as DAI per 1000 device days, allowing them to further analyze the impact of specific risk factors and guide their targeted interventions.

•Developing countries more frequently report percentage (cases over discharges or admissions) of HAI.

Surveillance
Outcome surveillance

• Risk for infection is higher among seriously ill patients who often have several indwelling devices; thus, the higher infection rates in ICUs.

• Since the denominator of number of device days is unknown, it is impossible to compare rates among the hospitals and the rates are less useful for comparisons of time periods within the same hospital because the specific risk factor is not captured.

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Surveillance

Outcome surveillance

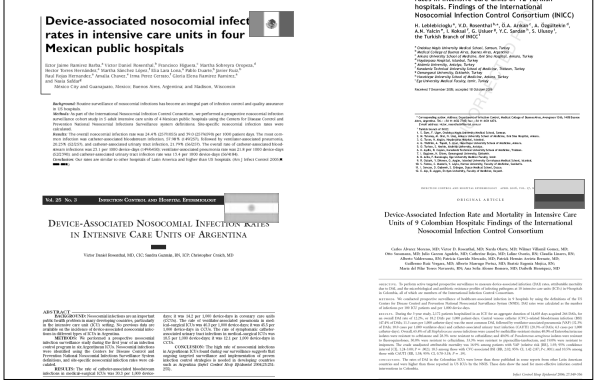
•Sometimes HAI rate is reported as number of infections per 1000 patient days, but again the rates may not be compared because of the lack of appropriate denominators.

• Device days were reported in few recent studies and infection rates were calculated by number of infections per 1000 device days following NHSN (formerly NNIS) methodology.

INICC Program

• INICC has reported HAI and mortality rates from several participating hospitals that applied both outcome and process surveillance.

Outcome Surveillance
Device Associated Infection Rates



Device-associated nosocomial infec… rates in intensive care units in four Mexican public hospitals

Vol. 25 No. 3 Infection Control and Hospital Epidemiology

Device-Associated Nosocomial Infection Rates in Intensive Care Units of Argentina

Victor Daniel Rosenthal, MD, CIC; Sandra Gamnik, RN, ICP; Christopher Crnich, MD

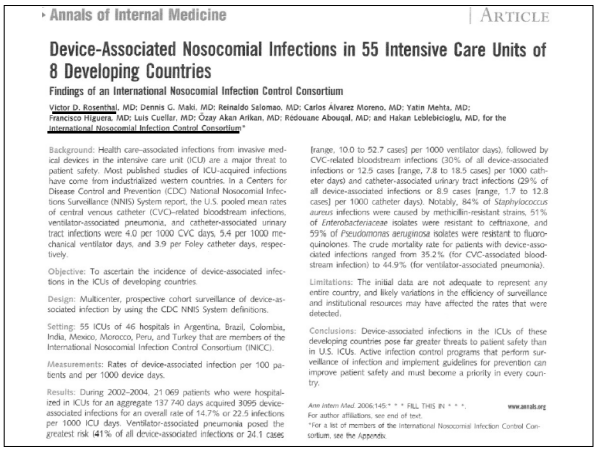
Device-associated hospital-acquired infections rates in intensive care units of 12 Turkish hospitals. Findings of the International Nosocomial Infection Control Consortium (INICC)

H. Leblebicioglu*, Y.D. Rosenthal**, O.A. Arikan*, A. Ozgunes*, A.N. Yalcin*, I. Koksal*, G. Ozkan*, Y.C. Sardan*, S. Ulusoy*, the Turkish Branch of INICC

Received 7 December 2006; accepted 19 October 2007

ORIGINAL ARTICLE

Device-Associated Infection Rate and Mortality in Intensive Care Units of 9 Colombian Hospitals: Findings of the International Nosocomial Infection Control Consortium



Annals of Internal Medicine | ARTICLE

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

Findings of an International Nosocomial Infection Control Consortium

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

Background: Health care–associated infections from invasive medical devices in the intensive care unit (ICU) are a major threat to patient safety. Most published studies of ICU-acquired infections have come from industrialized western countries. In a Centers for Disease Control and Prevention (CDC) National Nosocomial Infections Surveillance (NNIS) System report, the U.S. pooled mean rates of central venous catheter (CVC)–related bloodstream infections, ventilator-associated pneumonia, and catheter-associated urinary tract infections were 4.0 per 1000 CVC days, 5.4 per 1000 mechanical ventilator days, and 3.9 per Foley catheter days, respectively.

Objective: To ascertain the incidence of device-associated infections in the ICUs of developing countries.

Design: Multicenter, prospective cohort surveillance of device-associated infection by using the CDC NNIS System definitions.

Setting: 55 ICUs of 46 hospitals in Argentina, Brazil, Colombia, India, Mexico, Morocco, Peru, and Turkey that are members of the International Nosocomial Infection Control Consortium (INICC).

Measurements: Rates of device-associated infection per 100 patients and per 1000 device days.

Results: During 2002–2004, 21 069 patients who were hospitalized in ICUs for an aggregate 137 740 days acquired 3095 device-associated infections for an overall rate of 14.7% or 22.5 infections per 1000 ICU days. Ventilator-associated pneumonia posed the greatest risk (41% of all device-associated infections or 24.1 cases [range, 10.0 to 52.7 cases] per 1000 ventilator days), followed by CVC-related bloodstream infections (30% of all device-associated infections or 12.5 cases [range, 7.8 to 18.5 cases] per 1000 catheter days) and catheter-associated urinary tract infections (29% of all device-associated infections or 8.9 cases [range, 1.7 to 12.8 cases] per 1000 catheter days). Notably, 84% of *Staphylococcus aureus* infections were caused by methicillin-resistant strains, 51% of *Enterobacteriaceae* isolates were resistant to ceftriaxone, and 59% of *Pseudomonas aeruginosa* isolates were resistant to fluoroquinolones. The crude mortality rate for patients with device-associated infections ranged from 35.2% (for CVC-associated bloodstream infection) to 44.9% (for ventilator-associated pneumonia).

Limitations: The initial data are not adequate to represent any entire country, and likely variations in the efficiency of surveillance and institutional resources may have affected the rates that were detected.

