medicina *intensiva*

ORIGINAL ARTICLE

Southern European Intensive Care Nurses' Knowledge of Evidence-Based Guidelines for Preventing Ventilator-Associated Pneumonia

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Abstract
Objectives: To assess Southern European Intensive care unit nurses' knowledge about evidence-based guidelines for the prevention of ventilator-associated pneumonia and to compare these findings with a pan-European perspective.
Design: A sub-analysis from an observational study performed using a 9-questions, multiple-choice questionnaire performed during the period October 2006 - March 2007.
Setting: Six Southern European countries, selected from 22 participant European countries.
Participants: Volunteer nurses from intensive care units.
Results: 3329 questionnaires were obtained, 1182 of them belonging to Southern European countries with a 75.8% response rate. Global average score was 45,1%, being it significantly

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better in the South of Europe (46,6%, P<.001). A linear multiple regression analysis showed that years of working experience (per class of increase) (B=0.154±(SD) 0.045) (95% CI (0.066-0-242)) (p=0.001) and working in a smaller intensive care unit (B=-0,210±(SD) 0.059) ((95% CI) −0.326.−0.094) (p<0.001) was independently associated with better test scores.

Conclusions: Southern European critical care nurses' knowledge about ventilator-associated pneumonia prevention is poor, but significantly better than in the pan-European countries.

Grado de conocimiento de las guías de prevención de la neumonía asociada a ventilación mecánica de las enfermeras de cuidados intensivos del sur de Europa

Resumen

Objetivos: Determinar el grado de conocimiento de las enfermeras de cuidados intensivos del sur de Europa de las guías de prevención de la neumonía asociada a ventilación mecánica y compararlo con los resultados globales de Europa.

Diseño: Subanálisis de un estudio observacional realizado mediante un cuestionario de nueve preguntas con respuesta cerrada llevado a cabo entre octubre de 2006 y marzo de 2007.

Ámbito: Seis países del sur de Europa, de los 22 países europeos participantes.

Participantes: Enfermeras voluntarias de cuidados intensivos.

Resultados: Se recibieron 3.329 cuestionarios, de los cuales 1.182 fueron del sur de Europa donde hubo una tasa de respuesta del 75,8% La puntuación media global fue de 45,1% y la del sur de Europa 46,6% donde fue significativamente mejor (p < 0,001). El análisis de regresión lineal mostró que los años de experiencia (por aumento de categoría) están independientemente relacionados con mejores puntuaciones (B = 0,154 ± (ES) 0,045) (95% IC (0,066-0,242)) (p = 0,001) y trabajar en una unidad de cuidados intensivos con menor número de camas está independientemente relacionado con mejores puntuaciones (B = −0,210 ± (ES) 0,059) ((95% IC) −0,326-−0,094) (p < 0,001).

Conclusiones: El conocimiento de las enfermeras de las unidades de cuidados intensivos de los países del sur de Europa sobre las guías de prevención de la neumonía asociada a ventilación mecánica es bajo aunque mejor que en la muestra global de Europa.

Introduction

Mechanical ventilator-associated pneumonia (VAP) is known to be one of the most important infections acquired in Intensive Care Units (ICUs),[1-4] with an incidence of between 6-68%, and causes high morbidity-mortality and an increase in healthcare costs.[5] Considering the consequences of VAP, its prevention is an important concern in the care of critical patients and in the management of patients subjected to mechanical ventilation. In recent years, different measures and interventions have been evaluated in an attempt to prevent VAP or reduce its incidence. As a result of these studies, different evidence-based guides have been published, with a view to orienting healthcare professionals in relation to this problem, such as the guidelines developed by Dodek et al.[1] and the Centers for Disease Control and Prevention, among others.[6]

Given the importance of these guides and of their knowledge in order to guarantee their correct implementation, the EVIDENCE study was carried out to evaluate knowledge of these guides among European nurses and to consequently develop an electronic learning system on the prevention and control of respiratory infections, targeted to nursing personnel and other healthcare professionals.[5,7-9]

The aim of this sub-analysis was to determine the degree of knowledge of the VAP prevention guides among Intensive Care nursing personnel in southern Europe and compare the results with those of other European countries.

