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Special article

International Nosocomial Infection Control Consortium (INICC) report, data summary of 36 countries, for 2004-2009

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Developing countries
Limited-resources countries
Low-income countries

The results of a surveillance study conducted by the International Nosocomial Infection Control Consortium (INICC) from January 2004 through December 2009 in 422 intensive care units (ICUs) of 36 countries in Latin America, Asia, Africa, and Europe are reported. During the 6-year study period, using Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN; formerly the National Nosocomial Infection Surveillance system [NNIS]) definitions for device-associated health care-associated infections, we gathered prospective data from 313,008 patients hospitalized in the consortium's ICUs for an aggregate of 2,194,897 ICU bed-days. Despite the fact that the use of devices in the developing countries' ICUs was remarkably similar to that reported in US ICUs in the CDC's NHSN, rates of device-associated nosocomial infection were significantly higher in the ICUs of the INICC hospitals; the pooled rate of central line-associated bloodstream infection in the INICC ICUs of 6.8 per 1,000 central line-days was more than 3-fold higher than the 2.0 per 1,000 central line-days reported in comparable US ICUs. The overall rate of ventilator-associated pneumonia also was far higher (15.8 vs 3.3 per 1,000 ventilator-days), as was the rate of catheter-associated urinary tract infection (6.3 vs. 3.3 per 1,000 catheter-days). Notably, the frequencies of resistance of *Pseudomonas aeruginosa* isolates to imipenem (47.2% vs 23.0%), *Klebsiella pneumoniae* isolates to ceftazidime (76.3% vs 27.1%), *Escherichia coli* isolates to ceftazidime (66.7% vs 8.1%), *Staphylococcus aureus* isolates to methicillin (84.4% vs 56.8%), were also higher in the consortium's ICUs, and the crude unadjusted excess mortalities of device-related infections ranged from 7.3% (for catheter-associated urinary tract infection) to 15.2% (for ventilator-associated pneumonia).

This is an updated report of data on device-associated health care-associated infections (DA-HAIs) within intensive care units (ICUs) collected by hospitals participating in the International Nosocomial Infection Control Consortium (INICC)[1-17] between January 2004 and December 2009. The INICC is an international nonprofit, open, multicenter, collaborative health care-associated infection control program with a surveillance system based on that of the US National Healthcare Safety Network (NHSN[18,19]; formerly the National Nosocomial Infection Surveillance system [NNIS][20]). Founded in Argentina in 1998, the INICC is the first multinational research network established to control and reduce DA-HAIs through the analysis of data collected on a voluntary basis by a pool of hospitals worldwide.[1-17] INICC has the following goals: (1) to create a dynamic global network of hospitals in the developing world that conduct surveillance of DA-HAIs by means of standardized definitions and established methodologies, promote implementation of evidence-based infection control practices, and perform applied infection control research; (2) to provide training and surveillance tools to individual hospitals to allow them to conduct outcome and process surveillance of DA-HAIs, measure their consequences, and assess the impact of infection control practices; and (3) to improve the safety and quality of health care worldwide through implementation of systematized programs to reduce rates of DA-HAI-associated mortality, excess length of hospital stays,[21-24] excess costs, and bacterial resistance.

METHODS

The INICC has focused on surveillance and prevention of DA-HAI in adult and pediatric ICUs and high-risk nurseries.[3,10,13,25] Data are collected using standardized CDC NHSN protocols and definitions.[19,20] The INICC's methodology includes both outcome surveillance and process surveillance components. The modules of the components may be used singly or simultaneously, but once selected, they must be used for a minimum of 1 calendar month.[3,10,13,25]

All DA-HAIs of the outcome surveillance component are categorized using standard CDC NHSN definitions that include laboratory and clinical criteria.[19] Both laboratory-confirmed bloodstream infection (BSIs) and clinical sepsis without microbiologic confirmation of BSI are recorded and reported.[26]

Data are classified into specific module protocols addressing the following: DA-HAI rates, excess length of stay, evaluation of DA-HAI costs, crude excess mortality, microbiological profile, bacterial resistance, and antimicrobial use data within the outcome surveillance component. In addition, the INICC methodology includes a process for adjudication and validation of reported HAIs.[3,10,13,25]

Infection control professionals (ICPs) collect data on central line-associated primary BSIs (CLABSIs), catheter-associated urinary tract infections (CAUTIs), and ventilator-associated pneumonia (VAP) occurring in patients hospitalized in a specific patient care location in nearly all hospitals. ICUs are stratified according to the patient population as adult ICUs, pediatric ICUs, and neonatal ICUs (NICUs).