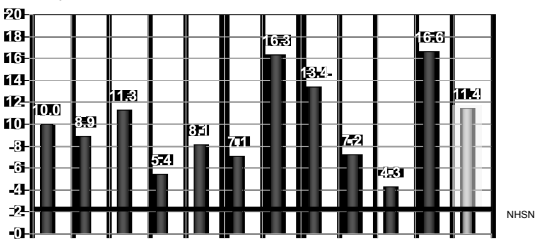
Conclusions: Device-associated infections in the ICUs of these developing countries pose far greater threats to patient safety than in U.S. ICUs. Active infection control programs that perform surveillance of infection and implement guidelines for prevention can improve patient safety and must become a priority in every country.

Ann Intern Med. 2006;145:* * * FILL THIS IN * * *. www.annals.org

For author affiliations, see end of text.

*For a list of members of the International Nosocomial Infection Control Consortium, see the Appendix.

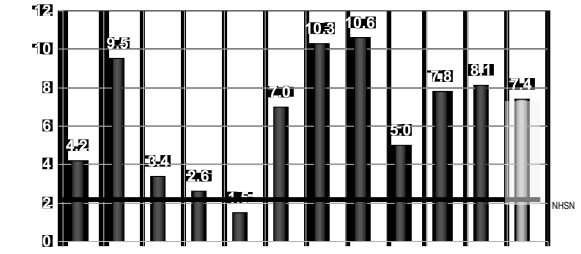
CVC-BSI per 1,000 CVC days



Rosenthal VD, *et al,* SHEA Meeting 2007, APIC Meeting 2007

29

CAUTI per 1.000 device days



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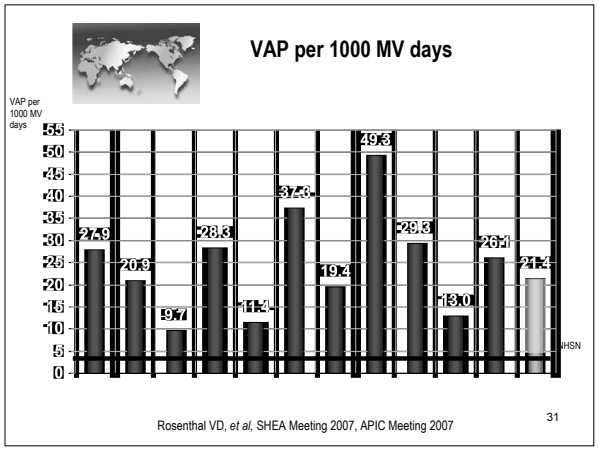

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31

Infection Control in Developing Countries 18

Patricia Lynch, Victor D. Rosenthal, Michael A. Borg, and Sergey R. Eremin

TABLE 18-3
DEVICE-ASSOCIATED INFECTIONS REPORTED BY HOSPITALS FROM COUNTRIES DEFINED AS LOW INCOME BY THE WORLD BANK

Country	Type of Study/Unit	Type of HAI	HAI Rate	Year	Reference
Argentina	Multicenter adult ICU	IVD-BSI*	30.3 per 1,000 central line days	2004	[71]
Brazil	Multicenter adult ICU	IVD-BSI	9.2 per 1,000 central line days	2006	[45]
Brazil	Multicenter new born ICU	IVD-BSI	17.3 to 34.9 per 1,000 central line days	2004	[44]
Colombia	Multicenter adult ICU	IVD-BSI	11.3 per 1,000 central line days	2006	[50]
Croatia	Adult ICU	IVD-BSI	8.3 per 1,000 central line days	2006	[51]
Egypt	Pediatric ICU	IVD-BSI	18.7 per 1,000 central line days	2005	[52]
India	Multicenter adult ICU	IVD-BSI	11.1 per 1,000 central line days	2005	[53]
Mexico	Multicenter adult ICU	IVD-BSI	23.1 per 1,000 central line days	2006	[56]
Mexico	Pediatric ward	IVD-BSI	26.0 per 1,000 central line days	2001	[72]
Morocco	Adult medical ICU	IVD-BSI	5.8 per 1,000 central line days	2005	[57]
Peru	Multicenter adult ICU	IVD-BSI	7.8 per 1,000 central line days	2005	[58]
Philippines	Adult ICU	IVD-BSI	8.6 per 1,000 central line days	2006	[59]
Turkey	Hospitalwide	IVD-BSI	9.2 per 1,000 central line days	2004	[73]
Turkey	Multicenter adult ICU	IVD-BSI	24.5 per 1,000 central line days	2005	[66]
Saudi Arabia	Pediatric ICU	IVD-BSI	20.0 per 1,000 central line days	2006	[74]
INICC	Multicenter adult ICU	IVD-BSI	13.0 per 1,000 central line days	2005	[154]

BACTERIAL RESÍSTANCE

Table 3. Central Venous Catheter–Associated Bloodstream Infections in the International Nosocomial Infection Control Consortium Intensive Care Units*

Variable	Country								Overall
	A	B	C	D	E	F	G	H	
CVC-associated bloodstream infections, *n*	119	86	126	109	151	11	35	293	930
Rate per 100 patients (range)†	1.3 (0.0–13.0)	8.4 (0.0–11.3)	5.8 (0.0–9.0)	3.2 (0.0–5.2)	10.0 (1.0–15.2)	2.7‡	2.6 (0.0–3.3)	12.7 (1.0–47.6)	4.4 (1.3–12.7)
Rate per 1000 CVC days (range)†	10.7 (0.0–18.9)	9.2 (0.0–25.8)	11.3 (0.0–20.3)	8.8 (0.0–15.4)	16.3 (4.2–23.3)	18.5‡	7.8 (0.0–10.7)	17.9 (6.0–41.5)	12.5 (7.8–18.5)
Proportion of cases, %§									
Enterobacteriaceae	31	26	31	42	29	33	19	22	27
Pseudomonas aeruginosa	10	5	5	13	15	18	10	9	9
Acinetobacter spp.	4	8	7	10	5	9	5	22	13
Staphylococcus aureus	34	20	37	8	8	18	38	26	25
Enterococci	1	5	1	5	0	0	0	4	3
Coagulase-negative staphylococci	20	30	14	8	38	9	5	13	18
Candida spp.	1	7	2	10	6	9	24	4	5
Susceptibility of resistant microorganisms, %									
MRSA	64	100	70.6	100	0	31	80	92	85
Ceftriaxone-resistant *Enterobacteriaceae*	31	100	33.3	71	50	95	50	100	57
Fluoroquinolone-resistant *P. aeruginosa*	56	70	0.0	0	100	0	100	51	49
Vancomycin-resistant enterococci	9	0	0.0	0	0	0	0	0	3

* CVC = central venous catheter; MRSA = methicillin-resistant *Staphylococcus aureus*.
† Ranges for individual countries are for the individual hospitals; overall ranges are for the individual countries.
‡ Range not given because only 1 participating hospital was from country F.
§ Partial listing of major pathogens; does not total 100%.

