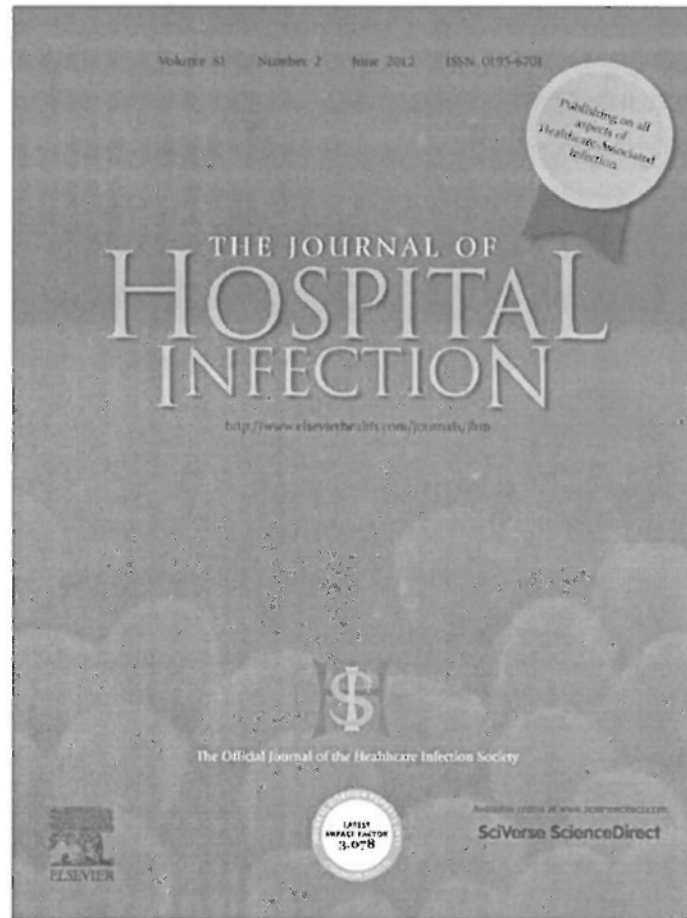


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Short report

Guidelines for preventing catheter infection: assessment of knowledge and practice among paediatric and neonatal intensive care healthcare workers

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SUMMARY

We analysed knowledge of and adherence to guidelines for the prevention of catheter-related infection (CRI) among Spanish healthcare workers (HCWs) from paediatric and neonatal intensive care units by distributing 357 questionnaires to 31 Spanish hospitals. The overall mean scores for individual knowledge and daily practice were 5.61 and 5.78, respectively. Our results reveal room for improvement in Spanish HCWs' knowledge of prevention of CRI. Continuing education programmes and implementation of care bundles must be introduced to improve prevention and management of CRI.

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Introduction

Catheter-related bloodstream infection (CRBSI) is one of the main nosocomial infections in patients admitted to intensive care units (ICUs), and incidence rates are especially high in the paediatric population.^{1,2} The Guidelines of the Centers for Disease Control and Prevention recommend implementing

a series of measures to decrease incidence. These include using full-barrier sterile precautions during catheter insertion, cleaning the skin with chlorhexidine, handwashing, avoiding the femoral site, removing unnecessary catheters, and continuing medical education.³

Knowledge of guidelines for the prevention of CRBSI among healthcare workers (HCWs) has not been fully assessed, and no comparisons have been made between different professional categories. Moreover, little is known about the difference between HCW knowledge and daily clinical practice.

The objective was to assess and compare the knowledge of HCWs from paediatric and neonatal ICUs (PICU, NICU) about guidelines for the prevention of CRBSI and adherence to these guidelines in daily practice.

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Discussion

This evaluation of knowledge of guidelines for the prevention of CRBSI demonstrated that there is room for improvement. Continuing medical education and sequential evaluation of institutional knowledge are necessary in order to follow up the acquisition of knowledge and practice after educational interventions. In this study, knowledge was not significantly different between physicians and nurses, whereas professional experience was significantly influential.

Infectious Diseases Society of America guidelines recommend implementing several preventive measures to decrease the incidence of CRBSI.³ Many studies have demonstrated the clinical impact of implementing preventive measures on the incidence of CRBSI.^{4–6} However, assessment of HCW knowledge using continuing education programmes has not been analysed in detail. Most published studies regarding assessment of knowledge are obtained mainly in nurses from adult ICUs.

