ORIGINAL ARTICLE

Findings of the International Nosocomial Infection Control Consortium (INICC) Part I: Effectiveness of a Multidimensional Infection Control Approach on Catheter-Associated Urinary Tract Infection Rates in Pediatric Intensive Care Units of 6 Developing Countries

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q1 DESIGN. A before-after prospective surveillance study to assess the impact of a multidimensional infection control approach for the
q2 reduction of catheter-associated urinary tract infection (CAUTI) rates.

SETTING. Pediatric intensive care units (PICUs) of hospital members of the International Nosocomial Infection Control Consortium
q3 (INICC) from 10 cities of the following 6 developing countries: Colombia, El Salvador, India, Mexico, the Philippines, and Turkey.

PATIENTS. PICU inpatients.

METHODS. We performed a prospective active surveillance to determine rates of CAUTI among 3,877 patients hospitalized in 10 PICUs for a total of 27,345 bed-days. The study was divided into a baseline period (phase 1) and an intervention period (phase 2). In phase 1, surveillance was performed without the implementation of the multidimensional approach. In phase 2, we implemented a multidimensional infection control approach that included outcome surveillance, process surveillance, feedback on CAUTI rates, feedback on performance, education, and a bundle of preventive measures. The rates of CAUTI obtained in phase 1 were compared with the rates obtained in phase 2, after interventions were implemented.

RESULTS. During the study period, we recorded 8,513 urinary catheter (UC) days, including 1,513 UC-days in phase 1 and 7,000 UC-days in phase 2. In phase 1, the CAUTI rate was 5.9 cases per 1,000 UC-days, and in phase 2, after implementing the multidimensional
q4 infection control approach for CAUTI prevention, there rate of CAUTI decreased to 2.6 cases per 1,000 UC-days (relative risk, 0.43 [95%
confidence interval, 0.21–1.0]), indicating a rate reduction of 57%.

CONCLUSIONS. Our findings demonstrated that implementing a multidimensional infection control approach is associated with a significant reduction in the CAUTI rate of PICUs in developing countries.

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Over the last several decades, catheter-associated urinary tract infection (CAUTI) has been described in the scientific literature as one of the most common device-associated health care–associated infections (DA-HAIs) developed by patients hospitalized in the intensive care unit (ICU).[1-3] The acquisition of CAUTI by critically ill patients has been associated with considerable morbidity, prolonged hospital length of stay, bacterial resistance, and greater healthcare expenditures and costs.[4-5] Recently published studies show divergence in terms of its association with excess mortality, which was

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found to result from confounding by unmeasured variables.[4,6-8] Most studies reporting on the effectiveness of evidence-based prevention programs in pediatric ICUs (PICUs) are from high-income countries,[9-11] and there is a pressing need for implementation of prevention strategies and programs in the developing world.[12]

The International Nosocomial Infection Control Consortium (INICC) has performed outcome and process surveillance as part of an integral program specifically designed for ICUs in developing countries since 2002.[13] The implementation of the INICC multidimensional program for CAUTI prevention is based on the guidelines published by the Society for Health Care Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA) in 2008.[14] These guidelines describe different recommendations for CAUTI prevention in the ICU that are classified into categories based on the existing scientific evidence, the applicability of the intervention, and the prospective economic effects.

The results reported from INICC hospitals revealed that DA-HAI rates in the ICUs of countries with limited resources are 3–5 times higher than rates in the ICUs of high-income countries.[15,16]

As a countervailing strategy to reduce the high rates of CAUTI in our PICUs, we implemented a multidimensional infection control model in developing countries from June 2003 through December 2010. Our approach included a specific bundle of interventions for CAUTI prevention, education, outcome surveillance, process surveillance, feedback on CAUTI rates, and performance feedback on infection control
q5 practices. This study is, to our knowledge, the first to analyze the effect of this preventive multidimensional strategy on
q6 CAUTI rates in the PICU of resource-limited countries.