33

BACTERIAL RESÍSTANCE

Device-Associated Infections in the Intensive Care Unit | ARTICLE

Table 5. Comparison of Device Use and Rates of Device-Associated Infection in the Intensive Care Units of the International Nosocomial Infection Control Consortium and of the U.S. National Nosocomial Surveillance System*

Variable	U.S. NNIS ICUs: 1992–2004	INICC ICUs: 2002–2005
Rate of device use†‡		
Mechanical ventilators	0.43 (0.23–0.62)	0.38 (0.19–0.64)‡
CVCs	0.57 (0.36–0.74)	0.54 (0.22–0.97)
Urinary catheters	0.78 (0.65–0.90)	0.73 (0.48–0.94)
Rate per 1000 device days†‡		
Ventilator-associated pneumonia	5.4 (1.2–7.2)	24.1 (10.0–52.7)‡
CVC-associated bloodstream infection	4.0 (1.7–7.6)	12.5 (7.8–18.5)
Catheter-associated UTI	3.9 (1.3–7.5)	8.9 (1.7–12.8)
Proportion of device-associated infections with resistance, %§		
MRSA	59	84
Ceftriaxone-resistant *Enterobacteriaceae*	19	55
Ciprofloxacin-resistant *Pseudomonas aeruginosa*	29	59
Vancomycin-resistant enterococci	29	5

* Data are from an NNIS report (1). CVC = central venous catheter; INICC = International Nosocomial Infection Control Consortium; MRSA = methicillin-resistant *Staphylococcus aureus*; NNIS = National Nosocomial Infection Surveillance System; UTI = urinary tract infection.
† Overall (pooled) and 10th to 90th percentile range for U.S. NNIS teaching hospitals.
‡ Overall (pooled) and range of individual countries for the INICC hospitals.
§ Overall (pooled) data from NNIS, 1992–2004 (300 hospitals), and from INICC, 2002–2005.

34

Surveillance
Outcome Surveillance

Rates of DAI in developing countries were far higher than reported by the NHSN system:

• the overall rate of CVC associated BSI in the International Nosocomial Infection Control Consortium (INICC) medical–surgical ICUs, 11.4 per 1000 CVC days, is around six-fold higher than the 2 per 1000 CVC-days reported for comparable U.S. ICUs by NHSN;

• the overall rate of CAUTI was also higher, 7.4 as compared with 2 per 1000 catheter-days.

• and the overall rate of VAP was also higher than pooled NNIS rates, 21.4 vs. 4 per 1000 ventilator-days;

Surveillance
Outcome Surveillance

There are a number of explanations for the higher rates of DAI representative of developing country ICUs, as previously suggested by several investigators:

• Most developing countries do not have mandatory laws for HAI control programs, and also hospital accreditation is not mandatory. Hand hygiene is highly variable.

•There are very limited funds and resources for infection control, and nurse-to-patient staffing ratios are lower than in most industrialized countries ICUs.

•Use of outdated technology is also a factor: i.e., developing countries use open intravenous infusion and urinary collection systems rather than closed systems that are the standard of care in industrialized countries.

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Surveillance
Outcome Surveillance

- In developing countries even with different health care systems, generally, the perception is that rates of HAI are low and that compliance with hand hygiene recommendations always occurs. However, frequently, no formal outcome and process surveillance is conducted to validate the perception.
- Outcome surveillance of DAIs defines the magnitude of the problem, identifies the highest risk devices, and provides the framework for planning to reduce infection risk.

Surveillance
Outcome Surveillance

- Outcome surveillance also allow measuring other variables as length of stay, mortality and cost

Extra Length of Stay

Nosocomial infections in medical-surgical intensive care units in Argentina: Attributable mortality and length of stay

Victor Daniel Rosenthal, MD, CIC,[a] Sandra Guzman, RN,[a] and Pablo Wenceslao Orellano, MSc[b]
Buenos Aires, Argentina

Background: Nosocomial infections are an important public health problem in many developing countries, particularly in the intensive care unit (ICU). Limited data exists on the incidence and burden of nosocomial infection in the ICU in Argentina.

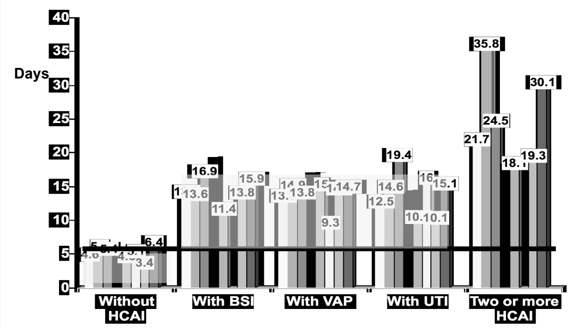
Methods: We performed baseline prospective nosocomial infection surveillance of all patients for 6 months in 3 medical-surgical ICUs (MS-ICUs) in Argentina (2 months in each ICU). Nosocomial infections were identifed using the Centers for Disease Control and Prevention National Nosocomial Infections Surveillance definitions. Overall and site-specific nosocomial infection rates, attributable mortality, and excess length of hospital stay were calculated.

Results: The overall nosocomial infection rate was 27% and 90 per 1000 patient-days. The most common site of infection was catheter-related bloodstream infection (32%), followed by ventilator-associated pneumonia (25%), and catheter-associated urinary tract infection (23%). The rate of central catheter-associated bloodstream infection in the MS-ICU was 44.61 per 1000 device-days, with an atttributable mortality of 25%, and 12 attributable extra days of hospital stay. The urinary catheter-associated urinary tract infection rate in the MS-ICU was 22.55 per 1000 urinary catheter-days, with an attributable mortality of 5%, and 5 excess extra days of hospital stay. The ventilator-associated pneumonia rate in the MS-ICU was 50.87 per 1000 ventilator-days with an attributable mortality of 35%, and 10 attributable extra days of hospitalization.