Material and method

A European observational study was carried out based on a validated questionnaire designed to assess knowledge of the VAP prevention guides and, on the basis of the needs detected from the study, to develop an electronic learning system on the prevention and control of respiratory infections, targeted to nursing personnel and other healthcare professionals (URL: www.vvizv.be/Pages/Evidence.php).[5,7-9]

The questionnaire was developed following the VAP prevention guidelines of Dodek et al.,[1] and consisted of 9 closed questions with four possible answers and a single correct answer. The questionnaire was subsequently validated by a group of experts. The questionnaire validation and development processes have been described by Labeau et al.[5] The questionnaire addressed the recommended intubation route (nasal versus oral), the frequency with which the ventilator circuits are replaced, the types of

Table 1 Nursing personnel answers in the VAP prevention knowledge test

Item	%answer
1. Oral vs nasal route for intubation	
a. Oral intubation is recommended	63.8[a]
b. Nasal intubation is recommended	3.5
c. Both intubation routes can be recommended	27.5
d. Don't know	5.2
2. Frequency with which the ventilator circuits are replaced	
a. Replacement is recommended every 48 hours (or when clinically indicated)	16.5
b. Replacement is recommended every week (or when clinically indicated)	37.6
c. Replacement is recommended for every new patient (or when clinically indicated)	43.7[a]
d. Don't know	2.1
3. Type of humidifiers	
a. Heat humidifiers are recommended	16.3
b. Heat and moisture exchange humidifiers are recommended	37.2[a]
c. Both types of humidifiers are recommended	22.4
d. Don't know	24.0
4. Frequency with which the humidifiers are replaced	
a. Replacement is recommended every 48 hours (or when clinically indicated)	46.8
b. Replacement is recommended every 72 hours (or when clinically indicated)	11.9
c. Replacement is recommended every week (or when clinically indicated)	18.2[a]
d. Don't know	23.1
5. Open vs closed aspiration systems	
a. Open aspiration systems are recommended	10.7
b. Closed aspiration systems are recommended	46.6[a]
c. Both systems are recommended	36.7
d. Don't know	5.9
6. Frequency with which the aspiration equipment is replaced	
a. Replacement is recommended every day (or when clinically indicated)	59.1
b. Replacement is recommended every week (or when clinically indicated)	12.1
c. Replacement is recommended for every new patient (or when clinically indicated)	22.3[a]
d. Don't know	6.4
7. Endotracheal tubes with subglottic aspiration	
a. These tubes reduce the risk of VAP	44.9[a]
b. These tubes increase the risk of VAP	7.0
c. These tubes exert no influence upon the risk of VAP	8.9
d. Don't know	39.2
8. Kinetic vs standard beds	
a. Kinetic beds increase the risk of VAP	2.6
b. Kinetic beds reduce the risk of VAP	59.9[a]
c. Kinetic beds exert no influence upon the risk of VAP	17.0
d. Don't know	20.5
9. Patient position	
a. The supine position is recommended	2.5
b. The semi-seated position is recommended	83.8[a]
c. Patient position exerts no influence upon the risk of VAP	8.1
d. Don't know	5.7

VAP: ventilator-associated pneumonia.
Table 1 shows the questions and possible answers of the study questionnaire, as well as the answers obtained (as percentages); the correct answer in each case is marked with an a.

humidifiers and the frequency with which they are replaced, the aspiration systems (open versus closed) and their replacement frequency, endotracheal tubes with subglottic aspiration, kinetic versus standard beds, and the position of the patient (table 1). Each correct answer represented one point, and the wrong answers did not negatively affect the global score, which ranged from a minimum of 0 points to a maximum of 9 points.

In order to select the possible collaborating investigators, a search was made in the electronic database http://www.

pubmed.com. The selection criterion was authorship of recent articles on the prevention of infections and professional dedication to Intensive Care. Thirty-one potential collaborators were identified, and all were invited to serve as national representatives for the EVIDENCE study. Twenty-six investigators agreed to participate, representing 26 European countries. The questionnaire was sent to the investigators in mid-October 2006. These national representatives in turn established contact with the nursing supervisors of different hospitals, who then distributed the questionnaire to those Intensive Care nurses who volunteered to participate in the study. The national representative posteriorly sent the completed questionnaires from the different national centers to the sponsor site. In order to determine the percentage response, the national representative reported how many questionnaires had been distributed and how many had been completed and duly returned. On a monthly basis, informative bulletins were sent with updates on the study status, to reinforce the work network (awards received, questionnaires received from each country, and accepted publications and communications). The questionnaires were returned by conventional mail in early March 2007.

The present sub-study included the countries in southern Europe, defined as those countries in the southern half of the continent that had participated in the global study: Portugal, Spain, Italy, Turkey, Greece and Malta.

The demographic data included nationality, gender, years of experience in the ICU, number of beds in the ICU, and obtainment of the title of specialist in Intensive Care granted by a higher teaching institution or professional organization of similar accreditation.