METHODS

Setting and Study Design

This before-after prospective cohort study was conducted in 10 PICUs in 10 hospitals that were members of the INICC in the following 6 countries: El Salvador, Colombia, India, Mexico, Philippines, and Turkey. Each hospital had been actively participating in the INICC Surveillance Program for at least 3 months and has an infection control team (ICT) comprised of a medical doctor with formal education and background in internal medicine, infectious diseases, and/or hospital epidemiology and infection control professionals (ICPs). The study period was from June 2003 through December 2010 and was divided into a baseline period (phase 1) and an intervention period (phase 2). Each participating hospital's institutional review board agreed to the study protocol, and patient confidentiality was protected by codifying the recorded information and making it identifiable only to the ICT. Other hospital and PICU characteristics are summarized
q7 in Table 1.

Intervention Period (Phase 2)

The intervention period was initiated after 3 months of participation in the INICC Surveillance Program. The mean length of the intervention period ($\pm$ standard deviation) was
13.6 $\pm$ 10.4 months (range, 4–34 months). The INICC mul- q8
tidimensional infection control approach includes the following components: a bundle of infection control interventions, education, outcome surveillance, process surveillance, feedback on DA-HAI rates, and performance feedback on infection control practices.

INICC Methodology

The INICC Surveillance Program includes the following 2 components: outcome surveillance (DA-HAI rates and their adverse consequences, including mortality rates) and process surveillance (adherence to hand hygiene and other basic preventive infection control practices).[13]

Training, Validation, and Reporting

The INICC chairman trained the principal and secondary investigators at hospitals from Argentina, Colombia, India, Mexico, and Turkey. In the remaining countries, investigators were self-trained by means of a manual and training tool that described how to perform surveillance and complete surveillance forms. Investigators have continuous e-mail and telephone access to a support team at the INICC central office in Buenos Aires, Argentina, which is in charge of responding to all inquiries within 24 hours. The INICC chairman also reviews all queries and responses.

Each month, participating hospitals submit the completed surveillance forms to the INICC central office, where the validity of each case is checked and the recorded signs and symptoms of infection and the results of laboratory studies, radiographic studies, and cultures are scrutinized to assure that the NNIS system criteria for DA-HAI were fulfilled. The forms used for surveillance of each ICU patient permit both internal and external validation, because they include every clinical and microbiological criterion for each type of HAI. The ICT member who reviews the data forms filled in at the participating hospital can verify that adequate criteria for infection were fulfilled in each case. Moreover, the original patient data form can also be validated at the INICC Central Office before data on the reported infection are entered into the INICC database.

Outcome Surveillance

The methods and definitions for DA-HAI developed by the US Centers for Disease Control and Prevention for the NNIS/NHSN program are applied in outcome surveillance.[17] However, INICC methods have been adapted to the setting of developing countries because of their specific resource limitations and different socioeconomic status.[13]

Outcome surveillance includes rates of CAUTI per 1,000 UC-days, ventilator-associated pneumonia per 1,000 venti-

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TABLE 1. Characteristics of the Participating Hospitals, June 2003 through December 2010

Variable	No. (%) of PICUs (n = 10)	No. (%) of PICU patients (n = 3,877)	Period
Country			
India			
Overall	2 (20)	1,421 (37)	
PICU A		1,301	Nov 2006–Dec 2010
PICU B		120	Dec 2009–Nov 2010
El Salvador	1 (10)	1,145 (30)	Jan 2007–Nov 2009
Colombia			
Overall	3 (30)	534 (14)	
PICU A		171	Sep 2009–Apr 2010
PICU B		314	Jun 2003–Jun 2006
PICU C		49	Jan 2009–Dec 2009
Turkey			
Overall	2 (20)	296 (8)	
PICU A		204	Sep 2008–Oct 2009
PICU B		92	Oct 2009–Nov 2010
Mexico	1 (10)	229 (6)	Sep 2005–Apr 2006
Philippines	1 (10)	252 (6)	Jan 2005–Dec 2009
Type of hospital			
Academic teaching	6 (60)	2,056 (53)	...
Public hospital	1 (10)	229 (6)	...
Private community	3 (30)	1,592 (53)	...