Conclusion: Our study finds high rates of nosocomial infections in ICUs in Argentina, associated with a considerable attributable mortality and excess length of stay. Ongoing targeted surveillance and implementation of infection control strategies is necessary to control this growing problem. (Am J Infect Control 2003;31:291-5.)

39

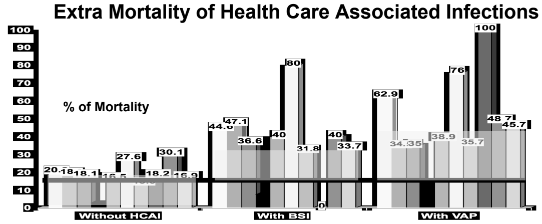
Extra Length of Stay and Device-Associated Nosocomial Infection Rates in Intensive Care Units.



Rosenthal VD, *et al*, ICAAC Meeting. 2005

40

Extra Mortality of Health Care Associated Infections



	Overall	Extra mortality	RR	95% CI	P-value
Overall Crude Mortality of patients without infection, %	16.9		1.0	-	-
%Crude mortality of patients with VAP, %	45.7	28.8	2.70	2.41-3.03	0.0000
%Crude mortality of patients with CVC-associated BSI, %	33.7	16.8	1.99	1.72-2.31	0.0000
%Crude mortality of patients with CAUTI, %	38.5	21.6	2.28	1.94-2.67	0.0000

Rosenthal VD, *et al*, ICAAC Meeting. 2005

41

Extra Costs

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

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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.)

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

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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.)

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 Fra[redacted]lan, 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

Outcome Surveillance and Process Surveillance
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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.

43

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.

44

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

45

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.

46

The attributable cost and length of hospital stay because of nosocomial PNEUMONIA in intensive care units in 3 hospitals in Argentina: a prospective, matched analysis.

Table 1. Baseline characteristics of patients with and without nosocomial pneumonia

	Cases, N = 307 (%)	Control, N = 307 (%)	*P* value
LOS (7 or more days)	307 (100)	307 (100)	NS
Age, mean, SD, years	73.79 SD 11.97	69.90 SD 11.48	NS
Sex (male)	157/307 (51.1)	157/307 (51.1)	NS
ICU (Ms ICU)	247/307 (80.5)	247/307 (80.5)	NS
Average severity of illness score, mean, SD	3.34 SD 0.95	3.11 SD 0.83	NS
Year	1998 (5.2)	1998 (6.8)	NS
	1999 (20.5)	1999 (18.9)	
	2000 (24.4)	2000 (22.8)	
	2001 (43.0)	2001 (44.6)	
	2001 (6.8)	2001 (6.8)	

ICU, Intensive care unit; *LOS*, length of stay; *Ms ICU*, Medical Surgical Intensive care unit.

47

Rosenthal VD, et al. Am J Infect Control 2005;33(3):157-61.

The attributable cost and length of hospital stay because of nosocomial PNEUMONIA in intensive care units in 3 hospitals in Argentina: a prospective, matched analysis.

	Case (N= 307)	Control (N= 307)	Attributable Extra Expenditures
Total Days	**6,043**	**3,295**	**Total Extra Days: 2,748**
Alos	**19.68**	**10.73**	**Mean Extra Days: 8.95**
Total Fixed Cost	**$1,510,750**	**$823,750**	**Fixed Extra Cost: $687,000**
Mean Fixed Cost	**$4,921**	**$2,683**	**Mean Extra Cost: $2,238**
Total Atb DDD	**7,815**	**3,181**	**Atb Extra DDD: 4,634**
Mean Atb DDD	**25.45**	**10.36**	**Mean Extra Atb DDD: 15.09**
Total Atb Cost	**$515,790**	**$209,946**	**Atb Extra Cost: $305,844**
Mean Atb Cost	**$1,680.09**	**$683.86**	**Mean Extra Atb Cost: $996.22**
Total Global Cost	**$1,518,565**	**$826,931**	**Total Extra Global Cost: $691,634**
Mean Global Cost	**$4,946.46**	**$2,693.58**	**Mean Total Extra Global Cost: $2,252.88**
Total Mortality	**195**	**102**	**Total Extra Dead: 90**
Average Mortality	**63.5%**	**33.2%**	**Extra Attributable Mortality: 30.3%**

48

Rosenthal VD, et al. Am J Infect Control 2005;33(3):157-61.

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Outcome Surveillance and Process Surveillance
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Surveillance
Process Surveillance

- Process surveillance is the standardized collection of data regarding the infection control practices actually used in the facility.

•This includes compliance with recommendations for hand hygiene, vascular catheter care, urinary catheter care, measures to prevent VAP such as position of the head, type of secretion suctioning; and measures to prevent surgical site infections as pre-surgical shower, clipping and antibiotic prophylaxis, or others.

Surveillance
Process Surveillance

• Process surveillance is usually done by observation of actual practices, analysis of the data and performance feedback to the personnel who performed the care or are responsible for it.

•Hand hygiene is a fundamental aspect of infection control; several studies reported a decline in HAI rates when compliance with hand hygiene was enhanced.

Surveillance
Process Surveillance

• Despite universal acknowledgement of the pivotal role that hand hygiene and device care play in reducing infection risk , hand hygiene compliance among healthcare workers in developing countries remains poor, with rates ranging from 9% to 75%.

•Several interventions have been attempted to improve hand hygiene practices; among the most effective ones are those that emphasize targeted education, process surveillance and frequent performance feedback.

Surveillance
Process Surveillance

•Dubbert, et al found that while education alone improved compliance rates in a transient way, process surveillance and performance feedback resulted in sustained improvement in compliance.

•In developing countries, implementation of education, process surveillance and performance feedback, improved considerably the adherence to hand hygiene; examples from developing countries were reported from Argentina,China, Mexico,Russia, Turkey, and others.

ICU no sinks

53

Sinks No Supplies.

Bad Hand Hygiene technique

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One sink every two beds

Alcohol Gel Available at each bed side

55

Hand Hygiene using antiseptic soap, disposable paper towels, no rings, no watch

Surveillance
Process Surveillance

• In Argentina between April 1999 and October 2003; 15,531 patient contacts were observed in one hospital. The baseline rate of HW before contact with patients was 17%. With education and process surveillance and performance feedback, hand hygiene before contact with the patients increased to 58%.