Labeau *et al.* performed a multinational survey (22 European countries) to determine European ICU nurses' knowledge of guidelines for prevention of CRBSI.⁷ The mean test score was 44.4%, and professional seniority and number of ICU beds were associated with better scores. A study carried out among Hungarian nurses demonstrated that knowledge regarding CRBSI was also quite low (mean score, 3.66 on 10 questions), and no association was detected between professional seniority or number of ICU beds and better scores.⁸

Mimoz *et al.* estimated physicians' knowledge and/or application of recommendations on insertion and maintenance of central venous catheters in 41 French university hospital ICUs.⁹ In some aspects, knowledge and application of these recommendations were not as good as they should have been; however, no significant differences were detected between senior and junior physicians.

Kennedy *et al.* performed a self-administered survey among 215 nurses and patient care assistants in a 55-bed NICU to assess knowledge, beliefs, and practices regarding nosocomial infections, central venous catheter care, and hand hygiene.¹⁰ The response rate was 68%, and there was no agreement between catheter knowledge and beliefs and practice.

The main limitation of the present study is that the statistically significant difference between knowledge and reported practice may be due to a reporting bias on the part of the participants. Consequently, it is impossible to assess whether or not HCWs' self-reported compliance with catheter care is accurate. In addition, when we performed the study, guidelines for the prevention of intravascular catheter-related infection had not been updated. Hence our use of >0.5% chlorhexidine–alcohol instead of 2% aqueous chlorhexidine.

To our knowledge, the present study is the first to provide data on HCW knowledge and practice in the prevention of CRBSI including all professional categories in Spanish hospitals.

A simple questionnaire allowed us to evaluate HCW knowledge and practice in the prevention of CRBSI in large teaching

institutions. We can also use these scores as baseline values to assess the impact of educational interventions.

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Conflict of interest statement

None declared.

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Table II
Mean and median scores on ten questions according to respondents' characteristics