NOTE. PICU, pediatric intensive care unit.

lator-days, central line–associated bloodstream infection per 1,000 central line–days, microorganism profile, bacterial resistance, length of stay, and mortality in their ICUs.

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 DA-HAI.[13]

Hand Hygiene Compliance

Hand hygiene compliance by healthcare workers (HCWs) is determined by measuring the frequency with which hand hygiene is performed when clearly indicated, and such practices are monitored by the hospital infection control practitioner during randomly selected 1-hour observation periods 3 times per week. Although HCWs know that hand hygiene practices are regularly monitored, they are not actually aware of the precise moment at which observations are taking place.[13]

Contacts are monitored through direct observation, and the ICPs record the hand hygiene opportunities and compliance before contact with each patient. ICPs are trained to detect hand hygiene compliance and record it on a form specifically designed for the study. In particular, the INICC direct observation comprises the "Five Moments for Hand Hygiene" as recommended by the World Health Organization.[18]

Performance Feedback

The concept of using performance feedback on outcome surveillance and process surveillance as a valuable control measure in resource-limited hospitals was based on its effectiveness as proved in previous INICC studies.[19-24]

On a monthly basis, upon processing the hospital surveillance data, the INICC Headquarters team prepares and sends to each participating hospital a final report on that hospital's institutional rates of DA-HAIs, microorganism profile, bacterial resistance, length of stay and mortality in their ICUs, and compliance with hand hygiene, central line, and UC care as well as measures to prevent ventilator-associated pneumonia. The participating ICU staff receive feedback on their performance at monthly meetings by means of the review of charts showing a running record of DA-HAI rates compiled by the INICC headquarters team, which are also posted in a prominent location in the ICU.[13]

Components of Practice Bundle to Prevent CAUTI

The bundle consisted of the following interventions:

1. Education and training on insertion, care, and maintenance of indwelling catheters, alternatives to indwelling catheters, and procedures for catheter insertion, management, insertion, and removal.
2. Insertion of UCs only when needed and the removal of such catheters when they are not necessary.
3. Use of indwelling urethral catheters for perioperative pro-

cedures and for selected surgical procedures; urine output monitoring for critically ill patients; management of acute urinary retention and urinary obstruction; assistance in pressure ulcer healing for incontinent residents.

4. Consideration of other methods for management, including condom catheters or in-and-out catheterization, when appropriate.
5. Hand hygiene before insertion and manipulation of the catheter.
6. Use of as small a catheter as possible.
7. Use of gloves, a drape, and sponges; a sterile or antiseptic solution for cleaning the urethral meatus; and a single-use packet of sterile lubricant jelly for insertion.
8. Insertion of catheters by use of aseptic technique and sterile equipment.
9. Appropriate management of indwelling catheters, including properly securing indwelling catheters to prevent movement; maintaining a sterile, continuously closed drainage system; not disconnecting the catheter and drainage tube; replacing the collecting system by use of aseptic technique and after disinfecting the catheter tubing junction when breaks in aseptic technique, disconnection, or leakage occur.
10. Maintaining unobstructed urine flow.
11. Keeping the collecting bag below the level of the bladder at all times.
12. Emptying the collecting bag regularly and avoiding allowing the draining spigot to touch the collecting container.
13. Cleaning of the meatal area as part of routine hygiene.
14. Surveillance of CAUTI, using standardized criteria to identify patients with CAUTI, and recording catheter-days as a denominator.

The data were collected from PICUs with standardized forms that included information on the bundle components. These components were based on the practical recommendations for acute care hospitals published by the SHEA and IDSA in 2008.[14]

Definitions

CAUTI. For the diagnosis of CAUTI, the patient must meet
q9 1 of 2 criteria. The first criterion is satisfied when a patient with a UC has a positive urine culture result yielding 10^5 colony-forming units (CFU) per mL or more with no more than 2 microorganisms isolated and has 1 or more of the following symptoms with no other recognized cause: fever (temperature, $\geq 38°C$), urgency, or suprapubic tenderness.
q10 The second criterion is satisfied when a patient with a UC has at least 2 of the following criteria with no other recognized cause: positive results of a dipstick analysis for leukocyte esterase or nitrate and pyuria ($\geq$10 leukocytes/mL).[17]