All NICUs are level III or level II/III units, in which ICPs collect data on CLABSIs and umbilical catheter-associated primary BSIs or VAP for each of 5 birth weight categories (<750 g, 750-1,000 g, 1,001-1,500 g, 1,501-2,500 g, >2,500 g). ICPs also collect data on corresponding denominator data, patient-days, and specific device-days.

The INICC also receives aggregated data from hospitals with previous experience in conducting surveillance of DA-HAIs. Original and aggregated data were used to calculate DA-HAI rates. Only original data were used to calculate mortality and length of stay. The process surveillance component includes the following modules: hand hygiene compliance monitoring in ICUs, central and peripheral vascular catheter care compliance monitoring, urinary catheter care compliance monitoring, monitoring of compliance with measures to prevent VAP, and performance feedback. Data from the process surveillance module on hand hygiene compliance are included in this report.[3,10,13,25]

The identity of all INICC hospitals, cities and countries is kept confidential, in accordance with the INICC charter.

RESULTS

Table 1 presents characteristics of 422 ICUs from 36 countries in Latin America, Asia, Africa, and Europe currently participating in the INICC that contributed data for this report. The hospitals' mean duration of participation in the INICC is 23.9 ± 21.7 months (range, 1-72 months).

For the outcome surveillance component, DA-HAI rates, device utilization (DU) ratios, crude excess mortality by specific type of

DA-HAI, antimicrobial utilization, and bacterial resistance for January 2004 through December 2009 are summarized in Tables 2-17. Tables 2-7 present DA-HAI rates and DU ratios by infection type (CLABSI, CAUTI, and VAP) in adult and pediatric ICUs. The data for adult combined medical/surgical ICUs were not stratified by type or size of hospital. Device-days consisted of the total number of central line-days, urinary catheter-days, or ventilator-days. The DU ratio is an extrinsic risk factor for DA-HAI[19,20]; it also provides a marker for severity of illness, vis a vis patients' susceptibility to DA-HAI.

Tables 8-11 present DA-HAI rates and DU ratios from the high-risk nursery component of the INICC system for CLABSIs and VAPs. For NICUs, device-days consist of the total number of central line-days, umbilical catheter-days, and ventilator-days. The data for neonatal ICUs were stratified by weight. Tables 12 and 13 provide data on crude ICU mortality in patients hospitalized in each type of unit during the surveillance period with and without DA-HAI, along with crude excess mortality of adult and pediatric patients with CLABSI, CAUTI, and VAP, and infants in NICUs with CLABSI or VAP.

Tables 14 and 15 provide data on crude length of stay of patients hospitalized in each type of unit during the surveillance period with and without DA-HAI, along with crude excess length of stay of adult and pediatric patients with CLABSI, CAUTI, and VAP and infants in NICUs with CLABSI or VAP. Table 16 provides data on bacterial resistance of pathogens isolated from patients with DA-HAI in adult and pediatric ICUs and NICUs. Table 17 provides data on hand hygiene compliance in each type of unit. Tables 18 and 19 compare overall rates of CLABSI, CAUTI, and VAP (Table 18)[18] and rates of antimicrobial resistance (Table 19)[27] in the INICC ICUs and the CDC NHSN ICUs. Table 20 compares rates of CLABSI, CAUTI, and VAP in the INICC reports published in 2006,[3] 2008,[10] and 2010.[13]

Table 1
Features of the participating INICC hospitals, 2004-2009

	America	Asia	Africa	Europe	Pooled
ICUs, n	123	241	6	52	422
ICUs, type					
Medical ICU	3	34	0	5	42
Medical cardiac	6	17	0	4	27
Medical-surgical ICU	69	50	2	17	138
Neurosurgical ICU	1	22	0	2	25
Neurologic ICU	0	3	0	1	4
Neonatal ICU	19	10	2	5	36
Pediatric ICU	20	16	0	9	45
Respiratory ICU	0	16	1	1	18
Surgical ICU	3	40	1	6	50
Surgical-cardiothoracic ICU	0	26	0	2	28
Trauma ICU	2	7	0	0	9
Hospitals, n					
Academic teaching	19	45	5	25	94
Public	32	40	1	2	75
Private community	28	16	0	2	46