The statistical analysis was performed using the SPSS version 13.0.0 statistical package for Microsoft Windows (SPSS, Chicago, IL, USA). Statistical significance was considered for $p < 0.05$. Differences between groups were evaluated using the Student t-test for continuous variables with a normal distribution, the Mann-Whitney U-test test for continuous variables exhibiting a non-normal distribution, the chi-squared test and Fisher exact test for discrete variables, and the Kruskal Wallis test for assessing differences among the groups.

Multiple linear regression analysis was carried out using the Enter method, including all those variables found to be significant in the univariate analysis. The relationships between the total score and the demographic data are expressed as means in the linear regression analysis, using the Enter method.

For comparison of the two groups (global European sample and countries in southern Europe), the questionnaires from the south (n=1182) were subtracted from those of the global series (n=3329), yielding a total of 2147 questionnaires not originating from the participating countries in southern Europe.

Results

A total of 3329 questionnaires were obtained from nurses working in ICUs in 22 European countries (response rate 69.1%), out of the 26 that initially agreed to participate. In southern Europe a total of 1182 questionnaires were obtained from 6 countries (response rate 75.6%).

Table 2 Characteristics of the two groups (southern Europe versus rest of Europe)

Characteristics	Southern Europe (n=1182) (%)	Rest of Europe (n=2147) (%)
Gender		
Male	262 (22.2)	410 (19.1)
Female	919 (77.8)	1738 (80.9)
Number of beds in the ICU		
<8 beds	530 (44.8)	482 (22.5)
8-15 beds	416 (35.2)	915 (42.6)
>15 beds	229 (19.4)	658 (30.6)
Not answered	7 (0.6)	92 (4.3)
Years of experience in the ICU		
<1 year	167 (14.1)	253 (11.8)
1-5 years	459 (38.8)	510 (23.8)
6-10 years	256 (21.7)	434 (20.2)
>10 years	295 (5.0)	947 (44.1)
Not answered	5 (0.4)	3 (0.1)
Specialist in Intensive Care		
Yes	56 (4.8)	1201 (55.9)
No	401 (33.9)	721 (33.6)
Not answered	725 (61.3)	225 (10.5)

Table 2 shows the characteristics of the two groups (southern Europe versus rest of Europe), compared as absolute numbers and percentages.
ICU: Intensive Care Unit.

Participation by countries was as follows: Portugal submitted 484 questionnaires (40.9%), Turkey 197 (16.7%), Greece 175 (14.8%), Spain 143 (12.0%), Italy 140 (11.8%) and Malta 43 (3.6%). The mean score of the southern European countries was 4.20 out of 9 questions (46.6%) - this being significantly better than in the other European countries, where the score was 3.99 / 9 (44.3%)(p<0.001). The best scores were produced by the Italian nurses (5.24/9; 58.2%), while the poorest scores corresponded to Malta (3.47/9; 38.5%).

Table 1 shows the items of the study questionnaire together with the answers of the nurses among the four possible options, as well as the correct answer (*). Table 2 describes the characteristics of the surveyed nurses in southern Europe and in the sample corresponding to the rest of the countries. Table 3 relates the questionnaire scores to the characteristics of the nurses; significant differences were found in relation to the number of beds in the ICU (p=0.003), nationality (p<0.001), and years of experience in the ICU (p<0.001). Table 4 in turn shows the multivariate linear regression analysis, where in the same way as in the univariate analysis, experience in the ICU (by category increment: <1 year, 1-5 years, 6-10 years, or >10 years of experience) was found to be independently associated to better scores (p=0.001). In contrast, an increased number of beds in the ICU (< 8 beds, 8-15 beds or >15 beds) was associated to poorer scores (p<0.001). On adjusting the variables, nationality was not found to be independently associated to better scores.