Statistical Methods

Patient characteristics during baseline and during the last 3 months of the intervention period in each PICU were compared using Fisher exact test for dichotomous variables and unmatched Student *t* test for continuous variables. We calculated 95% confidence intervals (CIs) using VCStat (Castiglia). Relative risk (RR) ratios with 95% CIs were calculated for comparisons of rates of CAUTI using EPI Info, version 6. *P* values less than .05 by 2-sided tests were considered significant. In addition, we explored the change in CAUTI rates after an ICU joined INICC by looking at the follow-up period stratified by 3-month periods over the first year of follow-up, 6-month periods over the second and third years of follow-up, and then yearly (to allow somewhat for fewer subjects in ICUs with longer periods of follow-up). We calculated crude stratified rates and, using random-effects Poisson regression to allow for clustering by ICU, calculated incidence rate ratios (IRRs) for each time period, compared with the 3-month baseline period. Device days were included in the model as an offset with the coefficient constrained to be 0 (patients without UC during hospitalization were excluded). We performed an additional regression considering "time since ICU started the intervention period" as a continuous variable (excluding the baseline period) and calculated the IRR for reduction in HAI for each 3-month period of follow-up.

RESULTS

Over the whole study period, there were 3,877 patients who were hospitalized for 27,345 days in 10 PICUs for a total of 8,513 UC-days. The first PICUs to participate in the study began collecting data in June 2003, and the latest data included in this analysis are from December 2010. The data for participating hospitals were summarized and classified according to the number of PICUs, number of patients per PICU, type of hospital, and country. The majority of enrolled patients were from academic teaching hospitals (53%), followed by private community hospitals (53%). The remaining 6% of enrolled patients were from a public hospital in Mexico. All participating hospitals are from countries with developing economies. Seventy-two percent of enrolled patients belonged to countries with lower-middle-income economies (India, 37%; El Salvador, 29%; the Philippines, 6%). Twenty-eight percent of enrolled patients were from countries with upper-middle-income economies (Turkey, Colombia, and Mexico; Table 1).

Patient characteristics, such as sex, underlying diseases, previous infection, and duration of UC use, were similar during the baseline and intervention phases (Table 2). With
respect to infection prevention and control practices, we q11
found that hand hygiene compliance improved significantly in phase 2, from 48% to 70% (Table 2).

Regarding CAUTI rates, we recorded 9 CAUTIs in phase

TABLE 2. Characteristics of Patients, Hand Hygiene Improvement, and Catheter-Associated Urinary Tract Infection Rates in Patients Hospitalized in Pediatric Intensive Care Units in Phase 1 (Baseline Period) and Phase 2 (Intervention Period)

Variable	Baseline period	Intervention period	Rate ratio	95% CI	*P*
No. of patients	606	3,271			
Study period, mean months ± SD (range)	3	13.6 ± 10.4 (4–34)			
Urinary catheter duration, mean ± SD	2.50 ± 4.6	2.15 ± 5.71	...	...	.161
Sex, no. (%) of patients					
Male	348 (57)	1,869 (57)	0.99	0.89–1.11	.9315
Female	254 (42)	1,387 (42)			
Surgical stay, no. (%) of patients	118 (19)	606 (606)	0.95	0.78–1.16	.6207
Endocrine disease, no. (%) of patients	14 (2)	50 (2)	0.66	0.37–1.20	.1689
Chronic obstructive pulmonary disease, no. (%) of patients	129 (21)	767 (23)	1.10	0.91–1.33	.3093
Abdominal surgery, no. (%) of patients	11 (2)	47 (1)	0.79	0.41–1.53	.4843
Hand hygiene improvement					
No. of hand hygiene observations	868	420			
Hand hygiene compliance, % (no.)	48 (3,345)	70 (2,350)	1.45[a]	1.31–1.61	.0001
CAUTI					
No. of cases of CAUTI	9	18			
No. of UC-days	1,513	7,000			
UC use, mean	0.32	0.31	0.96	0.91–1.01	.1267
CAUTI rate, cases per 1,000 UC-days	5.9	2.6	0.43	0.21–1.02	.0344

NOTE. CAUTI, catheter-associated urinary tract infection; CI, confidence interval; SD, standard deviation; UC, urinary catheter.