DISCUSSION

The implementation effectiveness of an integrated infection control program focused on DA-HAI surveillance was demonstrated approximately 30 years ago, as shown in many studies conducted in the United States, with results indicating that the incidence of DA-HAI can be reduced by as much as 30%, and that a related reduction in health care costs was feasible as well.[28] For more than 30 years, the CDC's NNIS/NHSN network has provided benchmarking US ICU data on DA-HAIs and antibiotic resistance, which have proven to be invaluable for researchers and served as an inspiration for the INICC program.[3,10,13,25] Initially, the INICC surveillance concentrated on DA-HAI surveillance in ICUs, the health care setting that has the highest DA-HAI rates and that poses the greatest risk to patient safety, given the patients' critical condition and exposure to invasive devices.[3,10,13]

The rate of device use in the INICC ICUs is similar to or even lower than that reported in US ICUs by the NNIS/NHSN system[18]; however, DA-HAI rates identified in INICC ICUs are significantly higher than the published US rates (Table 18).[18,29] Likewise, the antimicrobial resistance rates found in INICC ICUs for methicillin-resistant *Staphylococcus aureus* (MRSA) isolates, enterobacteria resistant to ceftazidime (extended-spectrum β-lactamase producers), and *Pseudomonas aeruginosa* as resistant to fluoroquinolones were significantly higher than those reported in NHSN ICUs (Table 19).[27] Nonetheless, the rate of vancomycin-resistant enterococci is much lower in the INICC ICUs than in the NHSN ICUs.[27]

These higher DA-HAI rates may reflect the typical ICU situation in limited-resources countries as a whole, and several reasons have been exposed to explain this fact.[30] Among the primary plausible causes, it can be mentioned that in almost all limited-resources countries, there are still no legally enforceable rules or regulations concerning the implementation of infection control programs, such as national infection control guidelines, and in the few countries that have such a legal framework, adherence to and compliance with the guidelines is most irregular, and hospital accreditation is not mandatory. In most INICC hospitals, a lack of official regulations is strongly correlated with considerable variability in compliance with hand hygiene recommendations. This situation is further complicated by the fact that administrative and financial support in most INICC hospitals is insufficient to fund infection control programs,[30] which invariably results in very low nurse-to-patient staffing ratios—which have proven highly connected to high DA-HAI rates in ICUs[3]—hospital overcrowding, lack of medical supplies, and insufficient numbers of experienced nurses and trained health care workers.

The World Bank categorizes countries into 4 economic strata based on 2007 gross national income per capita: (1) low income, $935 or less; (2) lower middle income, $936-$3,705; (3) upper middle income, $3,706-$11,455; and (4) high income, $11,456 or more.[31] Within this categorization, 144 out of 209 countries (68%) are low-income and lower middle-income economies (also referred to as lower-income countries, low-resources countries, developing economies, or developing or emerging countries), representing more than 75% of the world's population. The relationships between DA-HAI rates and socioeconomic level (low income, middle income, or high income) and between DA-HAI rates and type of hospital (public, academic, or private) was recently published by the INICC.[32]

DA-HAI surveillance is essential to reduce hospitalized patients' risk of infection, because it effectively describes and addresses the importance and characteristics of the threatening situation created by HAIs. This must be followed by the implementation of practices aimed at DA-HAI prevention and control. In addition, participation in the INICC has played a fundamental role not only in increasing the awareness of DA-HAI risks in the INICC ICUs, but also in providing an exemplar for the institution of infection control practices. In many INICC ICUs, for example, the high incidence of DA-HAI has been reduced by carrying out targeted performance feedback programs for hand hygiene and central line, mechanical ventilator, and urinary catheter care.[33-39] Finally, it is of utmost importance to restrict the administration of anti-infective agents to effectively control antibiotic resistance.

To compare a hospital's DA-HAI rates and DU ratios with the rates identified in this report, the hospital should begin data collection by applying the methods and methodology described for the NHSN and INICC, and then calculate infection rates and DU ratios for the device-associated module. The major aim of these data is to serve as a guide for the implementation of prevention

Table 2
Pooled means and 95% CIs of the distribution of CLABSI rates (per 1,000 central line-days) and central line DU ratios by type of adult or pediatric ICU

Type of ICU	ICUs, n	Patients, n	CLABSI (LCBI), n*	CLABSI (CSEP), n†	CLABSI (LCBI + CSEP), n	Central line-days	Pooled mean CLABSI rate	95% CI
Medical	42	30,823	425	691	1,116	75,846	14.7	13.8-15.6
Medical cardiac	27	26,704	147	186	333	53,287	6.2	5.6-6.9
Medical/surgical	138	109,237	3,016	436	3,452	506,934	6.8	6.6-7.0
Neurologic	4	3,869	106	1	107	8,306	12.9	10.6-15.5
Neurosurgical	25	8,109	93	0	93	20,249	4.6	3.7-5.6
Pediatric	45	20,905	523	152	675	63,330	10.7	9.9-11.5
Respiratory	18	2,710	119	3	122	24,774	4.9	4.1-5.9
Surgical	50	63,270	946	47	993	197,207	5.0	4.7-5.4
Surgical cardiothoracic	28	25,130	87	15	102	66,835	1.5	1.2-1.9
Trauma	9	4,507	36	0	36	14,650	2.5	1.7-3.4
Overall	386	295,264	5,498	1,531	7,029	1,031,418	6.8	6.7-7.0

CI, confidence interval.
*LCBI, laboratory-confirmed BSI.
†CSEP, clinical sepsis without laboratory confirmation.

