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

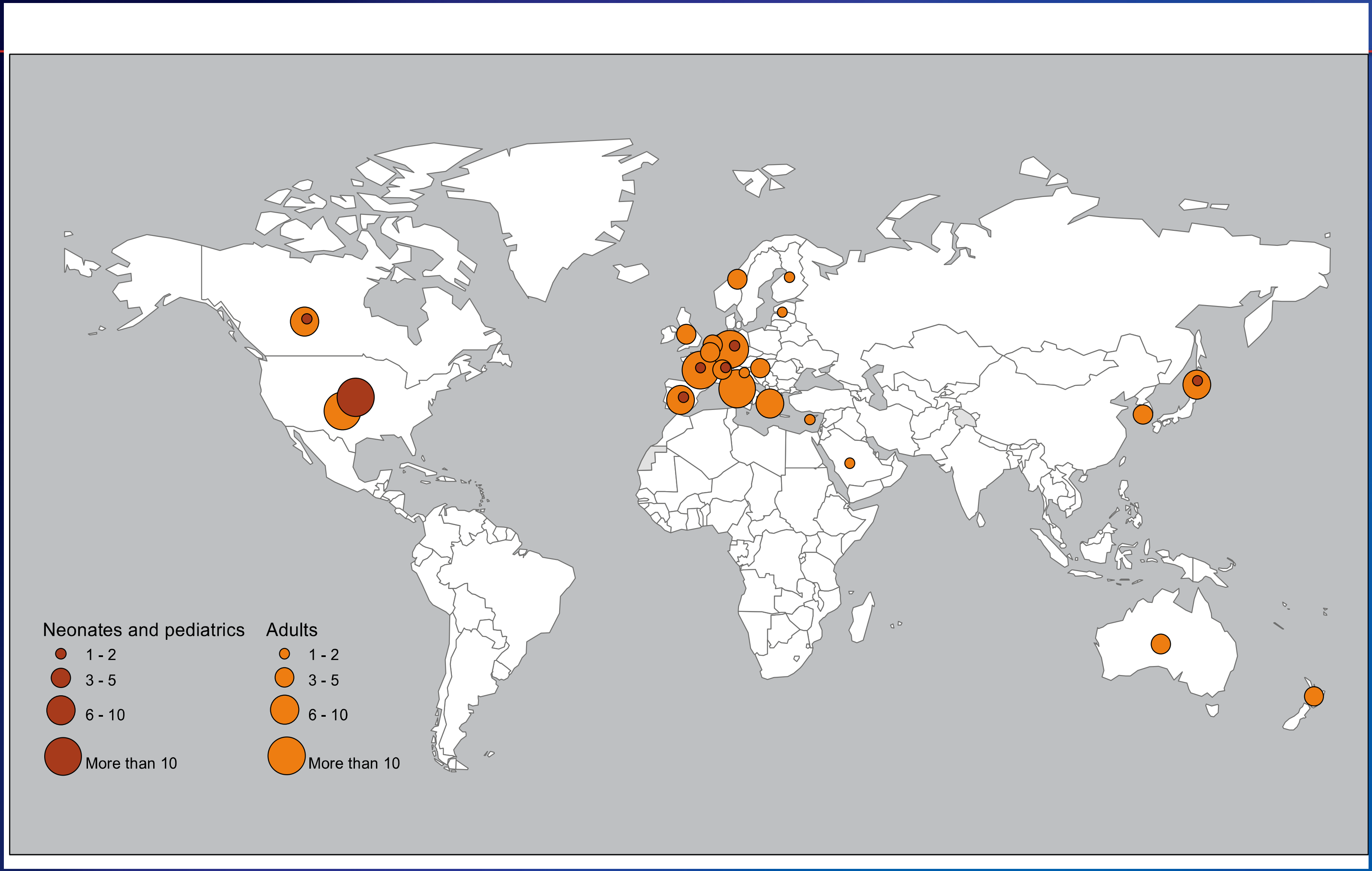
"Epidemiology and Prevention of VAP Internationally: INICC Experience."

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

Agenda

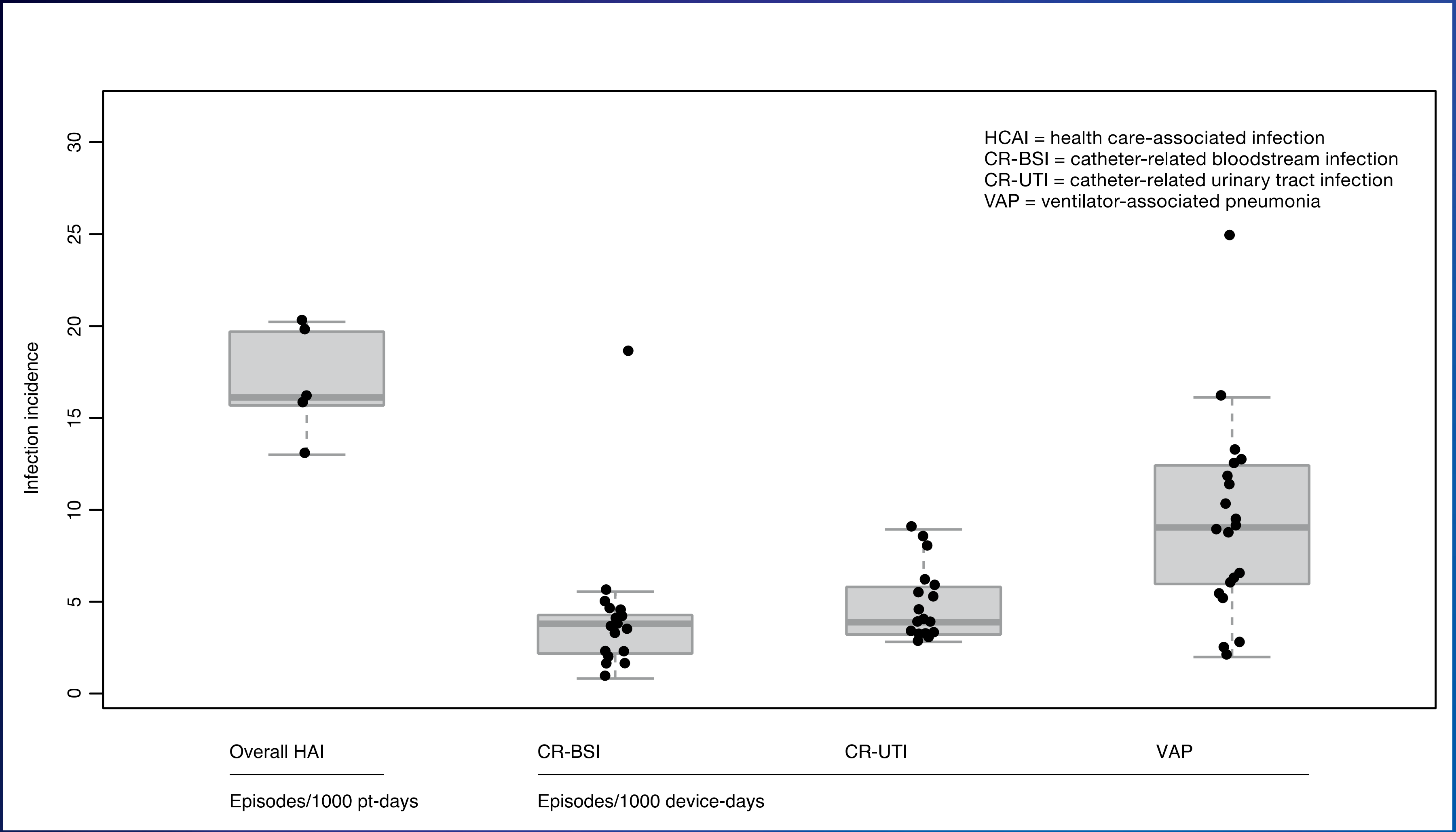
1. Introduction:
   A. VAP rates of High Income Countries
   B. VAP rates of Limited Resources Countries
   C. WHO paper comparing VAP rates
2. INICC
   A. Special situation of Developing Countries
3. INICC Papers
   A. International Annual Reports of VAP Rates
   B. VAP consecquences.
4. INICC HH Program.
5. INICC Program to reduce VAP.
   A. VAP rate reduction in Argentina, Cuba, China, India, and Turkey.
   B. VAP rate reduction in Adult ICUs
   C. VAP rate reduction in Pediatric ICUs.
   D. VAP 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.

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



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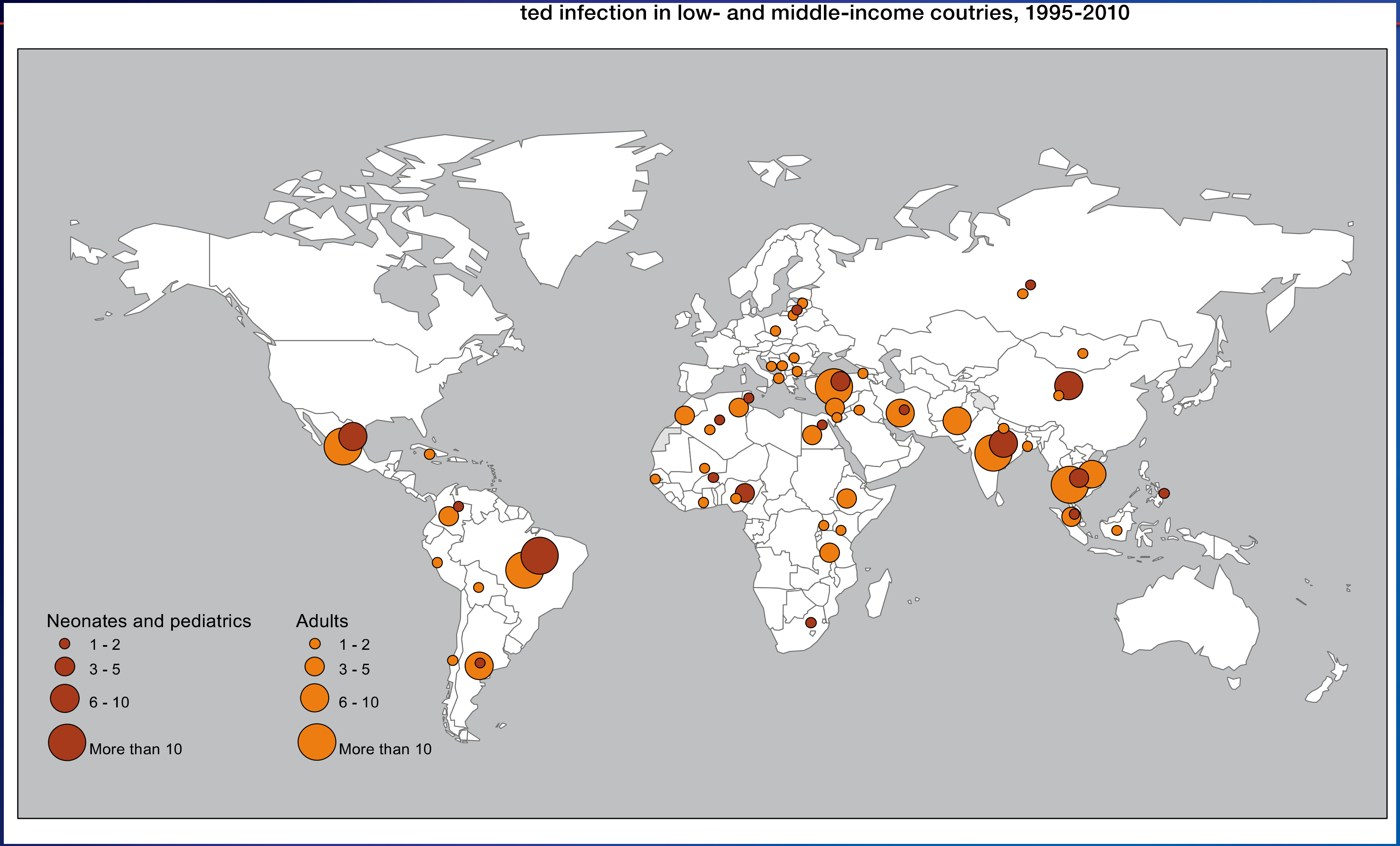
The burden of endemic health care-associated infection in low- and middle-income countries