[a] For hand hygiene, relative risk, rather than rate ratio, is calculated.

1 (baseline period), for an overall baseline rate of 5.9 CAUTIs per 1,000 UC-days. During phase 1, there were 1,513 documented UC-days, for a UC use mean of 0.32. q12

In phase 2, there were 7,000 UC-days, for a UC use mean of 0.31. After the implementation of the INICC multidimensional infection control approach, we recorded 18 CAUTIs, for an incidence density of 2.6 cases per 1,000 UC-days.

These results showed a CAUTI rate reduction from baseline of 57% (from 5.9 to 2.6 CAUTIs per 1,000 UC-days; RR, 0.43 [95% CI, 0.21–1.0]; $P = .0344$; Table 2).

The microorganism profile shows that *Candida* species, which accounted for 50% of isolates, was the most isolated uropathogen, with no variation in its frequency in both periods (phase 1 and phase 2). It was followed by *Enterococcus* species (25% of isolates) in phase 1. The remaining pathogens accounted for a maximum of 13% in both periods (Table 3).

Data are quite sparse, with few CAUTI in each period of follow-up. The most notable result is that, despite over 1,000 admissions to ICUs with over 2 years of participation in the INICC, no CAUTI was recorded in this period. The stratified rate ratios for the follow-up period show a decrease in all time periods, although the confidence intervals are wide and include 1 for all periods. (q13) Excluding the baseline period, when the time that an ICU had participated in the INICC at the time of admission was included as a continuous variable, we continued to see a decrease in CAUTI rate of 17% for every 3-month period that an ICU has participated in the INICC (nonsignificant; Table 4). q14

DISCUSSION

The analysis of our baseline data showed a high incidence density of CAUTI in our PICUs, which was reduced by 57% after the implementation of the multidimensional strategy. The reduction of CAUTI incidence continued during the intervention period without a regression to the mean. During the baseline period and the intervention period, patient characteristics (sex, underlying diseases, previous infection, and UC use) were similar. The enrolled patients were hospitalized

TABLE 3. Microorganism Related to Catheter-Associated Urinary Tract Infection in Pediatric Intensive Care Units in Phase 1 (Baseline Period) and Phase 2 (Intervention Period)

	No. (%) of isolates	
Isolated microorganisms	Baseline	Intervention
Candida species	4 (50)	4 (50)
Citrobacter species	1 (13)	0 (0)
Enterococcus species	2 (25)	0 (0)
Klebsiella species	0 (0)	1 (13)
Pseudomonas species	1 (13)	1 (13)
Staphylococcus aureus	0 (0)	1 (13)
Coagulase-negative staphylococci	0 (0)	1 (13)

table 4. Catheter-Associated Urinary Tract Infection Rates Stratified by the Length of Time that Each Unit has Participated in International Nosocomial Infection Control Consortium (INICC)

Variable	Cases with UC use	CAUTI	Crude CAUTI rate per 1,000 UC-days	IRR accounting for clustering by ICU
Months since joining INICC				
0–3 (baseline)	260	10	6.36 (3.43–11.84)	Baseline
3–6	265	5	3.31 (1.38–7.97)	0.52 (0.18–1.52)
6–9	187	3	2.82 (0.91–8.74)	0.46 (0.13–1.67)
9–12	168	2	1.72 (0.43–6.86)	0.27 (0.06–1.23)
12–18	216	6	3.95 (1.78–8.81)	0.53 (0.19–1.53)
18–24	36	1	5.46 (0.77–38.8)	0.68 (0.08–5.51)
24–36	143	0	...	...
36–48	123	0	...	...
48–60	55	0	...	...
Time since joining INICC in months per month	1,453	27	...	0.93 (0.87–0.99)[a]
Considering time since the intervention as a continuous variable (excluding the baseline period) per month	1,197	18	...	0.83 (0.66–1.07)[b]

note. CAUTI, catheter-associated urinary tract infection; IRR, incidence rate ratio; UC, urinary catheter.
[a] $P = .02$.
[b] $P = .15$.