Table 3
Pooled means and 95% CIs of central line DU ratios by type of adult or pediatric ICU

Type of ICU	ICUs, n	Central line-days	Patient-days	Pooled mean DU ratio	95% CI
Medical	42	75,846	151,243	0.50	0.50-0.50
Medical cardiac	27	53,287	94,180	0.57	0.56-0.57
Medical/surgical	138	506,934	949,971	0.53	0.53-0.53
Neurologic	4	8,306	22,860	0.36	0.36-0.37
Neurosurgical	25	20,249	47,019	0.43	0.43-0.44
Pediatric	45	63,330	165,046	0.38	0.38-0.39
Respiratory	18	24,774	39,942	0.62	0.62-0.63
Surgical	50	197,207	382,523	0.52	0.51-0.52
Surgical cardiothoracic	28	66,835	97,426	0.69	0.68-0.69
Trauma	9	14,650	26,201	0.56	0.55-0.57
Overall	386	1,031,418	1,976,411	0.52	0.52-0.52

CI, confidence interval.

Table 4
Pooled means and 95% CIs of the distribution of CAUTI rates per 1,000 urinary catheter-days, by type of adult or pediatric ICU

Type of ICU	ICU n	Patients, n	CAUTIs, n	Urinary catheter-days	Pooled mean CAUTI rate	95% CI
Medical	42	30,823	626	99,036	6.3	5.8-6.8
Medical cardiac	27	26,704	193	51,723	3.7	3.2-4.3
Medical/surgical	138	109,237	3,798	535,414	7.1	6.9-7.3
Neurologic	4	3,869	276	19,336	14.3	12.7-16.1
Neurosurgical	25	8,109	219	35,468	6.2	5.4-7.1
Pediatric	45	20,905	183	38,789	4.7	4.1-5.5
Respiratory	18	2,710	206	21,109	9.8	8.5-11.2
Surgical	50	63,270	869	173,759	5.0	4.7-5.4
Surgical cardiothoracic	28	25,130	90	56,185	1.6	1.3-1.9
Trauma	9	4,507	135	18,722	7.2	6.1-8.5
Overall	386	295,264	6,595	1,049,541	6.3	6.2-6.5

CI, confidence interval.

Table 5
Pooled means and 95% CIs of urinary catheter DU ratios by type of adult or pediatric ICU

Type of ICU	ICU n	Urinary catheter-days	Patient-days	Pooled mean DU ratio	95% CI
Medical	42	99,036	151,243	0.65	0.65-0.66
Medical cardiac	27	51,723	94,180	0.55	0.55-0.55
Medical/surgical	138	535,414	949,971	0.56	0.56-0.56
Neurologic	4	19,336	22,860	0.85	0.84-0.85
Neurosurgical	25	35,468	47,019	0.75	0.75-0.76
Pediatric	45	38,789	165,046	0.24	0.23-0.24
Respiratory	18	21,109	39,942	0.53	0.52-0.53
Surgical	50	173,759	382,523	0.45	0.45-0.46
Surgical cardiothoracic	28	56,185	97,426	0.58	0.58-0.58
Trauma	9	18,722	26,201	0.71	0.71-0.72
Overall	386	1,049,541	1,976,411	0.53	0.53-0.53

CI, confidence interval.