Improvement of Hand Hygiene Compliance

Effect of education and performance feedback on handwashing: The benefit of administrative support in Argentinean hospitals

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Background: Patients admitted to hospitals are at risk of acquiring nosocomial infections. Many peer-reviewed studies show that handwashing (HW) significantly reduces hospital infections and mortality. Our objective was to evaluate the effects of HW by health care workers (HCW) before contact with patients in 3 Argentinean hospitals. We performed an observational study of HCW to measure the effect of 2 interventions: education alone and education plus performance feedback.

Methods: A total of 3 hospitals were studied for adherence to a HW protocol. The observed HCW included physicians, nursing personnel, and ancillary staff. After initial observations to establish baseline rates of HW (phase 1), we evaluated the effect of education alone (phase 2), followed by education plus performance feedback (phase 3). We also evaluated the relationship between the administrative support and HW adherence.

Results: We observed 15,531 patient contacts in 3 hospitals. The baseline rate of HW before contact with patients was 17%. With education, HW before contact with the patients increased to 48% (relative risk 2.65; 95% confidence interval 2.55-3.02; *P* < .001). Using education and performance feedback HW further increased to 58% (relative risk 1.86; 95% confidence interval 1.78-2.51; *P* < .001). In the private hospitals where administrative support for the HW program was significantly greater, HW compliance was significantly higher (logistic regression analysis: odds ratio 5.57; 95% confidence interval 5.25-6.31; *P* < .001).

Conclusions: In this study, HW policies and education of HCW significantly improved HCW adherence to the HW protocol, however, when performance feedback was incorporated, the HW compliance increased to a greater degree. We identified that administrative support provides a positive influence in efforts to improve HW adherence. (Am J Infect Control 2005;33:485-92.)

Hand Hygiene Compliance Improvement.

Country	City	Hospital	Baseline period	Pre	Intervention period	Post	RR	95% CI	P Value
Argentina	Bernal	Bernal	4/99 to 5/99	24.0%	6/99 to 8/06	65.3%	2.71	2,12 - 3,48	0.0000
Argentina	Buenos Aires	Colegiales Medical Center	9/00 to 2/01	29.6%	3/99 to 1/05	68.9%	2.33	2,12 - 2,56	0.0000
Argentina	Buenos Aires	Estrada Medical Center	10/03 to 1/04	7.8%	2/04 to 10/04	54.5%	7.01	4,22 - 11,67	0.0000
Argentina	Avellaneda	Fiorito Hospital	7/05 to 9/05	2.2%	10/05 to 12/05	9.6%	4.28	1,63 -11,22	0.0012
Argentina	Lanús	Narciso López Hospital	7/5-10/5	9.6%	11/5 to 6/6	28.3%	2.95	1,33 - 6,53	0.0050
Argentina	Avellaneda	Presidente Perón Hospital	7/4-09/4	36.4%	10/4 to 7/5	48.0%	1.32	0.88 - 1.98	0.1800
Argentina	Buenos Aires	Carrillo Hospital	8/98-09/98	5.0%	10/98 to 6/00	26.4%	5.32	3.89 - 7.28	0.0000

58

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Hand Hygiene Compliance Improvement.

Country	City	Hospital	Baseline period	Pre	Intervention period	Post	RR	95% CI	P Value
Brazil	Sao Paulo	Santa Marcelina Hospital (UTI 1)	8/04 to 11/04	47.5%	12/04 to 4/06	68.5%	1.44	1,21 - 1,71	0.0000
Brazil	Porto Alegre	Porto Alegre General Hospital	8/4-11/4	29.0%	12/4 to 2/6	53.9%	2.01	1.71 - 2.37	0.0000
Brazil	Rio de Janeiro	HUCFF	4/3	56.7%	5/3 to 6/3	71.5%	1.26	0.98 -1.62	0.0707
Colombia	Bogotá	San Ignacio Hospital	8/03 to 9/03	18.4%	10/03 to 1/04	35.3%	1.92	1.45 - 2.54	0.0000
Mexico	Mexico	General Hospital of Mexico	6/02 to 7/02	24.0%	08/02 to 11/03	80.8%	3.37	2,46 - 4,63	0.0000
Mexico	Mexico	Celaya Hospital	1/04 to 5/04	10.7%	6/04 to 8/04	53.5%	4.98	3,25 - 7,63	0.0000
Mexico	Mexico	Irapuato Hospital	11/03 to 2/04	33.3%	3/04 to 5/05	47.9%	1.44	1,07 - 1,93	0.0146
Mexico	Mexico	De la Mujer Hospital (NEO)	10/03 to 2/04	43.8%	3/04 to 6/04	66.6%	1.52	1,33 - 1,74	0.0000

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59

Hand Hygiene Compliance Improvement.

Country	City	Hospital	Baseline period	Pre	Intervention period	Post	RR	95% CI	P Value
Mexico	Mexico	De la Mujer Hospital (UCI)	10/03 to 2/04	35.7%	3/04 to 6/04	60.0%	1.68	1,45 - 1,95	0.0000
Mexico	Mexico	IMSS-Especialidades	10/02 to 1/03	46.6%	2/03 to 11/03	76.0%	1.63	1,40 - 1,89	0.0000
Mexico	Mexico	IMSS-Mancera	10/02 to 1/03	35.5%	2/03 to 11/03	69.9%	1.97	1,29 - 3,00	0.0012
Mexico	Mexico	La Raza Medical Center	8/05 to 9/05	43.0%	10/05 to 04/06	79.1%	1.84	1,43 - 2,36	0.0000
Perú	Lima	INEN Hospital	5/04 to 8/04	37.1%	9/04 to 1/06	65.9%	1.77	1.01 - 3.13	0.0444
Perú	Lima	San Pablo Clinic	2/04 to 5/04	74.9%	6/04 to 10/05	89.2%	89.2	1,08 - 1,32	0.0006
Perú	Trujillo	Víctor Lazarte Hospital	1/04 to 3/04	40.9%	4/04 to 6/04	52.6%	1.29	1.01 – 1. 63	0.0390
El Salvador	San Salvador	Nat. Child.'s Ho. Benjamin Bloom	1/7	38.5%	2/7 to 3/7	49.3%	1.28	0.92 - 1.78	0.1396

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60

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Hand Hygiene Compliance Improvement.