Characteristic	Individual knowledge			Daily clinical practice		
	Mean (SD)	Median (IQR)	<i>P</i>	Mean (SD)	Median (IQR)	<i>P</i>
No. of participants (<i>N</i> = 357)			0.539			0.244
NICU (<i>N</i> = 157)	5.55 (1.82)	5 (4–7)		6.69 (1.46)	6 (5–7)	
PICU (<i>N</i> = 181)	5.66 (1.66)	6 (5–7)		5.88 (1.57)	6 (5–7)	
NPICU (<i>N</i> = 19)	5.68 (2.24)	6 (4–7)		5.63 (2.14)	6 (4–8)	
Sex			0.941			0.830
Male (<i>N</i> = 63)	5.68 (1.71)	6 (4–7)		5.75 (1.61)	5 (5–7)	
Female (<i>N</i> = 294)	5.60 (1.77)	6 (4–7)		5.79 (1.55)	6 (5–7)	
Professional category			0.002			0.001
Physician (<i>N</i> = 110)	6.01 (1.72)	6 (5–7)		6.02 (1.60)	6 (5–7)	
Medical resident (<i>N</i> = 14)	3.86 (1.79)	4 (2–5)		3.64 (2.17)	3.5 (2–5)	
Student (<i>N</i> = 18)	5.33 (1.91)	5 (4–7)		4.89 (1.68)	5 (3.75–5.25)	
Nursing staff (<i>N</i> = 196)	5.58 (1.69)	6 (4.25–7)		5.89 (1.31)	6 (5–7)	
Nursing assistant (<i>N</i> = 19)	5.21 (1.72)	6 (4–7)		5.74 (1.76)	6 (5–7)	
Graduate degree			0.010			0.001
Yes (<i>N</i> = 98)	6.04 (1.58)	6 (5–7)		6.22 (1.28)	6 (5–7)	
No (<i>N</i> = 259)	5.45 (1.80)	5 (4–7)		5.62 (1.62)	6 (5–7)	
No. of beds			0.685			0.188
<8 (<i>N</i> = 272)	5.56 (1.73)	6 (4–7)		5.75 (1.54)	6 (5–7)	
8–15 (<i>N</i> = 55)	5.89 (1.94)	6 (5–7)		6.09 (1.52)	6 (5–7)	
>15 (<i>N</i> = 21)	5.71 (1.90)	5 (4–7.5)		5.86 (1.85)	6 (4–7.5)	
None (<i>N</i> = 9)	5.33 (1.00)	5 (4.5–6)		4.89 (1.45)	4 (4–6.5)	
No. of inserted CVCs in the last 3 months			0.842			0.312
<10 (<i>N</i> = 233)	5.55 (1.75)	6 (4–7)		5.85 (1.51)	6 (5–7)	
10–20 (<i>N</i> = 37)	5.54 (2.01)	5 (4–7)		5.49 (1.59)	5 (4–6)	
21–40 (<i>N</i> = 8)	6.13 (0.83)	6 (5.25–7)		5.38 (0.52)	5 (5–6)	
>40 (<i>N</i> = 2)	5.50 (0.71)	5.5 (5–6)		5.00 (1.41)	5 (4–6)	
None (<i>N</i> = 77)	5.48 (1.75)	6 (4–7)		5.79 (1.76)	6 (5–7)	
Years of experience			0.003			<0.001
<1 (<i>N</i> = 27)	4.81 (1.92)	5 (3–6)		5.11 (2.08)	5 (4–6)	
1–5 (<i>N</i> = 126)	5.31 (1.75)	5 (4–7)		5.38 (1.50)	5 (5–6)	
6–10 (<i>N</i> = 71)	5.82 (1.67)	6 (5–7)		6.20 (1.42)	6 (5–7)	
>10 (<i>N</i> = 133)	5.95 (1.70)	6 (5–7)		6.08 (1.45)	6 (5–7)	
No. of control measures			0.056			0.009
1 (<i>N</i> = 113)	5.36 (1.61)	5 (4–7)		5.59 (1.52)	6 (5–7)	
2 (<i>N</i> = 114)	5.80 (1.79)	6 (4–7)		6.08 (1.34)	6 (5–7)	
3 (<i>N</i> = 95)	5.88 (1.80)	6 (5–7)		5.95 (1.73)	6 (5–7)	
Others (<i>N</i> = 5)	4.40 (2.41)	3 (2.5–7)		5.03 (1.56)	5 (4–6)	
There are no specific methods (<i>N</i> = 30)	5.20 (1.75)	5 (4–7)		4.80 (1.92)	5 (3–6.5)	
Type of control measure			0.250			
Internal protocols (<i>N</i> = 277)	5.71 (1.79)	6 (4–7)	0.062	5.90 (1.54)	6 (5–7)	0.038
Educational programmes (<i>N</i> = 163)	5.83 (1.66)	6 (5–7)	0.028	5.99 (1.63)	6 (5–7)	0.030
Observation by committee (<i>N</i> = 186)	5.74 (1.84)	6 (4–7)	0.234	5.92 (1.53)	6 (5–7)	0.088
There are no specific methods (<i>N</i> = 30)	5.20 (1.75)	5 (4–7)	0.250	5.03 (1.56)	5 (4–6)	0.011
Training sessions in the last			0.005			0.031
3 months (<i>N</i> = 71)	5.66 (1.96)	6 (4–7)		5.94 (1.59)	6 (5–7)	
6 months (<i>N</i> = 42)	5.90 (1.66)	6 (5–7)		5.74 (1.70)	6 (5–7)	
1 year (<i>N</i> = 65)	6.14 (1.40)	6 (5–7)		6.17 (1.43)	6 (5–7)	
>1 year (<i>N</i> = 97)	5.46 (1.80)	5 (4–7)		5.75 (1.38)	6 (5–7)	
Never (<i>N</i> = 82)	5.18 (1.73)	5 (4–6)		5.40 (1.70)	5 (4–6.25)	

SD, standard deviation; IQR, interquartile range; NICU, neonatal intensive care unit; PICU, paediatric intensive care unit; NPICU, neonatal and paediatric intensive care unit; CVC, central venous catheter.

P-values indicate how median scores differ according to the subgroups (Kruskal–Wallis test).

Q8. Should an antibiotic ointment be applied at the insertion site of a CVC?	No, because it causes antibiotic resistance	24.4%	0.549	32.7%	20.4%	21.4%	22.2%	21.1%	0.017
Q9. When lipid emulsions are administered through a CVC it is recommended to replace the administration set ...	Within 24 h	84.9%	0.832	84.5%	91.8%	50.0%	66.7%	68.4%	0.048
Q10. When manipulating the catheter insertion site and hubs it is recommended ...	To use clean or sterile gloves and alcoholic solutions/antiseptic soap and water for hand hygiene before manipulation	96.6%	1	98.2%	96.9%	85.7%	94.4%	94.7%	0.716
Mean (SD) score		5.61 (1.76)		5.78 (1.56)		0.014 ^c			
Median (IQR) score		6 (4–7)		6 (5–7)		0.029 ^d			

CVC, central venous catheter; ICU, intensive care unit; SD, standard deviation; IQR, interquartile range.

^a Calculated using the McNemar test in order to establish statistical significance between the answers from both groups.

^b Comparing physicians and nurses.

^c Calculated using the *t*-test for paired samples.

^d Calculated using Wilcoxon ranges.