Table 6
Pooled means and 95% CIs of the distribution of VAP rates, per 1,000 ventilator-days by type of adult or pediatric ICU

Type of ICU	Units, n	Patients, n	Ventilator-days	VAPs, n	Pooled mean VAP rate	95% CI
Medical	42	30,823	86,095	661	7.7	7.1-8.3
Medical cardiac	27	26,704	21,877	236	10.8	9.5-12.3
Medical/surgical	138	109,237	357,214	6,570	18.4	17.9-18.8
Neurologic	4	3,869	4,015	113	28.1	23.2-33.8
Neurosurgical	25	8,109	14,475	303	20.9	18.7-23.4
Pediatric	45	20,905	86,675	560	6.5	5.9-7.1
Respiratory	18	2,710	18,571	514	27.7	25.4-30.1
Surgical	50	63,270	135,431	2,213	16.3	15.7-17.0
Surgical cardiothoracic	28	25,130	32,575	484	14.9	13.6-16.2
Trauma	9	4,507	12,266	491	40.0	36.6-43.7
Overall	386	295,264	769,194	12,145	15.8	15.5-16.1

CI, confidence interval.

strategies and other quality improvement efforts locally, to help reduce DA-HAI rates to the minimum possible level.

In conclusion, the data presented in this report underscore the fact that HAIs—particularly DA-HAIs in ICU patients in limited-resources countries—pose a grave and often concealed risk to patient safety. The INICC's main goal is to enhance infection control practices by facilitating elemental, feasible, and inexpensive tools and resources to tackle this problem effectively and systematically, leading to stricter adherence to infection control programs and guidelines, with a correlated reduction in DA-HAI and its adverse effects, in the ICUs participating in the INICC, as well as in all other health care facilities in the developing world.

Table 7
Pooled means and 95% CIs of ventilator DU ratios by type of adult or pediatric ICU

Type of ICU	Units, n	Patient-days	Ventilator-days	Pooled mean DU ratio	95% CI
Medical	42	151,243	86,095	0.57	0.57-0.57
Medical cardiac	27	94,180	21,877	0.23	0.23-0.24
Medical/surgical	138	944,836	357,214	0.38	0.38-0.38
Neurologic	4	22,860	4,015	0.18	0.17-0.18
Neurosurgical	25	47,019	14,475	0.31	0.30-0.31
Pediatric	45	165,046	86,675	0.53	0.52-0.53
Respiratory	18	39,942	18,571	0.46	0.46-0.47
Surgical	50	382,523	135,431	0.35	0.35-0.36
Surgical cardiothoracic	28	97,426	32,575	0.33	0.33-0.34
Trauma	9	26,201	12,266	0.47	0.46-0.47
Overall	386	1,971,276	769,194	0.39	0.39-0.39

CI, confidence interval.

Table 8
Pooled means and 95% CIs of the distribution of CLABSI rates per 1,000 central line-days for level III NICUs

Birth weight category, kg	Units, n	Patients, n	Central line-days	CLABSI (LCBI), n*	CLABSI (CSEP), n†	CLABSI (LCBI + CSEP)	Pooled mean CLABSI rate	95% CI
<0.75	9	73	1,104	4	8	12	10.9	5.6-18.9
0.75-1.00	27	1,163	9,008	68	54	122	13.5	11.3-16.2
1.001-1.50	30	1,916	11,700	100	60	160	13.7	11.6-16.0
1.501-2.50	32	5,598	14,328	83	88	171	11.9	10.2-13.9
>2.50	33	6,670	10,890	55	54	109	10.0	8.2-12.1
Overall	36	15,420	47,030	310	264	574	12.2	11.2-13.2

CI, confidence interval.
*LCBI, laboratory-confirmed BSI.
†CSEP, clinical sepsis without laboratory confirmation.

Table 9
Pooled means and 95% CIs of central line DU ratios for level III NICUs

Birth weight category, kg	Units, n	Patient-days	Central line-days	Pooled mean DU ratio	95% CI
<0.75	9	2,716	1,104	0.41	0.39-0.43
0.75-1.00	27	22,796	9,008	0.40	0.39-0.40
1.001-1.50	30	40,875	11,700	0.29	0.28-0.29
1.501-2.50	32	65,358	14,328	0.22	0.22-0.22
>2.50	33	59,569	10,890	0.18	0.18-0.19
Overall	36	191,314	47,030	0.25	0.24-0.25

CI, confidence interval.

Table 10
Pooled means and 95% CIs of the distribution of VAP rates per 1,000 ventilator-days for level III NICUs

Birth weight category, kg	Units, n	Patients, n	Ventilator-days	VAPs, n	Pooled mean VAP rate	95% CI
<0.75	9	73	1,272	4	3.1	0.08-0.81
0.75-1.00	27	1,163	7,121	51	7.2	5.3-9.4
1.001-1.50	30	1,916	5,424	48	8.8	6.5-11.7
1.501-2.50	32	5,598	6,900	70	10.1	7.9-12.8
>2.50	33	6,670	6,936	77	11.1	8.8-13.9
Overall	36	15,420	27,653	250	9.0	7.9-10.2

CI, confidence interval.

