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**Dates:** Received: 28 April, 2015; Accepted: 26 May, 2015; Published: 29 May, 2015

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**Keywords:** Cardiac surgery; Postoperative care; Cross infections

## Observational Study

# Preventing Postoperative Healthcare Associated Infections: The Experience of Two European Cardiac Surgery Intensive Care Units

### Abstract

**Aims:** to investigate the relationship between nursing workloads (first shift) and Healthcare-associated Infections (HAI) in two European Cardiac Surgery Intensive Care Units (ICUs).

**Background:** Critically ill patients may develop an infection, because of their clinical condition, and the invasive interventions received. Inadequate nursing workloads may increase the risk of HAIs.

**Design:** observational study in two European ICUs (Spain and Italy).

**Methods:** in the period February-June 2010 we assessed 60 patients per ICU using the Simplified Acute Physiology Score II (SAPS II) and the Nine Equivalents of Nursing Manpower Score (NEMS).

**Results/Findings:** the two ICUs have similar SAPS II and NEMS scores, however the distribution of nurses activities is different. The time spent in HAIs surveillance activities is greater in the Spanish ICU (155 minutes over 340) than in the Italian ICU (45 minutes over 320).

**Conclusion:** in the Spanish ICU, the presence of RN assistants allows nurses to spend more time in activities of NI prevention. This could probably encourage the observance of safety rules such as evidence-based aseptic work practices.

## Summary Statement

### Why is this research or review needed?

- The phenomenon of healthcare-associated infections (HAIs), in the cardiovascular ICUs may result in significant patient morbidity and mortality, prolonged duration of hospital stay, and additional costs due to diagnostic and therapeutic interventions
- HAIs are considered an indicator of the quality of patient care, an adverse event, and a patient safety issue.

### What are the key findings?

- Nursing activities are more effective in reducing the risk of HAIs when performed in accordance with a prevention protocol.
- Nursing assistants help reducing the time spent in the everyday direct patient care.
- Excessive nursing workloads may negatively influence the time spent in HAIs surveillance activities.

### How should the findings be used to influence policy/practice/research/education?

- The presence of nursing assistants in ICUs should be encouraged.
- Nurses should be allowed to spend more time in NI

surveillance activities and to perform evidence-based aseptic work practices.

## Introduction

### Background

The phenomenon of healthcare-associated infections (HAIs), formerly called nosocomial infections (NIs) [1], has been well recognized in the literature. In the cardiovascular ICUs, HAIs may result in significant patient morbidity and mortality, prolonged duration of hospital stay, and additional costs due to diagnostic and therapeutic interventions [2]. For this reason, HAIs are considered an indicator of the quality of patient care, an adverse event, and a patient safety issue. The use of illness severity scores is very common in Intensive Care Units (ICUs) in order to predict outcome, differentiate disease severity and assess resource use [3]. The Simplified Acute Physiology Score II (SAPS II) [4] is a very commonly used score in Europe to compare a critically ill patient's severity and to evaluate clinical course and outcome [5].

Strategies of surveillance implementation [6,7] may result in decreasing HAI rates.

Following the successful of the US system of National Nosocomial Infection Surveillance Scheme (CDC/NHSN), a national network [8] for the surveillance of NIs has been developed in Europe since the early '90s (HELICS/IPSE).

Low nurse staffing levels and patient overcrowding may lead

to poor adherence to basic infection control measures (e.g., hand hygiene), and higher rates of adverse outcomes (e.g., HAIs) [9]. The analysis of the nursing staff workloads is possible through specific indicators, such as patients' illness severity scores 4 and nursing activities scores [10].

## Aim

The aim of the study was to compare the time spent by the nursing staff in surveillance activities during the first shift - the most intense in terms of workloads - in two South-European Cardiac Surgery ICUs.

## Methods

We compared the two ICUs analyzing two aspects: the severity of disease and the nursing staff workloads. The first variable was assessed using the Simplified Acute Physiology Score II (SAPS II), and the nursing staff workloads were analyzed using the Nine Equivalents of Nursing Manpower Score (NEMS). We informed the eligible patients that we were carrying out a quality assurance program, and that we would collect data about their health conditions.

We also asked permission to observe the nursing staff activities to both Hospital directions.

The observers' researchers were trained in the use of these tools through a brief didactic course.

### Simplified Acute Physiology Score II

This tool was developed and validated in France in 1984 in order to measure the severity of disease and to predict the risk of death in ICU patients aged 15 or more. Like the APACHE scores [12], SAPS was calculated from the worst values obtained during the first 24 hours after admission to the ICU. In 1993, Le Gall and colleagues [4] used logistic regression analysis to develop SAPS II, which includes 17 variables: 12 physiological variables, age, type of admission, and 3 variables related to underlying disease. The scores may vary from 0 to 163, and the predicted mortality from 0% to 100%. The score is calculated only once during the stay. The SAPS II score was validated using data from consecutive admissions to 137 ICUs in 12 countries. Each score corresponds to a recommended nurse to patients ratios.