in PICUs in countries with lower-middle-income and upper-middle-income economies.[25] There are intrinsic factors associated with the lower socioeconomic level of our PICUs that contribute to these high rates, such as a lack of adequate financial resources, low nurse-to-patient ratios, type of hospital, and insufficient medical supplies.[26]

The type of hospital in which our PICUs were located, however, was not a factor that explained the high CAUTI incidence in our study, because only 6% of enrolled patients were from public hospitals, which have been shown in the literature to pose the highest infection risk because of their more limited resources, compared with those of academic and private hospitals.[26]

In phase 2, after the implementation of the INICC multidimensional infection control strategy, we found a significant improvement in hand hygiene compliance, which increased to 70%. In this respect, in a study performed in Argentina, it was demonstrated that the inception of a program focused on education and frequent performance feedback resulted in a sustained improvement in hand hygiene compliance, which also coincided with a reduction in DA-HAI rates in the ICU.[21]

With respect to the microorganism profile, the leading isolated uropathogen was *Candida* species (50% of isolates) in both periods (phase 1 and phase 2), which was followed by *Enterococcus* species (25% of isolates). These findings do not coincide with the pathogens identified as the most frequent in PICU patients with CAUTI in a recent study performed in China. Its conclusions stated that gram-negative species were the predominant uropathogens, because *Escherichia coli* was the most frequently isolated pathogen.[27] On other hand, *Candida* species have been identified as species predisposing HCW hands to DA-HAI transmission. In a study performed in Turkey, the high rate of *Candida* species carriage on the hands of HCWs was evaluated as an important risk factor for colonization and infection by *Candida* species.[28] In relation to our findings, the improvement in hand hygiene compliance in phase 2 can plausibly account for a decrease in the transmission of *Candida* species by HCW hands and a correlated reduction in the incidence of CAUTI in our PICUs.

Pediatric patients hospitalized in PICUs who acquire a CAUTI are prone to experience long-term morbidity and risks, such as bacterial resistance patterns, hypertension, and, if the infection leads to renal scarring, renal insufficiency.[27,29] The INICC multidimensional strategy for CAUTI prevention implemented in this study included outcome and process surveillance of CAUTI, performance feedback, education,[30] hand hygiene,[23] and the simultaneous implementation of a practice bundle consisting of training on care, maintenance, and alternatives to indwelling catheters;[31] training on procedures for catheter insertion, management, and removal; insertion of UCs only when needed; removal of UCs when they are not necessary;[32] and maintenance of unobstructed urine flow, among other interventions. These preventive measures have already proven to be effective in reducing and controlling DA-HAI in several studies performed by INICC member hospitals in resource-limited countries.[19,23,24,33] In a study conducted by the INICC in Argentina, it was shown that, after the inception of a strategy that included education, performance feedback, outcome, and process surveillance, CAUTI rates decreased by 42% (from 21.3 to 12.39 CAUTIs per 1,000 catheter-days; RR, 0.58 [95% CI, 0.39–0.86]; $P = .006$).[23]

To date, only very few studies have been published that show the effectiveness of any systematic approach in reducing the rates of CAUTI among PICU patients. In a study from Saudi Arabia in 2007, the authors presented preliminary positive results obtained during the first stage of a quality control initiative to reduce the incidence of CAUTI among pediatric patients.[12]

Methodological Limitations

Our first concern is that we could not accurately characterize or quantify detailed information for each PICU with respect to compliance for each bundle component or with respect to other interventions included in our multidimensional approach, such as education and training. (q15) The extent to which nonquantifiable interventions were applied may have contributed to variations among the different PICUs. Second, although our findings cannot be generalized to PICU patients from every developing country, they indicate a trend towards reflecting the typical situation in resource-limited countries.