Table 11
Pooled means and 95% CIs of ventilator DU ratios by type of adult or pediatric ICU

Birth weight category, kg	Units, n	Patient-days	Ventilator-days	Pooled mean DU ratio	95% CI
<0.75	9	2,716	1,272	0.47	0.45-0.49
0.75-1.00	27	22,796	7,121	0.31	0.31-0.32
1.001-1.50	30	40,875	5,424	0.13	0.13-0.14
1.501-2.50	32	65,358	6,900	0.11	0.10-0.11
>2.50	33	59,569	6,936	0.12	0.11-0.12
Overall	36	191,314	27,653	0.14	0.14-0.15

CI, confidence interval.

Table 12
Pooled means and 95% CIs of the distribution of crude mortality and crude excess mortality* of ICU patients with DA-HAIs, adult and pediatric ICUs combined

	Deaths, n	Patients, n	Pooled crude mortality, %	95% CI
Crude mortality of patients without DA-HAI	11,908	119,501	10.0	9.8-10.14
Crude mortality of patients with CLABSI	414	1,679	24.7	22.6-26.8
Crude excess mortality of patients with CLABSI	414	1,679	14.7	12.8-16.6
Crude mortality rate of patients with CAUTI	290	1,677	17.3	15.5-19.2
Crude excess mortality of patients with CAUTI	290	1,677	7.3	5.7-9.1
Crude mortality rate of patients with VAP	1,265	5,020	25.2	24.0-24.5
Crude excess mortality of patients with VAP	1,265	5,020	15.2	14.2-14.3

CI, confidence interval.
*Crude excess mortality of DA-HAI = crude mortality of ICU patients with DA-HAI - crude mortality of patients without DA-HAI.

Table 13
Pooled means and 95% CIs of the distribution of crude mortality and crude excess mortality* of infants in NICUs, all birth weight categories combined

	Deaths, n	Patients, n	Pooled crude mortality, %	95% CI
Crude mortality of infants without DA-HAI	537	5,910	9.1	8.4-9.9
Crude mortality of infants with CLABSI	72	204	35.3	28.7-42.3
Crude excess mortality of infants with CLABSI	72	204	26.2	20.3-32.4
Crude mortality of infants with VAP	42	175	24.0	17.9-31.0
Crude excess mortality of infants with VAP	42	175	14.9	8.9-21.1

CI, confidence interval.
*Crude excess mortality of DA-HAI = crude mortality of ICU patients with DA-HAI - crude mortality of patients without DA-HAI.

Table 14
Pooled means and 95% CIs of the distribution of the length of stay and crude excess length of stay* of ICU patients with DA-HAI, adult and pediatric ICUs combined

	LOS, total days	Patients, n	Pooled average LOS, days	95% CI
LOS of patients without DA-HAI	746,251	119,501	6.2	6.2-6.3
LOS of patients with CLABSI	28,709	1,679	17.1	16.3-17.9
Extra LOS of patients with CLABSI	28,709	1,679	10.9	10.1-11.6
LOS of patients with CAUTI	30,982	1,677	18.5	17.6-19.4
Extra LOS of patients with CAUTI	30,982	1,677	12.2	11.4-13.1
LOS of patients with VAP	90,146	5,020	18.0	17.5-18.5
Extra LOS of patients with VAP	90,146	5,020	11.7	11.3-12.2

CI, confidence interval; *LOS*, length of stay.
*Crude excess LOS of DA-HAI = crude LOS of ICU patients with DA-HAI - crude LOS of patients without DA-HAI.

Table 15
Pooled means and 95% CIs of the distribution of the length of stay and crude excess length of stay* of infants in NICUs, all birth weight categories combined

	LOS, total days	Patients, n	Pooled average LOS, days	95% CI
LOS of infants without DA-HAI	64,212	5,910	10.9	10.6-11.1
LOS of infants with CLABSI	6,171	204	30.3	26.4-34.8
Extra LOS of infants with CLABSI	6,171	204	19.4	15.8-23.7
LOS of infants with VAP	5,944	175	34.0	29.4-39.6
Extra LOS of infants with VAP	5,944	175	23.1	18.8-28.5

CI, confidence interval; *LOS*, length of stay.
*Crude excess LOS of DA-HAI = crude LOS of ICU patients with DA-HAI - crude LOS of patients without DA-HAI.