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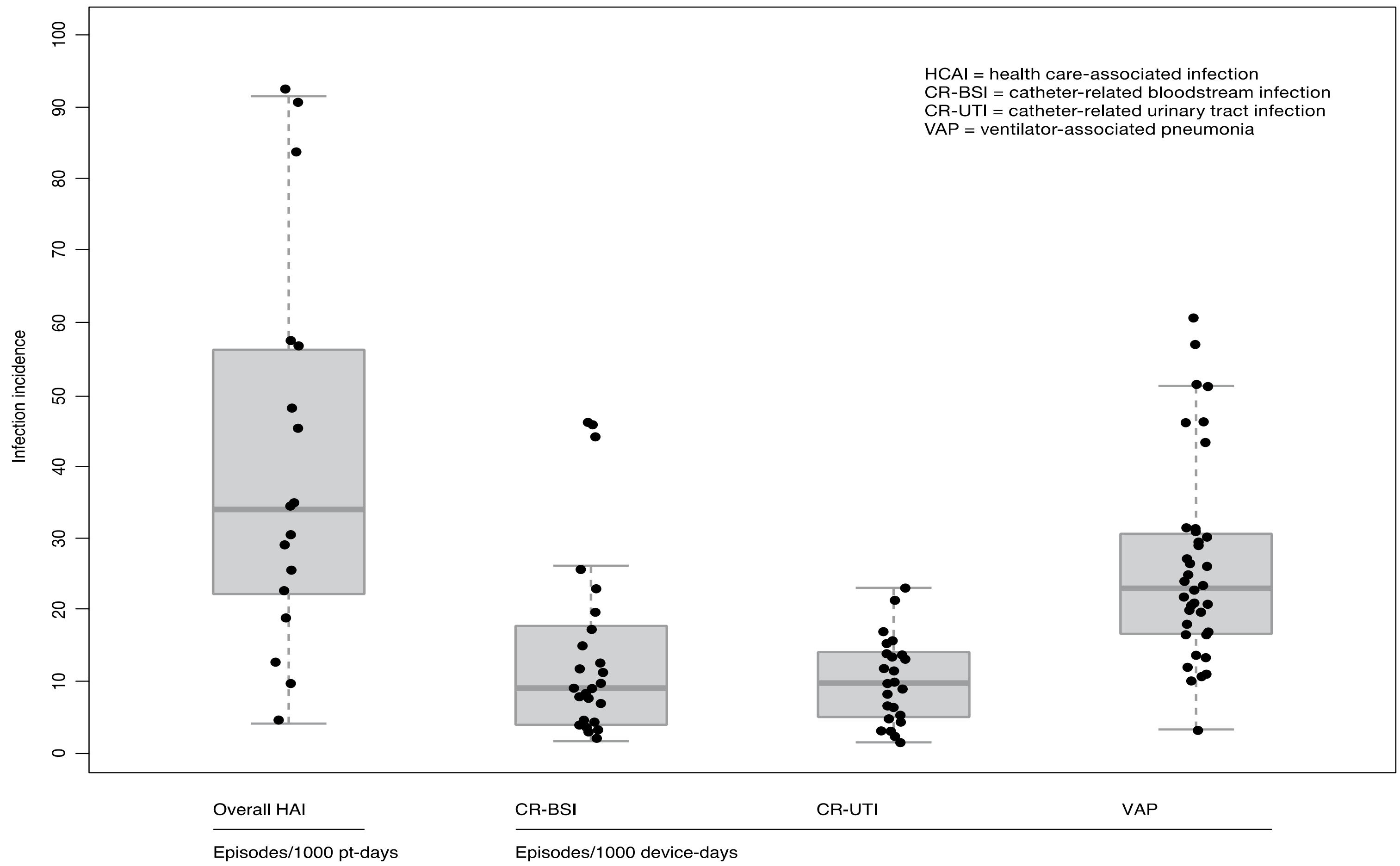
The burden of endemic health care-associated infection in low- and middle-income countries



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

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

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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‡	2 391 381
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)[86,87,89,90]	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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Nosocomial Infection Control Consortium (INI
y of 36 countries, for 2004-2009

ıal MD, MSc, CIC[a,*], Hu Bijie[b], Dennis G. Maki[c], Yatin Meht
hanarak[e], Eduardo A. Medeiros[f], Hakan Leblebicioglu[g], Dal
oreno[i], Ilham Abu Khader[j], Marisela Del Rocío González M
osephine Anne Navoa-Ng[m], Rédouane Abouqal[n], Humberto
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.

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 ave
-HAI	537	5910	
I	72	204	3
CLABSI	72	204	2
	42	175	2
VAP	42	175	1

American Journal of Infection Control, 2011.

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

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.)

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.

Table 2. Extra expenditures of nosocomial pneumonia

	Case (N = 307)	Control (N = 307)	Attributable extra expenditures
Total days	6043	3295	Total extra days: 2748
LOS	19.68	10.73	Mean extra days: 8.95
	SE 0.794	SE 0.308	*T* test *P* value ≤0.000
	SD 13.90	SD 5.39	
	Percentile 25% 11	Percentile 25% 8	
	Percentile 75% 24	Percentile 75% 11	
	Median 16	Median 9	
Total fixed cost	$1,510,750 (SE 0.794)	$823,750	Fixed Extra Cost: $687,000
Mean fixed cost	$4,921 (SE 198,43)	$2,683 (SE 76.97)	Mean extra cost: $2,238
Total antibiotic DDD	7815	3181	Antibiotic extra DDD: 4,634
Mean antibiotic DDD	25.45 (SE 1.4)	10.36 (SE 0.64)	Mean extra antibiotic DDD: 15.09
Total antibiotic cost	$515,790	$209,946	Antibiotic extra cost: $305,844
Mean antibiotic cost	$1,680.09 (SE 93.85)	$683.86 (SE 42.73)	Mean extra antibiotic 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 (SE 77.3)	Mean total extra global cost: $2,252.88
	SE 199.57	SE 77.3	
	SD 3,496.79	SD 1,354.55	*T* test *P* value 0.0000
	Percentile 25% 2751	Percentile 25% 2000	
	Percentile 75% 6049	Percentile 75% 2780	
	Median 4010	Median 2257	

DDD, Defined daily dose; *LOS*, length of stay.

Table 3. Extra mortality of nosocomial pneumonia

	Case (N = 307)	Control (N = 307)	Attributable extra expenditures
Total mortality	195	102	Total extra dead: 90
Percentage mortality	63.51%	33.22%	Extra attributable mortality: 30.3% Kruskal Wallis 56.31 *P* value ≤0.000

SOCIOECONOMIC SITUATION IMPACT ON HAI RATES:

INICC FINDINGS

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; Maria Guadalupe Miranda Novales; Ilham Abu Khader; Khaldi Ammar; Nayide Barahona Guzmán; Josephine Anne Navoa-Ng; Zeinab Salah Seliem; Teodora Atencio Espinoza; Cheong Yuet Meng; Kushlani Jayatilleke; International Nosocomial Infection Control Members