Country	City	Hospital	Baseline period	Pre	Intervention period	Post	RR	95% CI	P Value
Philippines	Quezon	Saint Luke's (PED)	12/05 to 1/06	32.7%	2/06 to 10/06	70.6%	2.16	1.32 - 3.53	0.0017
India	Bangalore	Wockhardt Medical Center	11/04 to 12/04	54.8%	1/05 to 5/06	95.2%	1.74	1,40 - 2,16	0.0000
India	Kolkata	AMRI Hospitals	5/6 to 7/6	71.5%	8/6 to 4/7	73.9%	1.03	0.97 - 1.11	0.3337
Pakistan	Karachi	Liaquat National Hospital	1/6 to 4/6	25.8%	5/6 to 10/6	42.0%	1.63	1.33 - 1.99	0.0000
Turkey	Samsun	Ondokuz Mayis	1/4-9/4	70.4%	10/4 to 9/6	82.5%	1.17	1.05 - 1.31	0.0054
Turkey	Sanliurfa	Harran University	5/5-10/5	30.7%	11/5 to 4/6	56.1%	1.83	1,34 - 2,50	0.0001

61

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Hand Hygiene Compliance Improvement.

Country	City	Hospital	Baseline period	Pre	Intervention period	Post	RR	95% CI	P Value
Turkey	Trabzon	Karadeniz University	9/04 to 11/04	36.9%	12/04 to 6/05	47.0%	1.27	1,00 - 1,62	0.0464
Turkey	Ankara	Hacettepe University School of Medicine	5/04 to 7/04	28.5%	8/04 to 10/04	40.8%	1.43	1,17 - 1,75	0.0004
Turkey	Ankara	Ankara Univ.School of Medicine Ibni-Sina Hospital	8/03 to 11/03	19.2%	12/03 to 12/05	46.2%	2.4	2,00 - 2,87	0.0000
Turkey	Antalya	Akdeniz University	6/04 to 11/04	4.2%	12/04 to 9/06	16.0%	3.85	1.40 - 10.59	0.0049
Turkey	Istanbul	Haydarpasa Hospital	10/03 to 3/04	6.9%	4/04 to 9/06	43.1%	6.23	4.86 - 7.98	0.0000

62

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Surveillance
Outcome Surveillance

•The second step is to implement targeted specific infection control practices that have been shown to prevent HAI.

•INICC have evaluated hospitals in which outcome and process surveillance have been the driving force to reduce infection risk and infection-related mortality.

Surveillance
Process Surveillance

• In Argentina, a program was developed consisting of frequent focused education of healthcare workers, process surveillance and performance feedback.

•Simultaneously, HAI rates were measured at baseline and during the intervention to determine whether improved compliance would be associated with a reduction in HAI. A 42% relative reduction in HAI rates was reported from conducting process surveillance and emphasizing compliance with hand hygiene.

Surveillance
Process Surveillance

• It was the first study of reduction in HAI made by improving hand hygiene in Latin America and the investigators inferred that similar improvement could occur in similar developing countries.

• The authors found lower adherence among physicians, which is similar to results reported in industrialized countries.

Overall HCAI Rate Reduction

Reduction in nosocomial infection with improved hand hygiene in intensive care units of a tertiary care hospital in Argentina

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Background: Hand hygiene is a fundamental measure for the control of nosocomial infection. However, sustained compliance with hand hygiene in health care workers is poor. We attempted to enhance compliance with hand hygiene by implementing education, training, and performance feedback. We measured nosocomial infections in parallel.
Methods: We monitored the overall compliance with hand hygiene during routine patient care in intensive care units (ICUs); 1 medical surgical ICU and 1 coronary ICU, of 1 hospital in Buenos Aires, Argentina, before and during implementation of a hand hygiene education, training, and performance feedback program. Observational surveys were done twice a week from September 2000 to May 2002. Nosocomial infections in the ICUs were identified using the National Nosocomial Infections Surveillance (NNIS) criteria, with prospective surveillance.
Results: We observed 4347 opportunities for hand hygiene in both ICUs. Compliance improved progressively (handwashing adherence, 23.1% (268/1160) to 64.5% (2056/5187) (RR, 2.79; 95% CI: 2.46-3.17; $P < .0001$). During the same period, overall nosocomial infection in both ICUs decreased from 47.55 per 1000 patient-days (104/2187) to 27.93 per 1000 patient days (207/7409) RR, 0.59; 95% CI: 0.46-0.74, $P < .0001$).
Conclusion: A program consisting of focused education and frequent performance feedback produced a sustained improvement in compliance with hand hygiene, coinciding with a reduction in nosocomial infection rates in the ICUs. (Am J Infect Control 2005;33:392-7.)

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Outcome Surveillance and Process Surveillance
Dr. Victor Rosenthal
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Overall HAI Rate

Country	City	Hospital	Baseline Rate	Intervention Rate	Reduction Rate	RR	CI (95%)	P Value	Ref
Argentina	Bs. As.	Colegiales Medical Center	47.55 p/1000 bed-days	27.9 p/1000 bed-days	41%	0.59	0.46 - 0.74	<0.0001	1
Brazil	Porto Alegre	Porto Alegre G. Hospital	19.8%	4.8%	76%	0.24	0.07 - 0.80	0.0113	2
Colombia	Bogotá	La Victoria	21.3%	6.2%	71%	0.29	0.10 – 0.85	0.0161	3

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Overall HAI Rate

Country	City	Hospital	Baseline Rate	Intervention Rate	Reduction Rate	RR	CI (95%)	P Value	Ref
India	Bangalore	Wockhardt Hospital	2.5%	0.17%	99.3%	0.07	0.01 - 0.30	< 0.0001	1
India	Kolkata	ARMI Hospital	12 %	5.3%	55%	0.45	0.22 – 0.90	0.0200	2
India	Vellore	Christian Medical College	16.1 p/1000 bed-days	5.1 p/ 1000 bed-days	68%	0.32	0.09 - 1.06	0.0481	3
México	México D.F.	De la Mujer Hospital	12.96%	4.95%	62%	0.38	0.15 – 0.99	0.0393	4