Table 3 Mean scores of the 9 questions according to the characteristics of the nurses

Characteristics	Mean (%)	Median (interquartile range)	p
Total cohort (n=1182)	4.20 (46.6)	4 (3-5)	—
Gender			0.517
Female (n=919)	4.22 (46.8)	4 (3-5)	
Male (n=262)	4.15 (46.1)	4 (3-5)	
Number of beds in the ICU			0.003
<8 beds (n=530)	4.38 (48.6)	4 (3-5)	
8-15 beds (n=416)	4.12 (45.7)	4 (3-5)	
>15 beds (n=229)	4.00 (44.4)	4 (3-5)	
Years of experience in the ICU			<0.001
<1 year (n=167)	3.75 (41.6)	4 (3-5)	
1-5 years (n=459)	4.21 (46.7)	4 (3-5)	
6-10 years (n=256)	4.37 (48.5)	4 (3-5)	
>10 years (n=295)	4.35 (48.3)	4 (3-5)	
Postgraduate / master in Intensive Care			0.825[a]
Yes (n=56)	4.42 (49.1)	4 (3 - 6)	
No (n=401)	4.50 (50.0)	4.50 (3.25 - 5)	
Nationality			<0.001
Greece (n=175)	4.05 (45.0)	4 (3-5)	
Italy (n=140)	5.24 (58.2)	5 (4-7)	
Malta (n=43)	3.47 (38.5)	4 (3.75-5)	
Portugal (n=484)	3.99 (44.3)	4 (4-5)	
Spain (n=143)	4.10 (45.5)	4 (4-5)	
Turkey (n=197)	4.39 (48.7)	5 (3-6)	

Table 3 reports the mean (%) correct answers in the 9-question questionnaire with four possible answers in relation to the total cohort or identified subgroups (nurse gender, number of beds in the ICU, years of experience in the ICU, training in Intensive Care and nationality). The p-value shows how the scores differ according to subgroups. Statistical significance was considered for p<0.05.

[a]Only Greece, Italy and Spain, where such training can be received, have been taken into account. The total number of responders from these countries was 457.

Discussion

As far as we know, the ADVANCE study is the first to evaluate knowledge of the prevention guides among nurses, based on a validated and reliable questionnaire. We assume that our results to a certain point reflect the daily practice of the nursing personnel.

While the scores obtained by the nurses in southern Europe are low (below the 50% cutoff point for passing the test), they are significantly better than those recorded in the rest of Europe.[9]

Professional experience in Intensive Care has been found to be an important factor in acquiring knowledge of the ventilator-associated pneumonia (VAP) prevention guides.

Table 4 Adjusted correlation (linear regression) with mean knowledge of the VAP prevention

	B±standard error	95% confidence interval	p
Experience in ICU (per category increment)[a]	0.154 points[c]±0.045	0.066–0.242	0.001
Gender	0.135 points[c]±0.10	−0.079–0.348	0.216
Beds in ICU (per category increment)[b]	−0.210 points[c]±0.059	−0.326–0.094	<0.001
Nationality	−0.013 points[c]±0.029	−0.069–0.043	0.653

Table 4 shows the results of the multivariate analysis. The variables included were selected due to their significance in the univariate analysis (p<0.05), or because they formed part of the study hypothesis.

R^2=0.024.

ICU: Intensive Care Unit.

[a]The categories are <1 year, 1-5 years, 6-10 years and >10 years of experience.

[b]The categories are <8 beds, 8-15 beds and >15 beds.

[c]With respect to the total 9 points (one point per question).

This observation coincides with the findings of the study made among Belgian nurses and in the global European sample.[8,9]

The nurses working in smaller ICUs (fewer than 8 beds) obtained higher scores than those working in larger Units. While the reasons for this are not clear, teams with fewer people might improve implementation of the guides - though this hypothesis has not been cited in the literature.

In any case, our results must be viewed with caution. The irregular response rates of the different countries could have an impact in terms of representativeness; in effect, data from countries with a low response rate should be less representative than data from countries with a higher response rate.

The results show that having specialized in Intensive Care is not correlated to better questionnaire scores. This coincides with the findings of the global European study,[9] but not with the data obtained from the Belgian nurses,[8] where specialization in Intensive Care was effectively associated to higher scores. This discrepancy may be due to the fact that university and post-university training in nursing is very heterogeneous, depending not only on the country but also on the university involved - and these variations could not be taken into account in the statistical analysis. It is very possible that in some countries where post-university training is protocolized as a specialty, improved questionnaire scores can be expected.

It should be mentioned that there may be differences between the local or national guides and the international guides on which we have based the development of our questionnaire.[1,6] As a result, one of the possible explanations for the low scores could be knowledge among the nurses of other guides but not of those used for the present study.

In Europe there has been an important increase in VAP prevention guides at national level in recent years.[10] The development of a global European guide could help minimize conflicts in this sense, affording a useful tool, and limiting the proliferation of different guidelines.[10,11]

The impact of the different strategies has not been related to their importance in the questionnaire, and the costs likewise were not taken into account. These considerations could be important in emerging economies, since many of the resources (such as for example kinetic beds) are very expensive, and nurses therefore may not be familiarized with them since they are not available in their usual working place.