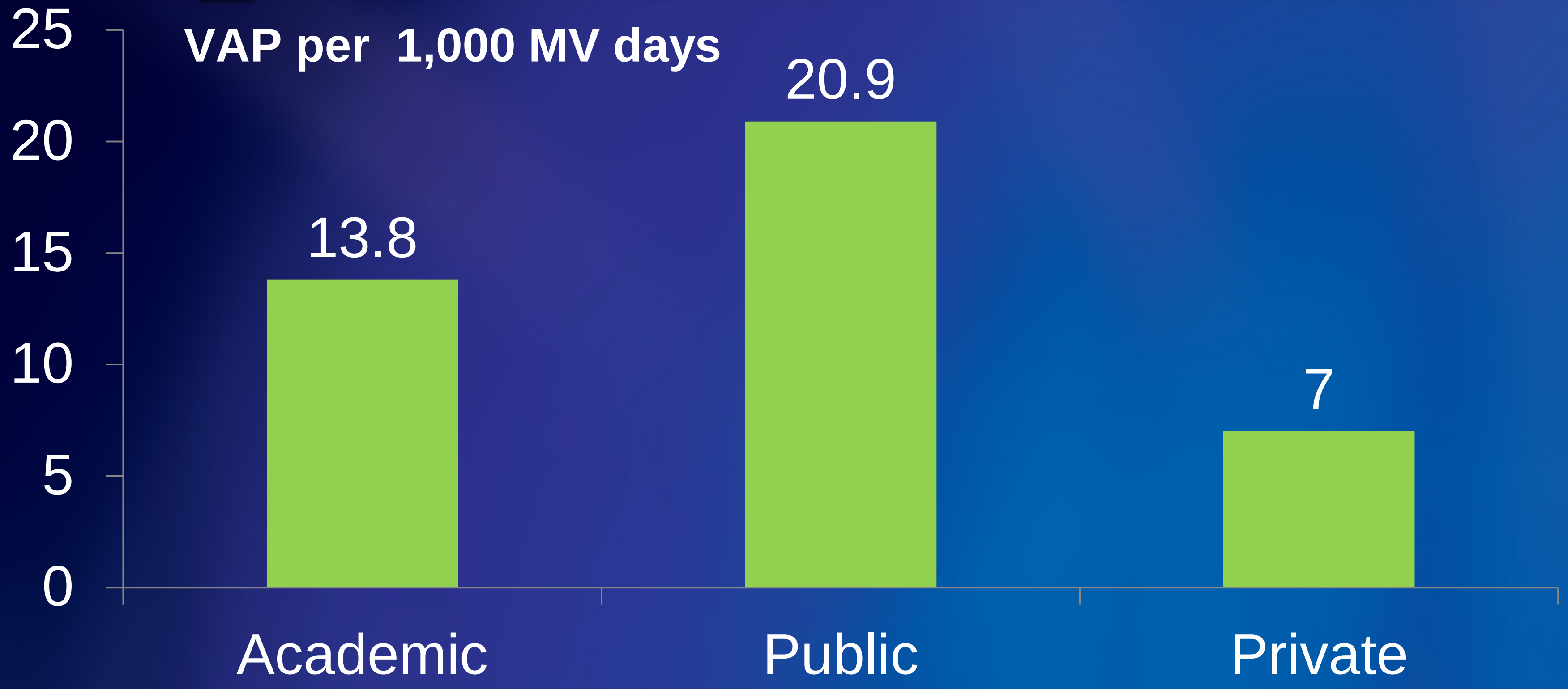
Infection (2011) 39:439–450
DOI 10.1007/s15010-011-0136-2

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

VAP Rates Stratified By Hospital Type



95%CI 13.3-14.2 19.8-21.0 6.4-7.7

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

Epidemiol. Infect. (2011), **139**, 1757–1763.
doi:10.1017/S0950268811000094

Time-dependent analysis of extra length of stay and mortality due to ventilator-associated pneumonia in intensive-care units of ten limited-resources countries: findings of the International Nosocomial Infection Control Consortium (INICC)

V. D. ROSENTHAL[1]*, F. E. UDWADIA[2], H. J. MUÑOZ[3], N. ERBEN[4], F. HIGUERA[5], K. ABIDI[6], E. A. MEDEIROS[7], E. FERNÁNDEZ MALDONADO[8], S. S. KANJ[9], A. GIKAS[10], A. G. BARNETT[11], N. GRAVES[11] and the International Nosocomial Infection Control Consortium (INICC)†

[1] *International Nosocomial Infection Control Consortium, Buenos Aires, Argentina;* [2] *Breach Candy Hospital Trust, Mumbai, India;* [3] *Clínica Reina Sofía, Bogotá, Colombia;* [4] *Eskisehir Osmangazi University, Eskisehir, Turkey;* [5] *Hospital General de México, Mexico City, Mexico;* [6] *Ibn-Sina Hospital, Medical ICU, Rabat, Morocco;* [7] *Hospital São Paulo, São Paulo, Brazil;* [8] *Clínica San Pablo, Lima, Peru;* [9] *American University of Beirut Medical Center, Beirut, Lebanon;* [10] *University Hospital of Heraklion, Heraklion, Greece;* [11] *School of Public Health, Queensland University of Technology*

Summary

SUMMARY

Ventilator-associated pneumonias (VAPs) are a worldwide problem that significantly increases patient morbidity, mortality, and length of stay (LoS), and their effects should be estimated to account for the timing of infection. The purpose of the study was to estimate extra LoS and mortality in an intensive-care unit (ICU) due to a VAP in a cohort of 69 248 admissions followed for 283 069 days in ICUs from 10 countries. Data were arranged according to the multi-state format. Extra LoS and increased risk of death were estimated independently in each country, and their results were combined using a random-effects meta-analysis. VAP prolonged LoS by an average of 2·03 days (95% CI 1·52–2·54 days), and increased the risk of death by 14% (95% CI 2–27). The increased risk of death due to VAP was explained by confounding with patient morbidity.

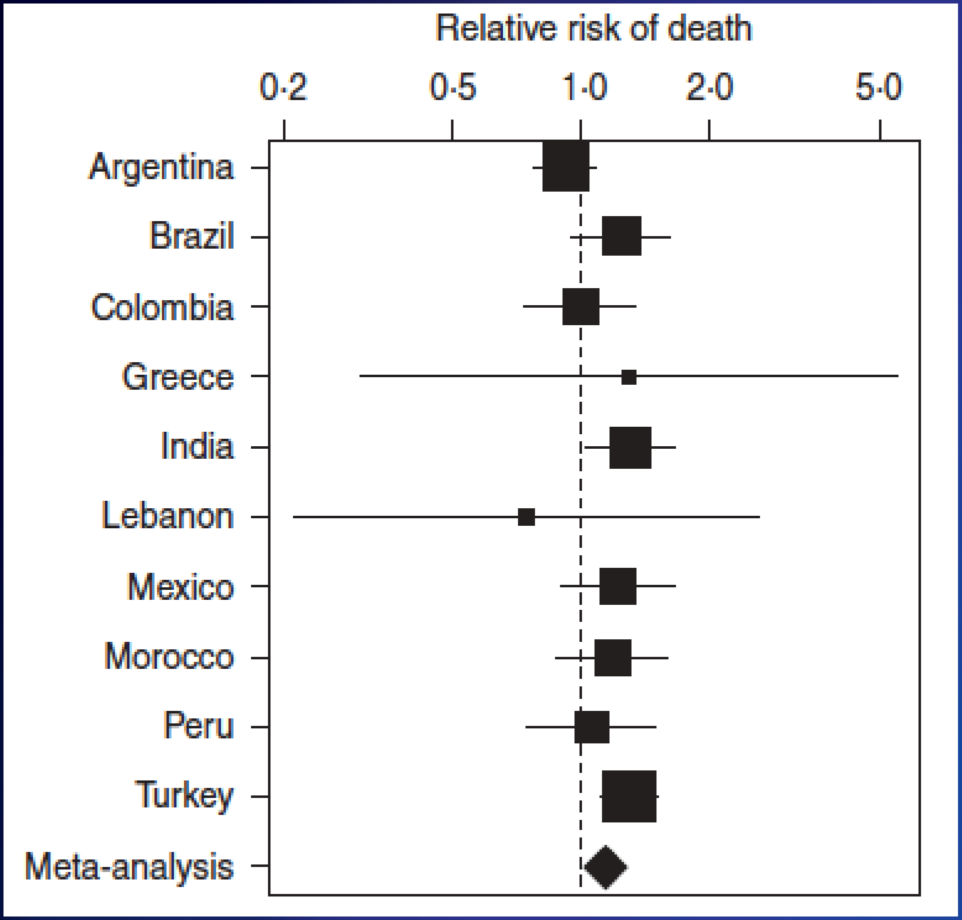
Meta-analysis
Extra Mortality and Extra LoS

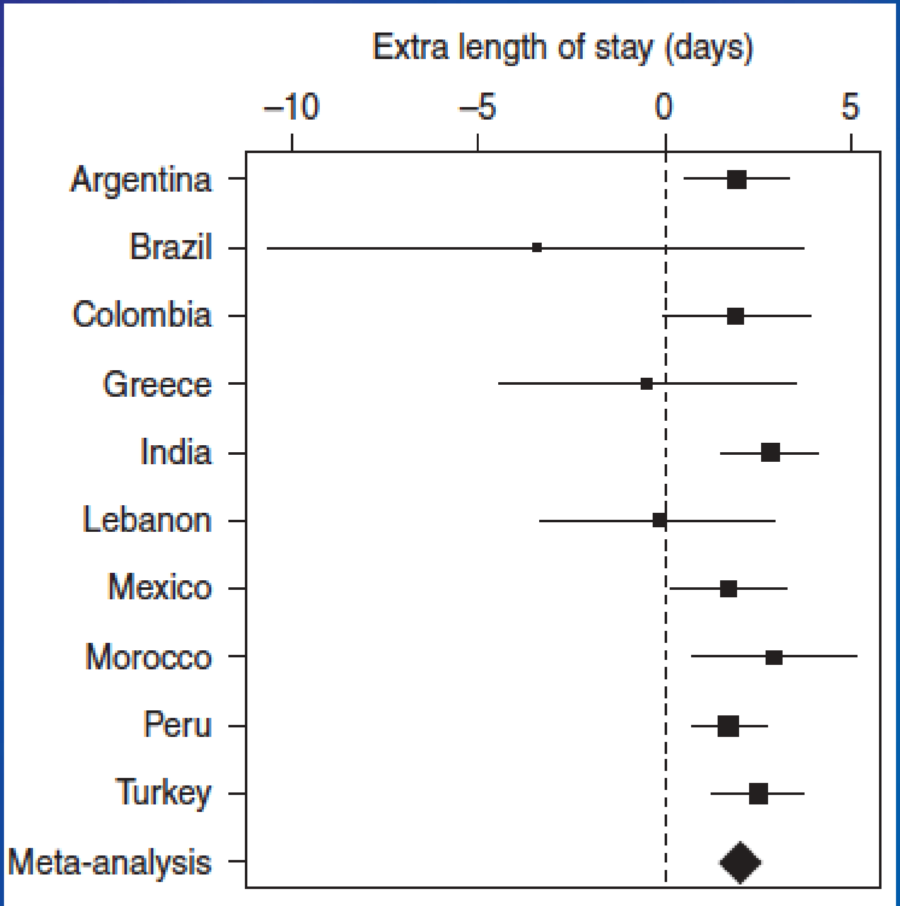
Table 2. *Estimated extra length of stay (LoS) and relative risk of death due to a ventilator-acquired pneumonia*

Country	Admissions	Total extra LoS, days	Relative risk of death
Argentina	3532	1·93 (0·57 to 3·28)	0·92 (0·78 to 1·08)
Brazil	1350	−3·45 (−10·61 to 3·70)	1·24 (0·96 to 1·61)
Colombia	3651	1·92 (−0·05 to 3·89)	0·99 (0·74 to 1·34)
Greece	89	−0·45 (−4·44 to 3·53)	1·29 (0·31 to 5·45)
India	11130	2·85 (1·58 to 4·12)	1·31 (1·03 to 1·65)
Lebanon	241	−0·17 (−3·31 to 2·96)	0·74 (0·21 to 2·59)
Mexico	1622	1·69 (0·14 to 3·24)	1·21 (0·89 to 1·65)
Morocco	796	2·94 (0·74 to 5·14)	1·18 (0·88 to 1·58)
Peru	854	1·73 (0·74 to 2·73)	1·05 (0·75 to 1·49)
Turkey	4234	2·52 (1·31 to 3·73)	1·30 (1·13 to 1·49)
Meta-analysis	27499	2·03 (1·52 to 2·54)	1·14 (1·02 to 1·27)
Heterogeneity test, τ^2 (*P* value)		0·006 (0·43)	0·009 (0·13)
Leave-one-out meta-analysis, mean (country)			
Smallest		1·88 (India)	1·09 (Turkey)
Largest		2·11 (Peru)	1·22 (Argentina)

Values are means (95 % confidence intervals).