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Overall HAI Rate

Country	City	Hospital	Baseline Rate	Intervention Rate	Reduction Rate	RR	CI (95%)	P Value	Ref
Turkey	Trabzon	Karadeniz Technical University School of Medicine	30 p/ 1000 bed-days	18.3 p/ 1000 bed-days	39%	0.61	0.38 - 0.98	0.0380	1
Turkey	Ankara	**Ankara University School of Medicine Ibni-Sina**	56.7%	37.8%	39%	0.61	0.44 – 0.84	0.0023	2
Turkey	Ankara	**Ankara University School of Medicine Ibni-Sina**	42.0 p/1000 bed-days	25.5 p/1000 bed-days	33%	0.67	0.48 – 0.92	0.0133	2
Turkey	Duzce	Duzce Medical School	55.0%	18.8%	66%	0.34	0.14 – 0.84	0.0142	3

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Mortality Reduction

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

Francisco Higuera, MD; Victor Daniel Rosenthal, MD, MSc, CIC; Pablo Duarte, MD; Javier Ruiz, MD; Guillermo Franco, MD; Nasia Safdar, MD

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:●●●–●●●)

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

Mortality Rate

Country	City	Hospital	Baseline Rate	Intervention Rate	Reduction Rate	RR	CI (95%)	P Value	Ref
India	New Delhi	Escorts Heart Institute	1.7%	0.5%	69%	0.31	0.15 - 0.66	0.0013	1
Mexico	Mexico DF	Mexico's General Hospital	48.5%	32.8%	78%	0.68	0.50 – 0.81	0.01	2
Peru	Trujillo	Victor Lazarte Echegara y Hospital	33.3%	14.8%	56%	0.44	0.28 – 0.70	0.0004	3

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Surveillance
Outcome Surveillance

•Targeted incidence of CVC-associated BSIs, CAUTIs and VAP in many developing countries hospitals have been substantially reduced by the institution of outcome surveillance, process surveillance, and targeted performance feedback programs for hand-hygiene, central venous catheter, ventilator and urinary catheter

Outcome Surveillance and Process Surveillance
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Surveillance
Process Surveillance

• Process surveillance for vascular and urinary catheter care, and mechanical ventilator care was also effective to reduce associated HAIs in several previous studies conducted in developing countries, such as Argentina, Brazil, Colombia, India, México, Turkey, among others.

Surveillance
Process Surveillance

•Position of the urinary catheter regarding the leg, and position of urine bag regarding the bed and other practices were assessed and entered into a standard form by local researchers who observed healthcare worker (HCW) behaviors in the study units daily five days a week.

CAUTI Rate Reduction

Vol. 25 No. 1 INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY 47

EFFECT OF EDUCATION AND PERFORMANCE FEEDBACK ON RATES OF CATHETER-ASSOCIATED URINARY TRACT INFECTION IN INTENSIVE CARE UNITS IN ARGENTINA

Victor Daniel Rosenthal, MD, MSc, CIC; Sandra Guzman, RN, ICP; Nasia Safdar, MD

ABSTRACT

OBJECTIVE: To evaluate the effect of education and performance feedback regarding compliance with catheter care and handwashing on rates of catheter-associated urinary tract infection (UTI) in intensive care units (ICUs).

SETTING: Two level III adult ICUs in a private healthcare facility in Argentina.

PATIENTS: All adult patients admitted to the study units who had a urinary catheter in place for at least 24 hours.

METHODS: A prospective, open trial in which rates of catheter-associated UTI determined during a baseline period of active surveillance without education and performance feedback were compared with rates of catheter-associated UTI after implementing education and performance feedback.

RESULTS: There were 1,779 catheter-days during the baseline period and 5,568 catheter-days during the intervention period. Compliance regarding prevention of compression of the tubing by a leg improved (from 83% to 98%; relative risk [RR], 1.15; 95% confidence interval [CI_{95}], 1.03 to 1.28; $P = .01$) and so did compliance with handwashing (from 23.1% to 65.2%; RR, 2.82; CI_{95}, 2.49 to 3.20; $P < .0001$). Catheter-associated UTI rates decreased significantly from 21.3 to 12.39 per 1,000 catheter-days (RR, 0.58; CI_{95} 0.39 to 0.86; $P = .006$).

CONCLUSION: Implementing education and performance feedback regarding catheter care measures and handwashing compliance was associated with a significant reduction in catheter-associated UTI rates. Similar programs may help reduce catheter-associated UTI rates in other Latin American hospitals (*Infect Control Hosp Epidemiol* 2004;25:47-50).

75

CAUTI Rate

Country	City	Hospital	Baseline Rate	Intervention Rate	Reduction Rate	RR	CI (95%)	P Value	Ref
Argentina	Buenos Aires	Colegiales	21.3 p/ 1000 catheter days	12.39 p/ 1000 catheter days	42%	0.58	0.39 - 0.86	0.006	1
India	Kolkata	AMRI Hospitals	7.4 p/1000 catheter days	2.2 p/1000 catheter days	70%	0.30	0.08 - 1.07	0.0481	2

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78

Surveillance
Process Surveillance

•Position of the bed head, cleanliness of tubes, aspiration technique, hand hygiene with alcohol hand rub or hand washing with water and antiseptic soap prior to patient contact and other practices were assessed and entered into a standard form by local researchers who observed healthcare worker (HCW) behaviors in the study units daily five days a week.

VAP Rate Reduction

Impact of an infection control program on rates of ventilator-associated pneumonia in intensive care units in 2 Argentinean hospitals

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Background: Hospitalized, critically ill patients have a significant risk of developing nosocomial infection. Most episodes of nosocomial pneumonia occur in patients undergoing mechanical ventilation (MV).
Objective: To ascertain the effect of an infection control program on rates of ventilator-associated pneumonia (VAP) in intensive care units (ICUs) in Argentina.
Methods: All adult patients who received MV for at least 24 hours in 4, level III adult ICUs in 2 Argentinean hospitals were included in the study. A before-after study in which rates of VAP were determined during a period of active surveillance without an infection control program (phase 1) were compared with rates of VAP after implementation of an infection control program that included educational and surveillance feedback components (phase 2).
Results: One thousand six hundred thirty-eight MV-days were accumulated in phase 1, and 1520 MV-days were accumulated during phase 2. Rates of VAP were significantly lower in phase 2 than in phase 1 (51.28 vs 35.50 episodes of VAP per 1000 MV-days, respectively, RR = 0.69, 95% CI: 0.49-0.98, $P \leq .003$).
Conclusion: Implementation of a multicomponent infection control program in Argentinean ICUs was associated with significant reductions in rates of VAP. (Am J Infect Control 2006;■:■■■-■■■.)