Table 16
Antimicrobial resistance rates in the INICC ICUs

Pathogen, Antimicrobial	Pathogenic isolates tested, pooled, CLABSI, n	Resistance, CLABSI, %	Pathogenic isolates tested, pooled, VAP, n	Resistance, VAP, %	Pathogenic isolates tested, pooled, CAUTI, n	Resistance, CAUTI, %
Staphylococcus aureus						
Oxacillin	646	84.4	634	73.2	42	71.4
Enterococcus faecalis						
Vancomycin	98	5.1	18	11.1	59	5.1
Pseudomonas aeruginosa						
Fluoroquinolones*	285	42.1	997	46.2	148	50.7
Piperacillin or piperacillin-tazobactam	589	36.2	1,789	40.2	254	41.7
Amikacin	278	27.7	1,008	28.3	127	29.9
Imipenem or meropenem	517	47.2	1,777	42.7	255	36.5
Cefepime	2	100.0	8	37.5	2	50.0
Klebsiella pneumoniae						
Ceftriaxone or ceftazidime	447	76.3	662	68.9	194	72.2
Imipenem, meropenem, or ertapenem	508	7.9	688	7.0	237	7.2
Acinetobacter baumannii						
Imipenem or meropenem	667	55.3	1,466	66.3	113	52.2
Escherichia coli						
Ceftriaxone or ceftazidime	171	66.7	323	67.5	320	49.7
Imipenem, meropenem, or ertapenem	182	4.4	360	4.2	326	5.5
Fluoroquinolones*	133	53.4	164	54.9	211	32.2

*Fluoroquinolones include ciprofloxacin, levofloxacin, moxifloxacin, and ofloxacin.

Table 17
Distribution of hand hygiene compliance rates by ICU type

Type of ICU	ICUs, n	Opportunities for HH, n	HH compliance, n	Pooled mean compliance, %	95% CI
Medical	7	7,889	6,038	76.5	75.6-77.5
Medical cardiac	9	9,275	5,637	60.8	59.8-61.8
Medical/surgical	61	74,557	39,581	53.1	52.7-53.5
Neurologic	2	1,436	587	40.9	38.3-43.5
Neurosurgical	3	5,773	4,633	80.3	79.2-81.3
Neonatal	16	6,940	5,428	78.2	77.2-79.2
Pediatric	8	3,620	2,160	59.7	58.0-61.3
Respiratory	2	1,183	443	37.4	34.7-40.3
Surgical	6	7,868	5,284	67.2	66.1-68.2
Surgical cardiothoracic	3	5,412	4,204	77.7	76.5-78.8
Trauma	2	6,106	4,880	79.9	78.9-80.9
Overall	119	130,059	78,875	60.6	60.4-60.9

CI, confidence interval; *HH*, hand hygiene.

Table 18
Comparison of DA-HAI rates per 1,000 device-days in the ICUs of the INICC and the US NHSN

	INICC 2004-2009, pooled mean (95% CI)	US NHSN 2006-2008, pooled mean (95% CI)
Medical cardiac ICU		
CLABSI	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		
CLABSI	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		
CLABSI	10.7 (9.9-11.5)	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 (1,501-2,500 g)		
CLABSI	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)

CI, confidence interval.

Table 19
Comparison of antimicrobial resistance rates in the ICUs of the INICC and the US NHSN

Pathogen, antimicrobial	INICC 2004-2009 Resistance, % (CLABSI)	US NHSN 2006-2007 Resistance, % (CLABSI)
Staphylococcus aureus		
Oxacillin	84.4	56.8
Enterococcus faecalis		
Vancomycin	5.1	78.9
Pseudomonas aeruginosa		
Fluoroquinolones*	42.1	30.5
Piperacillin or piperacillin-tazobactam	36.2	20.2
Amikacin	27.7	4.3
Imipenem or meropenem	47.2	23.0
Cefepime	100.0	12.6
Klebsiella pneumoniae		
Ceftriaxone or ceftazidime	76.3	27.1
Imipenem, meropenem, or ertapenem	7.9	10.8
Acinetobacter baumannii		
Imipenem or meropenem	55.3	29.2
Escherichia coli		
Ceftriaxone or ceftazidime	66.7	8.1
Imipenem, meropenem, or ertapenem	4.4	0.9
Fluoroquinolones*	53.4	30.8

CI, confidence interval.
*Fluoroquinolones include ciprofloxacin, levofloxacin, moxifloxacin, and ofloxacin.