Meta-analysis
Extra Mortality and Extra LoS





INICC Multidimensional Approach to reduce VAP 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

Strategies to Prevent VAP

1. Perform hand hygiene
2. Use noninvasive ventilation whenever possible
3. Minimize the duration of ventilation
4. Perform daily assessments of readiness to wean. Use weaning protocols.
5. Avoid unplanned extubation and reintubation
6. Avoid gastric overdistention
7. Maintain patients in a semi-recumbent position (30-45 elevation of the head of the bed) unless there are contraindications

Strategies to Prevent VAP

8. Use a cuffed endotracheal tube with in-line or subglottic suctioning
9. Maintain an endotracheal cuff pressure of at least 20 cm H2O. Cuff pressure must be monitored frequently
10. Orotracheal intubation is preferable to nasotracheal intubation
11. Perform comprehensive oral care, with an antiseptic solution
12. Use sterile water to rinse reusable respirator equipment
13. Remove condensate from ventilatory circuits. Keep the ventilatory circuit closed during condensate removal
14. Change the ventilatory circuit only when visibly soiled or malfunctioning
15. Store and disinfect respiratory therapy equipment properly

Education

Monthly sessions of education provided by ICP to the HCWs in charge of the insertion, care, and maintenance of CLs for HAI prevention based on CDC, WHO APIC, SHEA, and IDSA guidelines to prevent HAI.

Outcome Surveillance

- Outcome Surveillance included rates of HAI per 1000 device-days, use of invasive devices (CL, mechanical ventilator, and urinary catheter), severity illness score, underlying diseases, use of antibiotics, culture taken, microorganism profile, bacterial resistance, length of stay, mortality in their ICUs.
- HAI definitions and surveillance methods were performed applying the definitions for healthcare-associated infection (HAI) developed by the U.S. Centers for Disease Control and Prevention (CDC) for the National Healthcare Safety Network (NHSN) program.
- Additionally, INICC methods were adapted to the limited-resource setting of developing countries, due to their different socioeconomic status.
- ASIS score was used instead of APACHE II score due to budget limitations of participating ICUs from this limited-resource country. Thus, we decided to use ASIS score, as historically used by the CDC NNIS .

Process Surveillance

Process surveillance was designed to assess compliance with easily measurable key infection control practices, such as surveillance of compliance rates for hand hygiene practices and specific measures for the prevention of HAI.

Process Surveillance of HH

- Hand hygiene (HH) compliance rate was based on the frequency with which HH was performed as indicated in HCWs infection control training. Observing ICPs were trained to record HH opportunities and compliance on a form, during randomly selected observation periods of 30 minutes to 1 hour, 3 times a week. In particular, the INICC direct observation comprised the “Five Moments for Hand Hygiene” as recommended by the World Health Organization (WHO). The “Five Moments” included the monitoring of the following moments: (1) before patient contact, (2) before an aseptic task, (3) after body fluid exposure risk, (4) after patient contact, and (5) after contact with patient surroundings.Although HCWs knew that hand hygiene practices were regularly monitored, they were not informed of the schedule for HH observations.

Feedback of DA-HAI rates

- Upon processing the hospitals' outcome surveillance data on a monthly basis, the INICC Research Team, at INICC Headquarters located in Buenos Aires, prepares and sends to each ICT a final report on the results of outcome surveillance rates; that is, monthly DA-HAI rates, length of stay, bacterial profile and resistance, and mortality.
- Feedback of DA-HAI rates is provided to HCWs working in the AICU by communicating the outcomes of the patients.
- The resulting rates are reviewed by the ICT at monthly meetings, where charts are analyzed, and statistical graphs and visuals are posted inside the ICU, to provide an overview of rates of DA-HAIs.
- This infection control tool is key to increase awareness about outcomes of patients at their ICU, enable the ICT and ICU staff to focus on the necessary issues and apply specific strategies for improvement of high DA-HAI rates.

Performance Feedback

- Upon processing the hospitals' process surveillance data on a monthly basis, the INICC Research Team, at INICC Headquarters located in Buenos Aires, prepares and sends to each ICT a final report on the results of process surveillance rates, including compliance with hand hygiene, and care of CL.
- Performance feedback is provided to HCWs working in the AICU by communicating the assessment of practices routinely performed by them.
- The resulting rates are reviewed by the ICT at monthly meetings, where charts are analyzed, and statistical graphs and visuals are posted inside the ICU, to provide an overview of rates measuring compliance with infection control practices.
- This infection control tool is key to enable the ICT and ICU staff to focus on the necessary strategies for improvement of low compliance rates.

Statistical Methods

Patients' characteristics during baseline and during intervention period in each ICU were compared using Fisher's exact test for dichotomous variables and unmatched Student's t-test for continuous variables. Confidence intervals (CI) of 95% were calculated using VCStat (Castiglia). Relative risk (RR) ratios with 95% confidence intervals (CI) were calculated for comparisons of rates of HAI using EPI Info V6. P-values <0.05 by two-sided tests were considered significant.

Statistical Methods

- In order to analyze progressive HAI rate reduction, we used Poisson regression.
- We divided the data into the first three months (baseline period), followed by a nine-month period (intervention period), and annual follow-up periods for the following years.
- We compared the HAI rates for each follow-up period with the baseline HAI rate.
- For this comparison, we used as baseline data only those hospitals that contributed to follow-up in that period (i.e. excluding from the baseline hospitals with long lengths of follow-up that only contributed a shorter length of surveillance).
- We used random effects Poisson regression to account for clustering of CLAB rates within hospitals across time periods.
- These models were estimated using Stata 11.0. For this analysis we used IRR, 95% CI, and P value.

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY APRIL 2013, VOL. 34, NO. 4

ORIGINAL ARTICLE

Impact of the International Nosocomial Infection Control Consortium (INICC) Multidimensional Hand Hygiene Approach over 13 Years in 51 Cities of 19 Limited-Resource Countries from Latin America, Asia, the Middle East, and Europe

Victor D. Rosenthal, MD, MSc, CIC;[1] Mandakini Pawar, MD;[2] Hakan Leblebicioglu, MD;[3] Josephine Anne Navoa-Ng, MD;[4] Wilmer Villamil-Gómez, MD;[5] Alberto Armas-Ruiz, MD;[6] Luis E. Cuéllar, MD;[7] Eduardo A. Medeiros, MD;[8] Zan Mitrev, MD;[9] Achilleas Gikas, MD;[10] Yun Yang, MD;[11] Altaf Ahmed, MD;[12] Souha S. Kanj, MD;[13] Lourdes Dueñas, MD;[14] Vaidotas Gurskis, MD;[15] Trudell Mapp, RN;[16] Humberto Guanche-Garcell, MD;[17] Rosalía Fernández-Hidalgo, RN;[18] Andrzej Kübler, MD[19]

Infection Control and Hospital Epidemiology. April 2013

METHODS:

INICC Multidimensional HH Approach include:

1- administrative support,

2- supplies availability,

3- education and training,

4- reminders in the workplace,

5- process surveillance and

6- performance feedback.

Observations were done for HH compliance in each ICU, during randomly selected 30-minute periods.

EDUCATION

MONITORING

Characteristics of the Participating Hospitals (from April 1999 to December 2012).

	ICUs, n	Number of observations
Country		
Argentina	11	21998
Brazil	4	4837
China	5	2079
Colombia	11	13512
Costa Rica	1	303
Cuba	1	434
Greece	1	2315
El Salvador	3	1691
India	18	32869
Lebanon	1	1728
Lithuania	1	1565
Macedonia	1	3418
Mexico	10	13201
Pakistan	3	1830
Panama	1	551
Peru	5	6610
Philippines	9	17844
Poland	1	102
Turkey	12	22840
All countries	99	149,727
Type of ICU, n		
Adult	80 (81%)	131882
Pediatric	9 (9%)	9081
New Born	10 (10%)	8764
All ICUs	99 (100%)	149,727
Type of hospital, n (%)		
Academic Teaching	27 (42%)	50515
Public Hospital	16 (25%)	40530
Private Community	22 (34%)	58682
All hospitals	65 (100%)	149,727

Hand Hygiene Compliance by Type of Variable. Logistic Regression, Multivariate Analysis

Variable	Adjusted OR	95% CI	P. value
Gender (baseline: Female)	1.0		
Male	0.91	0.89 – 0.93	< 0.001
Type of professional (baseline: nurses)	1.0		
Physicians	0.68	0.66 – 0.70	< 0.001
Ancillary Staff	0.52	0.51 – 0.54	< 0.001
Type of contact (baseline: invasive)	1.0		
Non-invasive	0.95	0.93 – 0.98	< 0.001
Type of ICU (baseline: New Born)	1.0		
Adult ICU	0.49	0.47 – 0.52	< 0.001
Pediatric ICU	0.58	0.54 – 0.62	< 0.001
Work Shift (baseline: Night)	1.0		
Afternoon	0.79	0.76 – 0.81	< 0.001
Morning	0.83	0.81 – 0.86	< 0.001

Women better than men: 9%

Nurses better than Doctors: 32%

Invasive better than Non Invasive: 5%

Neonatal better than Adult ICU: 51%

Night better than Morning: 17%

Table 5. Hand Hygiene Improvement by Year of Participation

Years since joining INICC	HH observations	Number of ICUs Included	HH % (95% CI)	Adjusted OR
First 3 months (baseline)	11267	99	48.3% (47.6 – 49.0)	1.0
Second 3 months	7214	99	61.2% (60.5 – 61.9)	1.72 (1.65 – 1.81)
Third 3 months	5511	89	67.2% (66.4 – 67.8)	2.10 (1.99 – 2.2)
Fourth 3 months	4639	81	69.4% (68.6 – 70.1)	2.21 (2.10 – 2.33)
2nd year	8190	69	71.4% (70.9 – 71.9)	3.07 (2.92 – 3.23)
3rd year	5573	45	69.1% (68.4 – 69.7)	3.03 (2.84 – 3.22)
4th and 5th year	4278	32	81.2% (80.1 – 81.6)	3.3 (3.07 – 3.52)
6th and 7th year	1120	15	86.0% (85.2 – 86.8)	2.87 (2.57 – 3.19)

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VAP rate reduction in Argentina

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

V. D. Rosenthal, MD, CIC, MSc,[a,b] Sandra Guzman, RN, ICP,[a,b] and C. Crnich, MD[c]
Buenos Aires, Argentina, and Madison, Wisconsin

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;[redacted]:[redacted]-[redacted].)