Conclusions

q16 Our analysis of the multidimensional infection control program for CAUTI prevention showed that the reduction in the CAUTI rate in our PICUs was associated with a correlative improvement in hand hygiene, which was an integral component of our multifaceted strategy, and was the result of providing education and training on CAUTI prevention measures by means of our bundle of interventions. Our findings confirm that improvements in practices can lead to a reduction in the risk of CAUTIs and their adverse consequences in PICUs in resource-limited countries. Our successful results also indicate that there is a continuous need to foster sustained improvements in practices beyond December 2010. The intervention periods are longer than the baseline periods to show the impact and residual effect of intervention. This long intervention period is positive evidence that there is not a return to the initial rate over time, and the lack of regression to the mean can also be verified.[16]

The INICC was established to respond to the burden of DA-HAI in resource-limited countries and therefore provides investigators with free training and methodological tools to implement infection control programs based on feasible application of inexpensive preventive measures and strategies. We expect the multidimensional infection control approach designed by INICC will increasingly be performed in the developing world to achieve successful reductions in the prevalence of DA-HAI. Furthermore, the publication of INICC findings from resource-limited healthcare facilities increases the scientific literature from developing countries, which is much needed. For these reasons, every hospital worldwide is invited to join the INICC network.

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QUERIES TO THE AUTHOR

q1. Your article has been edited for grammar, clarity, consistency, and adherence to journal style. To expedite publication, we no longer ask authors for approval of routine grammatical and style changes. Please read the article to make sure your meaning has been retained; any layout problems (including table and figure placement) will be addressed after we have incorporated corrections. Note that we may be unable to make changes that conflict with journal style, obscure meaning, or create grammatical or other problems. If you are writing corrections by hand, please print clearly, and be aware that corrections written too close to the edges of the paper may not transmit by fax. Finally, please note that a delayed, incomplete, or illegible response may delay publication of your article. Thank you!

q2. Please indicate the degrees (MD, PhD, etc) for each of the authors.

q3. In the list of authors for Part II, middle initials are used for Victor Danial Rosenthal and Josephine Anne Navoa-Ng. For consistency between articles, please indicate whether you would prefer to use initials or to spell the names out.

q4. Please confirm that you intend relative risk, as edited.

q5. Ok to combine single-sentence paragraphs with adjoining paragraphs, in accordance with journal style?

q6. OK to add “to our knowledge”?

q7. Your tables and/or figures have been edited in accordance with journal style. Please check carefully to ensure that all edits are acceptable and that the integrity of the data has been maintained. Please also confirm, where applicable, that units of measure are correct, that table column heads accurately reflect the information in the columns below, and that all material contained in figure legends and table footnotes (including definitions of symbols and abbreviations) is correct.

q8. Correct to change “average” to “mean”? Or do you intend “median”?

q9. Please review and confirm that your meaning is retained in the sentence that begins “The first criterion is satisfied...”

q10. Please confirm that the sentence that begins “The second criterion...” is OK as edited.

q11. a) Please clarify the data in the row for hand hygiene compliance in Table 2. Is the number given in parentheses after the percentage the numerator or denominator? What is the relationship between these numbers and the no. of hand hygiene observations given directly above? b) In the row for UC use, please clarify the data; mean what?

q12. Please clarify the units for UC use mean; how is this being calculated?

q13. In table 4, are the data in the column “Crude CAUTI rate per 1,000 UC-days” mean values and 95% CIs or median values and ranges?

q14. a) In Table 4, please clarify the ranges of months in the leftmost column. Please note that, as written, the ranges overlap. Do you intend 0-3 months, 4-6 months, 7-9 months, and so on? b) Please clarify the data in the last two rows of Table 4. The data in the first two columns in the row “Time since joining INICC in months per month” seems to be the total number of admissions and CAUTIs. The data in the last row is close to but does not equal the total (excluding baseline), which would be 1193 and 17).

q15. Please confirm that your meaning is retained in the sentence that begins “The extent to which...”

q16. Please confirm that the sentence that begins “Our analysis of the multidimensional infection control program...” is OK as edited.