Methods

Setting and participants

This was a prospective multicentre study. Sixty-six PICUs and NICUs from 45 Spanish hospitals were invited to participate. In most hospitals, the PICU was separate from the NICU, and only five of the final participating hospitals had both ICUs located in the same unit. HCWs (physicians, medical residents, students, nursing staff, and nursing assistants) from each PICU and NICU were invited to participate in the study. The local ethics committees approved the study.

Assessment of knowledge

Participants completed an anonymous online multiple-choice questionnaire (10 questions) on personal knowledge of CRBSI; participants completed the same questionnaire on daily practice with respect to CRBSI. 'I don't know' was considered an incorrect answer. Each correct answer was scored as 1 point and incorrect answers as 0 points. We created individual and grouped scores of adequate responses ranging from 0 to 10.

We also recorded participants' demographic and occupational data.

Statistical analysis

The qualitative variables appear with their frequency distribution. The quantitative variables are summarized as the mean and median. Statistical significance was calculated using the McNemar test based on the qualitative variables of both groups' answers, whereas the statistical significance was calculated using Wilcoxon ranges. Kruskal–Wallis test or analysis of variance was used to compare how scores differed according to participants' characteristics.

Statistical significance was set at $P \leq 0.05$. Statistical analysis was performed using SPSS® 16.0 and EPIDAT®.

Results

Overall, 40/66 ICUs from 31/45 hospitals agreed to participate. The questionnaire was completed by 357 of the 558 HCWs invited to participate (64.0%). Of these, 196 were nurses (55.7%), 110 physicians (30.8%), 19 nursing assistants (5.3%), 18 medical students (5.0%), and 14 medical residents (3.9%).

The mean score for personal knowledge and daily clinical practice was 5.61 and 5.78, respectively ($P = 0.029$). Physicians had a better knowledge of catheter replacement and use of coated catheters or antibiotic ointments, whereas nurses seemed to have a better knowledge of when to replace administration sets and catheter dressings (Table I).

The median scores of participants were compared according to several demographic and occupational characteristics (Table II). In general, those participants with more years of experience and who had recently received training sessions had better scores than those with less experience and who did not receive any training. Moreover, qualification to graduate level was also related to better results.

Table 1
Assessment of individual knowledge and daily clinical practice in the prevention of catheter-related bloodstream infection (percentage of correct answers according to professional category)

Questions	Adequate answer	Overall individual knowledge (N = 357)	Overall clinical practice (N = 357)	P ^a	Physicians' knowledge (N = 110)	Nurses' knowledge (N = 196)	Residents' knowledge (N = 14)	Medical students' knowledge (N = 18)	Nursing assistants' knowledge (N = 19)	P ^b
Q1. Should CVCs be replaced routinely?	No, only when indicated	64.7%	84.9%	<0.001	77.3%	60.2%	50.0%	50.0%	63.2%	0.002
Q2. Is it recommended to replace CVCs using a guidewire?	No, only when indicated	61.1%	70.0%	<0.001	78.2%	55.6%	35.7%	50.0%	52.6%	<0.001
Q3. When neither lipid emulsions nor blood products are administered through a CVC, it is recommended to replace the administration set ...	Every 72–96 h	40.9%	33.9%	<0.001	42.7%	43.4%	14.3%	44.4%	26.3%	0.914
Q4. In paediatric/neonatal ICUs with a high rate of catheter-related infections, should a CVC coated or impregnated with an antiseptic agent be used?	No, because the use of such catheters has not yet been approved in this population	20.2%	21.3%	0.572	30.0%	17.3%	0%	27.8%	0%	0.010
Q5. It is recommended to change the dressing on the catheter insertion site ...	When indicated (e.g. soiled, loosened) and at least weekly	76.5%	73.1%	0.148	69.1%	78.6%	78.6%	88.9%	84.2%	0.066
Q6. It is recommended to cover up the catheter insertion site with ...	(sterile gauze) Both are recommended because the type of dressing does not affect the risk for catheter-related infections	33.6%	26.1%	<0.001	33.6%	35.7%	14.3%	27.8%	31.6%	0.715
Q7. It is recommended to disinfect the catheter insertion site with ...	2% aqueous chlorhexidine	65.0%	61.6%	0.036	62.7%	64.8%	42.9%	66.7%	94.7%	0.717

**CERTIFICADO DE PARTICIPACIÓN EN EL ESTUDIO DE CONOCIMIENTOS
SOBRE CATÉTERES EN UNIDADES DE CUIDADOS INTENSIVOS PEDIÁTRICAS
ESPAÑOLAS. "PROYECTO ECCAUPE"**

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