Table 1. Baseline characteristics of patients

Variable	Preintervention (n = 435)	Intervention (n = 366)	P value
Sex (male)	236 (54.3%)	188 (51.4%)	.41
Age (yr), mean ± SD	72.38 ± 12.21	73.79 ± 10.93	.08
ASIS, mean ± SD	3.69 ± 0.74	3.74 ± 0.70	.36
Medical admission	312 (71.7%)	282 (77.0%)	.10
Diabetes	66 (15.2%)	55 (15.0%)	.96
Hypertension	182 (41.8%)	153 (41.8%)	.95
Heart failure	65 (14.9%)	72 (19.07%)	.09
Myocardial infarction	35 (8.0%)	34 (9.3%)	.61
Valve replacement	7 (1.6%)	2 (0.5%)	.19*
Smoker	40 (9.2%)	31 (8.5%)	.81
Cancer	16 (3.7%)	17 (4.6%)	.61
Obesity	29 (6.7%)	25 (6.8%)	.96
Ethanol use	3 (0.7%)	5 (1.4%)	.40*
Hip replacement	6 (1.4%)	4 (1.1%)	.76*
Stroke	79 (18.2%)	76 (20.8%)	.39
Urinary catheter use	419 (96.3%)	354 (96.7%)	.90

Table 2. ICU stay, antibiotic use, device utilization, and device-related infections during study periods

Variable	Preintervention	Intervention
ICU stay, days	5.32 (SD: 6.04)	5.65 (SD: 7.01)
Antibiotic use	729 DDD per 1000 patient day	602 DDD per 1000 patient day
Duration of mechanical ventilation, days	3.68 (SD: 5.04)	3.89 (SD: 6.41)
Utilization of mechanical ventilation	0.12	0.11
Utilization of vascular catheters	0.15	0.26
CVC-related BSI per 1000 CVC-days	6.91 (24/3469)	5.96 (11/1845)
Utilization of urinary catheters	0.53	0.53
CAUTI per 1000 catheter-days	13.10 (93/7097)	16.22 (110/6779)

VAP Rates

Table 3. Rates of ventilator-associated pneumonia in phase 1 versus phase 2

	VAPs per 1000 MV-days*	RR	95% CI	P value
Phase 1	51.28 (84/1638)			
Phase 2	35.50 (54/1520)	0.69[†]	0.49-0.98	<.003

VAP rate reduction in Cuba

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Effectiveness of a multidimensional approach for the prevention of ventilator-associated pneumonia in an adult intensive care unit in Cuba: Findings of the International Nosocomial Infection Control Consortium (INICC)

Humberto Guanche-Garcell[a], Clara Morales-Pérez[a], Victor D. Rosenthal[b,*]

[a] *Hospital Docente Clínico Quirúrgico "Joaquín Albarrán Domínguez", Havana, Cuba*
[b] *International Nosocomial Infection Control Consortium, Buenos Aires, Argentina*[1]

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Characteristics of Patients

Table 1 Patient characteristics, device use, and ventilator-associated pneumonia rates during Phase 1 (baseline period) and Phase 2 (intervention period).

Patient Characteristics	Baseline	Intervention	RR[a]	95% CI	P-Value
Study period in months, *n*	3	47	—	—	—
Patients, *n*	67	1008	—	—	—
[a]Bed days, *n*	363	5648	—	—	—
[b]MV days, *n*	114	2350	—	—	—
[c]MV use, mean	0.31	0.42	1.32	1.1–1.6	0.0032
MV duration, mean ± SD	1.7 ± 3.0	2.34 ± 4.6	—	—	0.265
Age, mean ± SD	60.0 ± 19.0	61.4 ± 17.6	—	—	0.534
Male	31(46%)	501(50%)	1.07	0.75–1.54	0.7
Female	36(46%)	506(50%)	—	—	—
Pulmonary disease, *n* (%)	11(16%)	247(25%)	1.54	0.84–2.81	0.16
Abdominal surgery, *n* (%)	5(7%)	112(12%)	1.54	0.63–3.78	0.34
Chronic obstructive, *n* (%)	11(16%)	186(19%)	1.16	0.63–2.12	0.64
Trauma, *n* (%)	2(3%)	18(2%)	0.62	0.14–2.68	0.52
Previous infections, *n* (%)	14(21%)	511(50%)	2.54	1.5–4.32	0.0004
Cardiac failure, *n* (%)	15(22%)	449(45%)	2.03	1.21–3.4	0.006
Endocrine diseases, *n* (%)	9(13%)	238(24)	1.8	0.93–3.51	0.08
Renal impairment, *n* (%)	4(6%)	31(3%)	0.53	0.2–1.51	0.23
Hepatic failure, *n* (%)	2(3%)	32(3%)	1.1	0.26–4.61	0.9
Thoracic surgery, *n* (%)	2(3%)	27(3%)	0.93	0.22–3.92	0.924
Stroke, *n* (%)	14(21%)	287(29%)	1.4	0.82–2.4	0.215
VAP, *n*	6	36	—	—	—
VAP rate per 1000MV days	52.63	15.32	0.3	0.12–0.7	0.003

VAP, ventilator-associated pneumonia; MV, mechanical ventilator; RR, relative risk; CI, confidence interval; SD, standard deviation; ASIS, average severity of illness score.

[a] Bed-days are the total number of days that patients were in the ICU during the selected time period.

[b] MV-days: the total number of days of exposure to mechanical ventilation by all of the patients in the selected population during the selected time period.

[c] MV use ratios were calculated by dividing the total number of MV-days by the total number of Bed-days.

VAP Rates

Table 2 ventilator-associated pneumonia rates stratified by ICU length of participation in INICC and obtained by poisson regression analysis.

Months since joining INICC	MV-days	VAP	Crude VAP rate/1000 MV days	RR (95% CI)	*P*-Value
1–3 months (baseline)	114	6	52.63	–	1
4–12 months	557	8	14.36	0.27 (0.09–0.79)	0.0099
Second year	686	15	22	0.42 (0.16–1.07)	0.0604
Third year	545	10	18.35	0.35 (0.13–0.96)	0.0326
Fourth year	562	3	5.34	0.10 (0.03–0.41)	0.0001

INICC, International Nosocomial Infection Control Consortium, VAP, ventilator-associated pneumonia; MV, mechanical ventilator; RR, relative risk; ICU, intensive care unit.

VAP rate reduction in China

Journal of Critical Care (2012) **xx**, xxx–xxx

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Journal of Critical Care

Impact of a multidimensional approach on ventilator-associated pneumonia rates in a hospital of Shanghai: Findings of the International Nosocomial Infection Control Consortium☆,☆☆,★,

Lili Tao [a,*] Bijie Hu MD [b,*] Victor Daniel Rosenthal MD ,[c] Yiwen Zhang ,[d] Xiaodong Gao ,[b] Lixian He [b]

[a]Department of Respiratory Medicine, Huadong Hospital, Fudan University, Shanghai, China
[b]Department of Respiratory Medicine, Zhongshan Hospital, Fudan University, Shanghai, China
[c]International Nosocomial Infection Control Consortium, Buenos Aires, Argentina
[d]Intensive Care Unit, Ningbo First Hospital, Ningbo, China

Components of the Bundle

2005

- 1. Performance of active outcome surveillance for VAP
- 2. Education regarding epidemiology of VAP, risk factors, and interventions
- 3. Performance of regular oral care with an antiseptic solution (chlorhexidine 2 times daily for patients with mechanical ventilation)

2006

- 4. Promotion of adherence to hand-hygiene guidelines. This included the use of ethanol solution towels and alcohol hand rub. Alcohol hand rub bottles were available bedside. Alcohol hand rub was requested before and after patient and patient's fl uid contact

2008

- 5. Maintenance of patients in a semirecumbent position (30° -45° elevation of the head of the bed), unless there are contraindications
- 6. Feedback of VAP rates
- 7. Process surveillance: direct observation of hand hygiene compliance, duration of the ventilation, andventilation ratio use, using structured observation tools at regularly scheduled intervals
- 8. Performance feedback of infection control practices.