Table 20
Comparison of DA-HAI rates per 1,000 device-days in the INICC ICUs, 2006, 2008, 2010, and 2011 reports

	INICC 2002-2005 (published in 2006),[3] pooled mean (95% CI)	INICC 2002-2007 (published in 2008),[10] pooled mean (95% CI)	INICC 2003-2008 (published in 2010),[13] pooled mean (95% CI)	INICC 2004-2009 (this report), pooled mean (95% CI)
Number of countries	8	18	25	36
Participating countries	Argentina, Brazil, Colombia, India, Mexico, Morocco, Peru, Turkey	Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, India, Kosovo, Lebanon, Macedonia, Mexico, Morocco, Nigeria, Peru, Philippines, El Salvador, Turkey, Uruguay.	Argentina, Brazil, China, Colombia, Costa Rica, Cuba, Greece, India, Jordan, Kosovo, Lebanon, Lithuania, Macedonia, Mexico, Morocco, Pakistan, Panama, Peru, Philippines, El Salvador, Thailand, Tunisia, Turkey, Venezuela, Uruguay	Argentina, Brazil, Bulgaria, China, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Egypt, Greece, India, Jordan, Kosovo, Lebanon, Lithuania, Macedonia, Malaysia, Mexico, Morocco, Pakistan, Panama, Peru, Philippines, Puerto Rico, El Salvador, Saudi Arabia, Singapore, Sri Lanka, Sudan, Thailand, Tunisia, Turkey, Venezuela, Vietnam, Uruguay
Number of ICUs, n	55	98	173	422
Number of patients, n	21,069	43,114	155,358	313,008
Number of bed days, n	137,740	272,279	923,624	2,194,897
Number of CLABs, n	930	1,820	4,241	7,603

Table 20 Continued

	INICC 2002-2005 (published in 2006),[3] pooled mean (95% CI)	INICC 2002-2007 (published in 2008),[10] pooled mean (95% CI)	INICC 2003-2008 (published in 2010),[13] pooled mean (95% CI)	INICC 2004-2009 (this report), pooled mean (95% CI)
CLABSI rate				
Pooled	12.5 (11.7-13.3)	9.2 (8.8-9.7)	7.6 (7.4-7.9)	6.8 (6.7-7.0)
Medical cardiac ICU	-	9.9 (8.7-11.3)	8.5 (7.5-9.7)	6.2 (5.6-6.9)
Medical-surgical ICU	-	8.9 (8.4-9.4)	7.4 (7.2-7.7)	6.8 (6.6-7.1)
Pediatric ICU	-	6.9 (5.6-8.3)	7.8 (7.1-8.5)	10.7 (9.9-11.5)
Neonatal ICU (1501-2500 g)	-	15.2 (10.3-21.5)	13.9 (12.4-15.6)	11.9 (10.2-13.9)
Number of CAUTIs, n	888	1,312	3,390	6,595
CAUTI rate				
Pooled	8.9 (8.3-9.5)	6.5 (6.1-6.9)	6.3 (6.0-6.5)	6.3 (6.2-6.5)
Medical cardiac ICU	-	6.4 (5.3-7.7)	4.4 (3.5-5.3)	3.7 (3.2-4.3)
Medical-surgical ICU	-	6.6 (6.2-7.0)	6.1 (5.9-6.4)	7.1 (6.9-7.4)
Pediatric ICU	-	4.0 (2.4-6.2)	4.4 (3.6-5.4)	4.7 (4.1-5.5)
Number of VAPs, n	1,277	2,314	5,660	12,395
VAP rate				
Pooled	24.1 (22.8-25.5)	19.5 (18.7-20.3)	13.6 (13.3-14.0)	15.8 (15.5-16.1)
Medical cardiac ICU	-	20.2 (17.0-23.9)	14.9 (12.4-17.9)	10.8 (9.5-12.3)
Medical-surgical ICU	-	19.8 (14.2-27.1)	14.7 (14.2-15.2)	18.4 (17.9-18.8)
Pediatric ICU	-	7.9 (6.0-10.1)	5.5 (4.9-6.0)	6.5 (5.9-7.1)
Neonatal ICU (1,501-2,500 g)	-	6.68 (3.0-12.7)	9.50 (7.9-11.3)	10.1 (7.9-12.8)

CI, confidence interval.

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Author contributions include: idea, conception and design (V.D.R.); software development (V.D.R.); assembly of data (V.D.R.); analysis and interpretation of the data (V.D.R.); epidemiological analysis (V.D.R.); statistical analysis (V.D.R.); administrative, technical, and logistic support (V.D.R.); drafting of the article (V.D.R., D.G.M.); critical revision of the article for important intellectual content (all authors); final approval of the article (all authors); provision of study patients (all authors, except D.G.M.); and collection of data (all authors, except D.G.M.).

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APPENDIX. INICC MEMBERS, LISTED BY COUNTRY ALPHABETICALLY

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