Although our results offer a pessimistic impression of nursing personnel knowledge of the VAP prevention guides in southern Europe, it is encouraging to note that training - as the first step in the implementation of quality programs with multiple facets - is distinction in the prevention of VAP.[12-14] Training sessions contribute to ensure that nurses obtain higher scores in the knowledge test[15] and, more importantly, they help integrate the acquired knowledge to daily professional practice.[12-14]

A limitation of this study is that the study population consisted of volunteer and non-randomized nurses. This may have led to the obtainment of higher scores, since the participants may have been more interested or motivated in preventing infections, and thus may have had more knowledge of the prevention guides.

Conclusions

The results of this study show knowledge of the ventilator-associated pneumonia guides among European nurses to be limited, but significantly better in southern Europe. Such knowledge also varies according to the size of the ICU and the experience of the nurses in Intensive Care.

Ethical approval

The EVIDENCE Study has been approved by the Clinical Research Ethics Committee of the University of Ghent.

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Conflict of interest

The authors declare no conflict of interest.

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Annex 1

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References

1. Dodek PM, Keenan S, Cook DJ, Heyland D, Jacka M, Hand L, et al. Evidence-based clinical practice guideline for the prevention of ventilator-associated pneumonia. Ann Intern Med. 2004; 141:305-13.
2. Chastre J, Fagon J-Y. State of the art. Ventilator-associated pneumonia. Am J Resp Crit Care Med. 2002;165:867-903.
3. Myny D, Depuydt P, Colardyn F, Blot S. Ventilator-associated pneumonia in a tertiary care ICU: analysis of risk factors for acquisition and mortality. Acta Clin Belg. 2005;60:114-21.
4. Depuydt PO, Benoit DM, Vogelaers DP, Decruyenaere JM, Vandijck DM, Claeys G, et al. Systematic surveillance cultures as a tool to predict involvement of multidrug antibiotic resistant bacteria in ventilator-associated pneumonia. Intensive Care Med. 2008;34:675-82.
5. Labeau S, Vandijck DM, Claes B, Van Aken P, Blot SI. Critical care nurses' knowledge of evidence-based guidelines for preventing ventilator-associated pneumonia: An evaluation questionnaire. Am J Crit Care. 2007;16:371-7.
6. Centers for Disease Control and Prevention. Guidelines for preventing health-care-associated pneumonia, 2003: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee. MMWR. 2004;53.
7. Labeau S, Vereecke A, Vandijck D, Claes B, Blot S. Critical care nurses' knowledge of evidence-based guidelines for preventing infections associated with central venous catheters: an evaluation questionnaire. Am J Crit Care. 2008;17:65-71.
8. Blot SI, Labeau S, Vandijck DM, Van Aken P, Claes B. Evidence-based guidelines for the prevention of ventilator-associated pneumonia. Results of a knowledge test among intensive care nurses. Intensive Care Med. 2007;33:1463-7.
9. Labeau S, Vandijck D, Rello J, Adam S, Rosa A, Wenisch C, et al. Evidence-based guidelines for the prevention of ventilator-associated pneumonia. Results of a knowledge test among European intensive care nurses. J Hosp Infect. 2008;70:180-5.
10. Lorente L, Blot S, Rello J. Evidence on measures for the prevention of ventilator-associated pneumonia. Eur Resp J. 2007;30:1193-207.
11. Masterton R, Craven D, Rello J, Struelens M, Frimodt-Moller N, Chastre J, et al. Hospital-acquired pneumonia guidelines in Europe: a review of their status and future development. J Antimicrob Chemother. 2007;60:206-13.
12. Apisarnthanarak A, Pinitchai U, Thongphubeth K, Yuekyen C, Warren DK, Zack JE, et al. Effectiveness of an educational program to reduce ventilator-associated pneumonia in a tertiary care center in Thailand: a 4-year study. Clin Infect Dis. 2007; 45:704-11.
13. Rosenthal VD, Guzman S, Crnich C. Impact of an infection control program on rates of ventilator-associated pneumonia in intensive care units in 2 Argentinean hospitals. Am J Infect Control. 2006;34:58-63.
14. Safdar N, Abad C. Educational interventions for prevention of healthcare-associated infection: A systematic review. Crit Care Med. 2008;36:933-40.
15. Tolentino-Delosreyes AF, Ruppert SD, Shiao SPK. Evidence-based practice: use of the ventilator bundle to prevent ventilator-associated pneumonia. Am J Crit Care. 2007;16:20-7.