VAP Rates

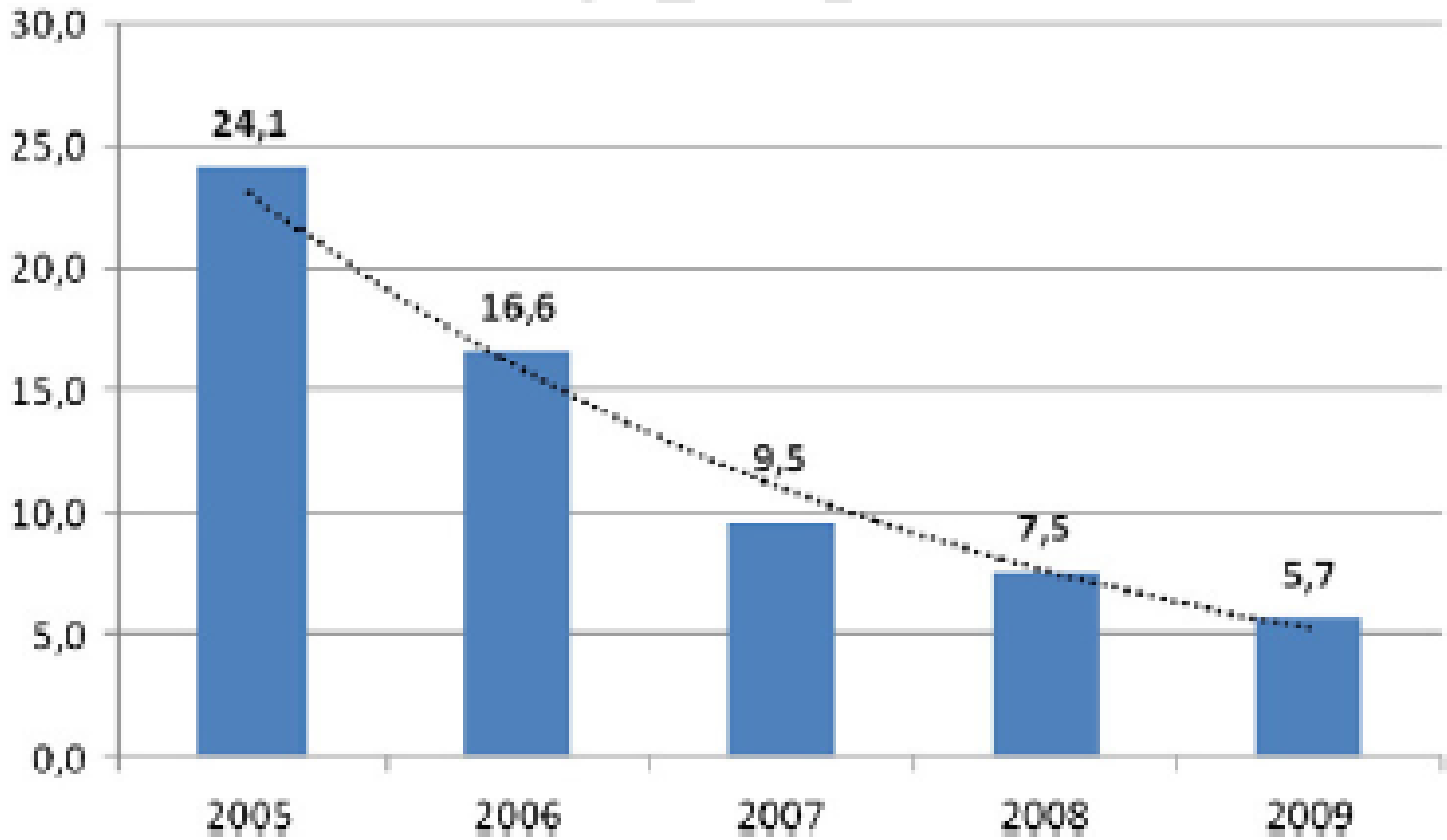

Fig. 1 Trend of the VAP rate from January 2005 to July 2009 in the participating ICUs of Zhongshan Hospital.

VAP rate reduction in Turkey

Infection
DOI 10.1007/s15010-013-0407-1

CLINICAL AND EPIDEMIOLOGICAL STUDY

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)

H. Leblebicioglu · A . N. Yalcin · V. D. Rosenthal · I. Koksa · F. Sirmatel · S.Unal · H. Turgut · D. Ozdemir · G. Ersoz · C. Uzun · S. Ulusoy · S. Esen · F. Ulger · A. Dilek · H. Yilmaz · O. Turhan · N. Gunay · E. Gumus · O. Dursun · G. Yýlmaz · S. Kaya · H. Ulusoy · M. Cengiz · L. Yilmaz · G. Yildirim · A. Topeli · S. Sacar · H. Sungurtekin · D. Uğurcan · M. F. Geyik · A. Şahin · S. Erdogan · A. Kaya · N. Kuyucu · B. Arda · F. Bacakoglu

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Characteristics of Patients, and Process Surveillance

Patients' characteristics	Baseline	Intervention	RR[a]	95 % CI	*P* value
Study period by hospital in months, mean ± SD (range)	3	28.64 ± 20.27 (6–72)	–	–	–
Number of patients, *n*	448	3,864	–	–	–
Bed-days,[a] *n*	4,602	50,666			
No. of MV days,[b] *n*	2,376	2,8181			
MV duration, mean ± SD	5.3 ± 10.1	7.3 ± 14.0	–	–	0.003
MV use ratio[c], mean	0.52	0.56	1.08	1.03–1.12	0.0005
Age in years, mean ± SD	52.37 ± 22.5	49 ± 21.6	–	–	0.001
ASIS score, mean ± SD	3.34 ± 1.0	3.5 ± 0.85	–	–	0.004
Male, *n* (%)	255 (58)	2,392 (38)	1.06	0.94–1.21	0.343
Female, *n* (%)	182 (42)	1,459 (62)	–	–	–
Surgical stay, *n* (%)	51 (11)	353 (9)	0.82	0.61–1.1	0.1723
Abdominal surgery, *n* (%)	18 (4)	227 (6)	1.46	0.9–2.36	0.12
Trauma, *n* (%)	65 (15)	594 (15)	1.06	0.82–1.37	0.658
Hepatic failure, *n* (%)	7 (2)	28 (1)	0.46	0.2–1.06	0.0624
Hand hygiene compliance, % (*n*/*n*)	41.94 (656/1,564)	47.61 (8,257/17,344)	1.14	1.05–1.23	0.002
MV compliance semi-recumbent position of the head (30°–45°), % (*n*/*n*)	90.55 (2,128/2,350)	92 (19,887/21,631)	1.02	0.97–1.06	0.51
MV compliance nebulizer without turbidity, % (*n*/*n*)	45.2 (1,062/2,350)	52.15 (11,280/21,631)	1.15	1.08–1.23	0.0001
VAP, *n*	74	474			
VAP rate per 1,000 MV days[b]	31.14	16.82	0.54	0.42–0.7	0.0001

VAP Rates

Table 3 Ventilator-associated pneumonia rates stratified by length of participation of each intensive care unit in INICC

Months since joining INICC	No. of ICUs	MV days	VAP	VAP rate/1,000 MV days	IRR accounting for clustering by ICU	*P* value
1–3 months (baseline)	11	2,376	74	31.14	–	1
4–12 months	11	6,639	176	26.51	0.88 (0.665–1.16)	0.361
Second year	8	5,672	89	15.7	0.67 (0.473–0.95)	0.025
Third year	4	5,818	89	15.3	0.75 (0.5–1.13)	0.167
Fourth year	3	7,617	99	13.0	0.7 (0.45–1.06)	0.094
Fifth–sixth years	2	2,435	21	8.62	0.44 (0.232–0.835)	0.012

Poisson regression

VAP rate reduction in India

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Effectiveness of a multidimensional approach for prevention of ventilator-associated pneumonia in 21 adult intensive-care units from 10 cities in India: findings of the International Nosocomial Infection Control Consortium (INICC)†

Y. MEHTA[1], N. JAGGI[2], V. D. ROSENTHAL[3]*, C. RODRIGUES[4], S. K. TODI[5], N. SAINI[6], F. E. UDWADIA[7], A. KARLEKAR[8], V. KOTHARI[9], S. N. MYATRA[10], M. CHAKRAVARTHY[11], S. SINGH[12], A. DWIVEDY[13], N. SEN[14] AND S. SAHU[15]

[1] *Medanta The Medicity, New Delhi, India;* [2] *Artemis Health Institute, New Delhi, India;* [3] *International Nosocomial Infection Control Consortium, Buenos Aires, Argentina;* [4] *PD Hinduja National Hospital & Medical Research Centre, Mumbai, India;* [5] *AMRI Hospitals, Kolkata, India;* [6] *Pushpanjali Crosslay Hospital, Ghaziabad, India;* [7] *Breach Candy Hospital Trust, Mumbai, India;* [8] *Escorts Heart Institute & Research Centre, New Delhi, India;* [9] *Kokilaben Dhirubhai Ambani Hospital, Mumbai, India;* [10] *Tata Memorial Hospital, Mumbai, India;* [11] *Fortis Hospitals, Bangalore, India;* [12] *Amrita Institute of Medical Sciences & Research Centre, Kochi, India;* [13] *Dr. L. H. Hiranandani Hospital, Mumbai, India;* [14] *Christian Medical College, Vellore, India;* [15] *Kalinga Hospital, Bhubaneswar, India*

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Table 1. *Characteristics of participating AICUs by speciality and type of hospital*

	AICUs *n* (%)	AICU patients *n* (%)
Type of AICU		
Cardiac medical	3 (14%)	5719
Cardiac surgical	2 (10%)	4300
Medical	3 (14%)	4343
Medical surgical	9 (42%)	25396
Surgical	2 (10%)	2944
Trauma	1 (5%)	1932
Ward	1 (5%)	2261
All AICUs	21 (100%)	46945
Type of hospital		
Academic teaching	4 (19%)	7421
Private community	13 (62%)	32001
Public	4 (18%)	7523
All hospitals	21 (100%)	46945

AICU, Adult intensive care unit.

Characteristics of Patients, and Process Surveillance

Table 2. *Patient characteristics, hand hygiene compliance, compliance with care bundle, device use, and VAP rates, in the baseline and intervention periods*

Patients' characteristics	Baseline period	Intervention period	RR	95% CI	*P* value
Study period by hospital in months, mean ± s.d. (range)	3	23·33 ± 16·86 (6–76)	—	—	—
Patients, *n*	3979	42 966	—	—	—
Bed days, *n*	18 154	205 166			
MV days, *n*	4819	60 755			
MV use, mean	0·27	0·30	1·12	1·08–1·15	0·0001
MV duration, mean ± s.d.	1·21 ± 3·1	1·42 ± 5·17	—	—	0·0001
Age, mean ± s.d.	54·78 ± 17·76	54·55 ± 18·28	—	—	0·455
ASIS score, mean ± s.d.	2·9 ± 1·2	2·6 ± 1·11	—	—	0·0001
Male	68% (2718)	66% (28421)	0·97	0·93–1·01	0·12
Female	32% (1260)	34% (14528)	—	—	—
Thoracic surgery, % (*n*)	1% (29)	1% (216)	0·7	0·47–1·02	0·061
Immune compromise, % (*n*)	1% (29)	1% (283)	0·91	0·62–1·33	0·6155
Hand hygiene compliance, % (*n*/*N*)	77·9% (2355/3023)	82% (29100/35521)	1·05	1·01–1·1	0·02
MV compliance with semi-recumbent position of the head (30–45°), % (*n*/*N*)	92·93% (552/594)	97·52% (8609/8828)	1·05	0·96–1·14	0·272
MV compliance water free tubing, % (*n*/*N*)	61·11% (363/594)	83·03% (7330/8828)	1·36	1·22–1·51	0·0001
MV compliance tubing without mucus, % (*n*/*N*)	70·88% (421/594)	86·63% (7648/8828)	1·22	1·11–1·35	0·0001
MV presence pharyngeal lake, % (*n*/*N*)	89·06% (529/594)	69·51% (6136/8828)	0·78	0·71–0·85	0·0001
MV compliance smooth enteric nourishment, % (*n*/*N*)	47·14% (280/594)	94·03% (8301/8828)	2·0	1·77–2·25	0·0001
VAP, *n*	84	657			
VAP rate/1000 MV days	17·43	10·81	0·62	0·5–0·78	0·0001

VAP Rates

Table 3. *VAP rates stratified by length of participation of ICU*

Months since joining INICC	No. of ICUs	MV days	VAP	Crude VAP rate per 1000 MV days	IRR accounting for clustering by ICU	*P* value
1–3 months (baseline)	21	4819	84	17·43	1	—
4–12 months	21	16 809	195	11·6	0·61 (0·5–0·8)	0·0001
Second year	17	13 709	226	16·5	0·87 (0·67–1·14)	0·324
Third year	12	11 086	112	10·10	0·53 (0·4–0·72)	0·0001
Fourth year	8	13 019	77	5·91	0·33 (0·0·27–0·46)	0·0001
Fifth–sixth years	2	6132	47	7·66	0·5 (0·322–0·73)	0·001

VAP, Ventilator-associated pneumonia; ICU, intensive care units; INICC, International Nosocomial Infection Control Consortium; MV, mechanical ventilator; IRR, incident rate ratio.