VAP Rate

Country	City	Hospital	Baseline Rate	Intervention Rate	Reduction Rate	RR	CI (95%)	P Value	Ref
Argentina	Buenos Aires, Bernal	Bernal and Colegiales M. Centers	51.28 p/1000 MV-days	35.5 p/1000 MV-days	31%	0.69	0.49 – 0.98	<0.003	1
Colombia	Bogota	San Ignacio Hospital	11.7 p/1000 MV-days	4.2 p/1000 MV-days	64%	0.36	0.18 – 0.70	0.0016	2
India	Vellore	Christian Medical College	22.7 p/1000 MV-days	6.6 p/1000 MV-days	71%	0.29	0.08 – 0.99	0.0358	3
India	New Delhi	Escorts Heart Institute	26.3 p/1000 MV-days	10.9 p/1000 MV-days	59%	0.41	0.25 – 0.70	0.0005	4
Turkey	Trabzon	Karadeniz Technical University	19.6 p/1000 MV-days	8.0 p/1000 MV-days	59%	0.41	0.21 – 0.80	0.0065	5

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Surveillance
Process Surveillance

•Placement of gauze on IVD insertion sites, marking the date on the IV administration set, condition of the gauze dressing (the presence or absence of moisture, blood, gross soilage and the appearance of the insertion site is checked) and other practices were assessed and entered into a standard form by local researchers who observed healthcare worker (HCW) behaviors in the study units daily five days a week.

IVD-BSI Rate Reduction

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

Francisco Higuera, MD; Victor Daniel Rosenthal, MD, MSc, CIC; Pablo Duarte, MD; Javier Ruiz, MD; Guillermo Franco, MD; Nasia Safdar, MD

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:●●●–●●●)
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

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

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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 0.37; 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.)

CVC insertion without aseptic technique | **CVC insertion using maximal barrier and aseptic technique**

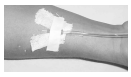
Raad, II, Hohn DC, Gilbreath BJ, et al. Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. Infection Control & Hospital Epidemiology 1994; 15:231-8.

Outcome Surveillance and Process Surveillance

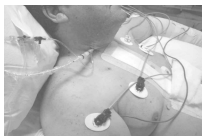
Dr. Victor Rosenthal

A Webber Training Teleclass

Peripheral catheter insertion place without sterile gauze



Central catheter insertion place without sterile gauze



Peripheral catheter insertion place with sterile gauze

Central catheter insertion place with sterile gauze and closed

85

One use vials, utilized multiple times

vials multi-doses with needle

Infusion system with administraton set and stopcock

CVC-BSI Rate

Country	City	Hospital	Baseline Rate	Intervention Rate	Reduction Rate	RR	CI (95%)	P Value	Ref
Argentina	Bernal	Bernal Medical Center	45.94 p/1000 CVC-days	11.1 p/1000 CVC-days	75%	0.25	0.17 – 0.36	<0.001	1
Brazil	Sao Paulo	Santa Marcelina	14 p/1000 CVC-days	7.1 p/1000 CVC-days	50%	0.5	0.32 – 0.8	0.0029	2
Colombia	Sucre	Santa María Medical Center	54.8 p/1000 CVC-days	6 p/1000 CVC-days	89%	0.11	0.01 – 0.98	0.0163	3
India	Mumbai	Hinduja National Hospital	12 p/1000 catheter days	5.2 p/1000 catheter days	57%	0.43	0.22 - 0.83	0.0099	4
Mexico	Mexico DF	Mexico's General Hospital	46.3 p/1000 CVC-days	19.5 p/1000 CVC-days	58%	0.42	0.27 – 0.66	0.0001	5

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87

CVC-BSI Rate

Country	City	Hospital	Baseline Rate	Intervention Rate	Reduction Rate	RR	CI (95%)	P Value	Ref
Mexico	México D.F.	De la Mujer Hospital	40.7 p/1000 CVC-days	10.3 p/1000 CVC-days	75%	0.25	0.08 - 0.84	0.0152	1
Morocco	Rabat	Ibn Sina-Medical ICU	22.9 p/1000 CVC-days	8.3 p/1000 CVC-days	64%	0.36	0.14 - 0.96	0.0334	2
Turkey	Istanbul	Haydarpasa Hospital	10 p/1000 CVC-days	1.8 p/1000 CVC-days	82%	0.18	0.05 - 0.6	0.0016	3
Turkey	Samsun	**Ondokuz Mayis University Medical School**	29.1p/1000 CVC-days	13.0 p/1000 CVC-days	55%	0.45	0.24 - 0.82	0.0076	4

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88

Conclusions

- In developing Countries HAI Rates and Bacterial Resistance are 3-5 times higher than international standards.
- The HAI increase length of stay (10 days), cost ($US 5,000-12,000) and mortality (2 times)
- By applying Process Surveillance, plus Education and Performance Feedback we were able to increase HH compliance, and other Infection Control Interventions compliance.
- By applying Outcome and Process Surveillance plus Feedback we were able to reduce Mortality, Overall HAI rates, and Device Associated HAI rates.

89

- **Every hospital are invited to incorporate into the INICC nonprofit research project.**
- **To incorporate, please only send an email to INICC with the following details:**
  - **Your name,**
  - **Your email,**
  - **Your working phone number,**
  - **Your hospital's name,**
  - **Your city.**

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90

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Thank you very much for your attention

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91

The Next Few Teleclasses

August 16	***What Can We Learn From the History of Communicable Disease Control?*** **(free teleclass)** … with Prof. Peter Curson, University of Sydney Broadcast live from the New Zealand Infection Control Association conference Sponsored by Johnson & Johnson
August 22	***ESBL's - Where are We Now?*** **(free teleclass)** … with Dr. Fong Chiew, Christchurch, NZ
September 20	***Extreme Makeover - ICP Edition: Exploring Challenges to Our Identity in Infection Control*** **(free teleclass)** … with Gwyneth Meyers, Calgary, Canada
September 24	***Infection Prevention: Challenging Behavior, Changing the Culture*** **(free teleclass)** … with Dr. Elaine Larson, Columbia University

For the full teleclass schedule – www.webbertraining.com
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