VAP rate reduction in Adult ICUs of 14 countries

Effectiveness of a multidimensional approach for prevention of ventilator-associated pneumonia in adult intensive care units from 14 developing countries of four continents: Findings of the International Nosocomial Infection Control Consortium

Victor D. Rosenthal; Camilla Rodrigues; Carlos Álvarez-Moreno; Naoufel Madani; Zan Mitrev; Guxiang Ye; Reinaldo Salomao; Fatma Ulger; Humberto Guanche-Garcell; Souha S. Kanj; Luis E. Cuéllar; Francisco Higuera; Trudell Mapp; Rosalía Fernández-Hidalgo

Objective: **The aim of this study was to analyze the effect of the International Nosocomial Infection Control Consortium's multidimensional approach on the reduction of ventilator-associated pneumonia in patients hospitalized in 44 adult intensive care units. These adult intensive care units were in 38 hospitals that were members of the International Nosocomial Infection Control Consortium, from 31 cities of the following 14 developing countries of four continents: Argentina, Brazil, China, Colombia, Costa Rica, Cuba, India, Lebanon, Macedonia, Mexico, Morocco, Panama, Peru, and Turkey.**

Methods: **We conducted a prospective active surveillance before–after study to assess the impact of a multidimensional approach on the ventilator-associated pneumonia rate. The study was divided into two phases. During phase 1, the infection control team at each intensive care unit conducted active prospective surveillance of ventilator-associated pneumonia by applying the definitions of the Centers for Disease Control and Prevention National Health Safety Network, and the methodology of International Nosocomial Infection Control Consortium. During phase 2, the multidimensional approach for ventilator-associated pneumonia was implemented at each intensive care unit, in addition to the active surveillance. The International Nosocomial Infection Control Consortium ventilator-associated pneumonia multidimensional approach included the following measures: 1) bundle of infection-control interventions; 2) education; 3) outcome surveillance; 4) process surveillance; 5) feedback of ventilator-associated pneumonia rates; and 6) performance feedback of infection-control practices. The ventilator-associated pneumonia rates obtained in phase 1 were compared with the rates obtained in phase 2. We performed a time-series analysis to analyze the impact of our intervention.**

Results: **During phase 1, we recorded 10,292 mechanical ventilator days, and during phase 2, with the implementation of the multidimensional approach, we recorded 127,374 mechanical ventilator days. The rate of ventilator-associated pneumonia was 22.0 per 1,000 mechanical ventilator days during phase 1, and 17.2 per 1,000 mechanical ventilator days during phase 2.The adjusted model of linear trend shows a 55.83% reduction in the rate of ventilator-associated pneumonia at the end of the study period; that is, the ventilator-associated pneumonia rate was 55.83% lower than it was at the beginning of the study.**

Conclusion: **The implementation the International Nosocomial Infection Control Consortium multidimensional approach for ventilator-associated pneumonia was associated with a significant reduction in the ventilator-associated pneumonia rate in the adult intensive care units setting of developing countries. (Crit Care Med 2012; 00:0–0)**

Key Words: adult intensive care unit; bundle; critical care; developing countries; device-associated infection; emerging countries; hand hygiene; healthcare-acquired infection; hospital-acquired pneumonia; hospital infection; incidence density; infection control; international multidimensional approach; International Nosocomial Infection Control Consortium; nosocomial infection control consortium; intensive care unit; limited-resources countries; low-income countries; nosocomial infection; nosocomial pneumonia; rates; surveillance; ventilator-associated pneumonia

Ventilator-associated pneumonia (VAP) has been considered to be the most serious health-care-associated infection, and it was reported to be the leading cause of morbidity and mortality for device-associated infections (DAI), particularly, in the adult intensive care unit (AICU) setting (1, 2). Additionally, in a large body of scientific literature, VAPs are among the most common types of DAI, resulting in a substantial increase in hospital costs and length of stay (LOS (1–3)).

The scope of the burden posed by VAP in developing countries, however, has

From the International Nosocomial Infection Control Consortium (VDR), Buenos Aires, Argentina; PD Hinduja National Hospital & Medical Research Centre (CR), Mumbai, India; Hospital Universitario San Ignacio (CAM), Universidad Pontificia Javeriana, Bogotá, Colombia; Ibn Sina- Medical ICU (NM), Rabat, Morocco; Filip II Special Hospital for Surgery (ZM), Skopje, Macedonia; Yangpu Hospital (GY), Shanghai, China; Hospital Santa Marcelina (RS), São Paulo, Brazil; Ondokuz Mayis University Medical School (FU), Samsun, Turkey; Hospital Docente Clínico Quirúrgico "Joaquín Albarrán Domínguez" (HGG), Havana, Cuba; American University of Beirut Medical Center (SSK), Beirut, Lebanon; Instituto Nacional de Enfermedades Neoplásicas (INEN) (LEC), Lima, Perú; Hospital General de México (FH), Mexico City, Mexico; Clínica Hospital San Fernando (TM), Panama City, Panama; Hospital Clínica Bíblica (RFH), San José, Costa Rica.

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For information regarding this article, E-mail: victor_rosenthal@inicc.org

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gical	31 (70%)	35,548
Surgical	5 (11%)	4,415
Ward	1 (2%)	1,621
Type of hospital, n (%)		
Academic teaching	16 (42%)	16,779
Private community	7 (18%)	5,442
Public hospital	15 (39%)	33,286

Characteristics of Patients

Table 2. Patient characteristics at baseline period and intervention period

Variables	Phase 1 Baseline Period	Phase 2 Intervention Period	*p*
Length of period in mos, mean (range)	3 mos	35.2 (12–57 mos)	
Number of patients	3,889	51,618	
Patient characteristics at admission			
ASIS Score mean, SD	3.0 ± 1.2	2.8 ± 1.1	.0001
Sex, n (%)			
Male	2,352 (60.5%)	30,784 (59.6%)	.2674
Female	1,535 (39.5%)	20,778 (40.3%)	
Age, mean ± SD	57.2 ± 19.5	57.6 ± 19.9	.181
Endocrine diseases, n (%)	464 (11.9%)	6,058 (11.7%)	.7001
Cardiac failure, n (%)	796 (20.5%)	11,709 (22.7%)	.0015
Cardiac surgery, n (%)	197 (5.1%)	2439 (4.7%)	.2674
Thoracic surgery, n (%)	21 (0.5%)	203 (0.4%)	.3970
Trauma, n (%)	106 (2.7%)	1,240 (2.4%)	.2411
Stroke, n (%)	95 (2.4%)	1,196 (2.3%)	.713
Previous infection, n (%)	181 (4.7%)	2,305 (4.5%)	.5522
Patient characteristics at discharge			
Length of stay in days, mean	6.9 ± 11.4	6.4 ± 9.4	.008

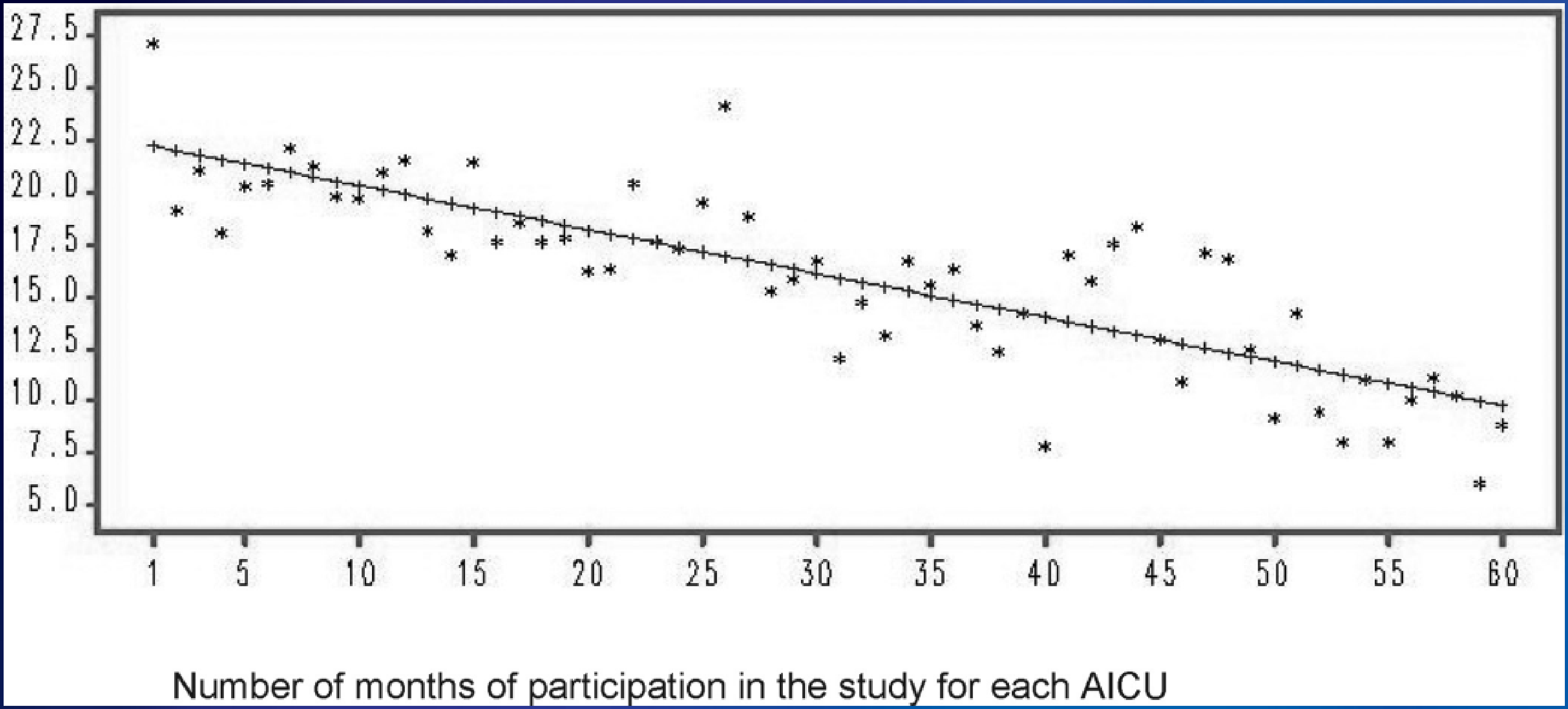
ASIS,

Process Surveillance

Table 3. Hand-hygiene compliance and mechanical ventilator care in the participating adult intensive care units

	Phase 1	Phase 2		
	Baseline Period (mos 1–3)	Intervention Period	% of Change	*p*
Adherence to hand-hygiene guidelines % (n)	55.0%	65.7%	17%	.0001
Mechanical ventilator use ratio, mean (95% confidence interval)	0.38	0.38		.9753
Mechanical ventilator duration, mean ± SD	6.8 ± 11.2	6.3 ± 10.6		.099
Maintenance of patients in a semirecumbent position (30–45 degrees elevation of the head of the bed)	85.1%	89.9%	6%	.001
Nebulizer without turbidity	59.2%	80.3%	27%	.0001
Pharyngeal lake present	70.8%	58.3%	18%	.0001
Removal of the mucus from ventilator circuits	80.7%	84.7%	5%	.0001
Removal of the condensate from ventilator circuits	73.0%	73.2%	0.3%	.8153
Respiratory therapy done	92.5%	91.8%	1%	.1116

Observed values of ventilator-associated pneumonia (VAP) rate and adjusted model. Number of months of participation in the study per each intensive care unit (AICU). VAP × 1000 mechanical ventilator (MV) days.



The adjusted model of linear trend shows a 55.83% reduction of the rate of VAP at the end of the study period; that is, the VAP rate is 55.83% lower than it was at the beginning of phase 2. (Fig. 1)

VAP rate reduction in Pediatric ICUs of 5 countries

Major article

Effectiveness of a multidimensional approach to reduce ventilator-associated pneumonia in pediatric intensive care units of 5 developing countries: International Nosocomial Infection Control Consortium findings

Victor D. Rosenthal MD, MSc, CIC [a,*], Carlos Álvarez-Moreno MD [b], Wilmer Villamil-Gómez MD [c], Sanjeev Singh MD [d], Bala Ramachandran MD [e], Josephine A. Navoa-Ng MD [f], Lourdes Dueñas MD [g], Ata N. Yalcin MD [h], Gulden Ersoz MD [i], Antonio Menco MD [c], Patrick Arrieta MD [c], Ana C. Bran-de Casares RN [g], Lilian de Jesus Machuca RN [g], Kavitha Radhakrishnan MD [d], Victoria D. Villanueva RN [f], Maria C.V. Tolentino RN [f], Ozge Turhan MD [h], Sevim Keskin RN [h], Eylul Gumus RN [h], Oguz Dursun MD [h], Ali Kaya MD [i], Necdet Kuyucu MD [i]

[a] *International Nosocomial Infection Control Consortium, Buenos Aires, Argentina*
[b] *Hospital Universitario San Ignacio, Universidad Pontificia Javeriana, Bogota, Colombia*
[c] *Clinica Santa Maria, Sucre, Colombia*
[d] *Amrita Institute of Medical Sciences and Research Center, Kochi, India*
[e] *KK Childs Trust Hospital, Ghaziabad, India*
[f] *St Luke's Medical Center, Quezon City, Philippines*
[g] *Hospital Nacional de Niños Benjamin Bloom, San Salvador, El Salvador*
[h] *Akdeniz University, Antalya, Turkey*
[i] *Faculty of Medicine, Mersin University, Mersin, Turkey*

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Sex, n (%)	
Male	710 (56)
Female	548 (43)
Underlying disease, n (%)	15 (1)
Renal failure, n (%)	15 (1)
Hepatic failure, n (%)	7 (1)
Cardiac surgery, n (%)	35 (3)
Abdominal surgery, n (%)	21 (2)
Thoracic surgery, n (%)	8 (1)
Trauma, n (%)	33 (3)
Previous infection, n (%)	109 (9)

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Process Surveillance

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VAP Rates

ates

eline iod	Intervention period	RR (95% CI)	*P* value
1	80		
2	9894		
1.7	8.1	0.69 (0.50-0.96)	.0286

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VAP rate reduction in NICUs of 10 countries

Findings of the International Nosocomial Infection Control Consortium (INICC) Part II: Impact of a Multidimensional Strategy to Reduce Ventilator-Associated Pneumonia in Neonatal Intensive Care Units in 10 Developing Countries

Victor D. Rosenthal;[1] Maria E. Rodríguez-Calderón;[2] Marena Rodríguez-Ferrer;[3] Tanu Singhal;[4] Mandakini Pawar;[5] Martha Sobreyra-Oropeza;[6] Amina Barkat;[7] Teodora Atencio-Espinoza;[8] Regina Berba;[9] Josephine A. Navoa-Ng;[10] Lourdes Dueñas;[11] Nejla Ben-Jaballah;[12] Davut Ozdemir;[13] Gulden Ersoz;[14] Canan Aygun[15]

DESIGN. Before-after prospective surveillance study to assess the efficacy of the International Nosocomial Infection Control Consortium (INICC) multidimensional infection control program to reduce the rate of occurrence of ventilator-associated pneumonia (VAP).

SETTING. Neonatal intensive care units (NICUs) of INICC member hospitals from 15 cities in the following 10 developing countries: Argentina, Colombia, El Salvador, India, Mexico, Morocco, Peru, the Philippines, Tunisia, and Turkey.

PATIENTS. NICU inpatients.

METHODS. VAP rates were determined during a first period of active surveillance without the implementation of the multidimensional approach (phase 1) to be then compared with VAP rates after implementation of the INICC multidimensional infection control program (phase 2), which included the following practices: a bundle of infection control interventions, education, outcome surveillance, process surveillance, feedback on VAP rates, and performance feedback on infection control practices. This study was conducted by infection control professionals who applied National Health Safety Network (NHSN) definitions for healthcare-associated infections and INICC surveillance methodology.

RESULTS. During phase 1, we recorded 3,153 mechanical ventilation (MV)–days, and during phase 2, after the implementation of the bundle of interventions, we recorded 15,981 MV-days. The VAP rate was 17.8 cases per 1,000 MV-days during phase 1 and 12.0 cases per 1,000 MV-days during phase 2 (relative risk, 0.67 [95% confidence interval, 0.50–0.91]; $P = .001$), indicating a 33% reduction in VAP rate.

CONCLUSIONS. Our results demonstrate that an implementation of the INICC multidimensional infection control program was associated with a significant reduction in VAP rate in NICUs in developing countries.

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Chracteristics of Patients, and Process Surveillance

TABLE 2. Characteristics of Patients, Hand Hygiene (HH) Improvement, and Ventilator-Associated Pneumonia (VAP) Rates in Patients Hospitalized in Neonatal Intensive Care Units in Phase 1 (Baseline Period) and Phase 2 (Intervention Period)

Variable	Baseline period	Intervention period	Rate ratio	95% CI	*P*
Patient characteristic					
Study period, mean months ± SD (range)	3	15.1 ± 9.1 (3–35)			
No. of patients	1,237	5,592			
Duration of MV, mean days ± SD	2.55 ± 7.3	2.85 ± 6.6			.144
No. of bed days	16,733	73,700			
Sex, no. (%) of patients					
Male	59 (731)	58 (3,261)	0.99	0.91–1.07	.7456
Female	41 (506)	42 (2329)			
Weight, mean kg ± SD	2.43 ± 1.14	2.36 ± 0.87			.094
HH improvement					
No. of HH observations	1,608	4,888			
HH compliance, % (no. of observations)	62 (1,004)	81 (3,947)	1.29[a]	1.21–1.39	.0001
VAP					
No. of cases of VAP	56	191			
No. of MV days	3,153	15,981			
MV use ratio, mean value (95% CI)	0.19 (0.18 – 0.20)	0.22 (0.21 – 0.23)	1.15	1.11–1.20	.0001
VAP rate per 1,000 MV-days	17.8	12.0	0.67	0.50–0.91	.0009

VAP Rates

	Baseline period (months 1-3)	Intervention period	RR (95% CI)	P value
No. of VAP	56	191		
No. of MV days	3,303	15,850		
VAP Rate per 1000 MV days	17.0	12.1	0.71 (0.53 – 0.96)	0.0234

RR, relative risk; CI, confidence interval; VAP, ventilator associated pneumonia; MV, mechanical ventilator

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Conclusions I

- According with WHO paper, based on INICC peer review publications, VAP rates in ICUs in limited resources countries are higher than in USA and Europe.
- VAP rates are higher in public than in private hospitals.
- INICC was successful to measure adverse consequences of VAP (mortality, extra length of stay, cost, bacterial resistance)

Conclusions II

- Six Components of INICC strategy:
  1. Bundles,
  2. Education,
  3. Outcome Surveillance (VAP rates, extra mortality, extra LOS, extra cost, bacterial resistance, etc.)
  4. Process Surveillance (Compliance with hand hygiene, with invasive device care)
  5. Feedback of VAP rates and consequences
  6. Performance Feedback
- It was effective to:
  - Increase compliance with:
    - Hand hygiene
    - Mechanical ventilator care
  - Reduce rates of:
    - VAP in ICUs of Argentina, Cuba, India, Turkey; and worldwide in Adults (56%), pediatric (31%) and neonatal ICUs (29%)

Thank you very much

Contact us by email:
Info@inicc.org

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