### Nine Equivalents of Nursing Manpower Score

This tool was derived from the TISS-28 in order to create a simpler system, easier to use [10]. EMS can be used to evaluate the efficacy of nursing workload use at the ICU, and classify ICUs based on the nurses' activities provided [3]. The over mentioned activities are divided into nine categories: basic monitoring, intravenous medication, mechanical ventilatory support, supplementary ventilatory care, single vaso-active medication, multiple vaso-active medication, dialysis techniques and specific interventions inside and outside the ICU. Each variable is weighted with a score, to a maximum of 56. Each score corresponds to a recommended nurse to patients ratios.

## Data collection and analysis

**Patients:** we considered eligible all the patients who underwent cardiac surgery during the period of observation and accepted to

enter the study. The sample was composed of 60 patients per ward, consecutively recruited.

**Setting and period of observation:** We collected the data at the Unidad de Cuidados Intesivos of the Hospital "Rio Hortega", Valladolid (Spain), and the Post-Operative Cardiac Surgery Unit of the University Hospital, Ancona (Italy) in the period 1st February - 30th June 2010. We observed the nursing workloads during the first shift (from 7 a.m to 2 p.m.), and we collected data about activities of NI surveillance performed by nurses during this time.

**Statistics:** The inter-rater reliability (IRR) of the measurements performed through the SAPS II and the NEMS tools was assessed with the IRR statistics Quickcalcs - Graf Pad SW© [11]. The variables "nursing workload" and "NI surveillance" were compared using the Chi square test statistic.

## Results

The mean scores observed in the Italian and Spanish ICUs are similar for both the SAPS II (40.83 and 41, respectively) and the NEMS tool (49 and 50, respectively). The assessment of the inter-rater reliability (IRR) of data, using QuickCalcs - Graf Pad SW © shows a Kappa value of 0.523 (95% C.I. 0.437 - 0.610, SE = 0.044) (Tables 1 and 2).

We also observed the NI surveillance activities performed by the nursing staff scheduled during the first shift in both ICUs (Table 3). In the Spanish ICU, these activities were performed in accordance with the government project "Bacteriemia zero" [13], which is part of a protocol of global strategy of HAI prevention in the ICUs supported by the Joint Commission.

The distribution of nurses' activities is different between the Italian and the Spanish ICU.

In the Spanish ICU, many activities of daily living (patients' toileting and bathing) are performed by nursing assistants, while in the Italian ICU the nursing staff have to perform all the tasks involved in the everyday direct patient care.

As a result of this different healthcare organization, in the Spanish ICU the nursing staff spend much more time in HAIs surveillance activities. The difference seems to be statistically relevant (Table 4).

**Table 1:** T-test results based on the p-value: noise level.

SAPS II score	Nurse to Patients ratios
<10	¼
10-15	1/2,5
>15	1/1

**Table 2:** NEMS scores and recommended Nurse-to-Patients staffing ratios.

NEMS class	NEMS scores	Nurse to Patients ratios
I	≥40	1/1
II	20 - 39	1/1 - 1/2 - 1/3
III	10 - 19	1/2 - 1/3 - 1/4
IV	< 10 points	1/4 - 1/5

**Table 3:** Scheduled NI surveillance activities performed by the nursing staff.

Nursing activities	Spanish ICU	Italian ICU
– Management of intravascular devices	– disinfection of catheter hubs prior to blood sampling or infusion therapy – collection of blood samples for cultural tests	– disinfection of catheter hubs prior to blood sampling or infusion therapy
– Management of respiratory devices	– sterile bronchial suction, – collection of bronchial samples for culture tests	– sterile bronchial suction,
– Management of closed urinary drainage systems	– collection of urine samples for culture tests	– use of closed urinary systems
– Nursing students education and training	– in accordance with the government protocol “Bacteremia zero”.	– promotion of hand hygiene practice among nursing students
– Patient care and hygiene	– collections of samples using swabs (skin wounds, pharyngeal, nasal, rectal, axillary) – sampling of gastric secretions	

**Table 4:** Nursing activities during the first shift.

Nursing activities	Spanish ICU	Italian ICU	p*
Direct patient care	185	275	<0.0001
NI surveillance	155	45	
Other	80	100	
Total	420	420	

## Discussion of Findings

The observers’ researchers showed a moderate strength of agreement in the use of both the SAPS II and the NEMS tool.

The nursing workloads and the time spent in NI surveillance during the first shift in both ICUs seem to be influenced by the different distribution of health-care activities.

We did not specifically compare the experience of the nursing staff (years of work in ICU), nor the level of education because of the current laws: the Strasbourg Treaty (1967) about the minimal standards for the instruction and education of nurses, and the Treaty of Rome (1957) which provides the right for the free movement of workers within the European Economic Community. Nurses who obtained their title of RN in Europe may work in each State of the European Union.

## Implications for healthcare providers

Nursing activities are more effective in reducing the risk of HAIs when performed in accordance with a prevention protocol, so nurses should be allowed to spend more time in NI surveillance activities and to perform evidence-based aseptic work practices.

The presence of nursing assistants in ICUs should be encouraged, because they help reducing the time spent in the everyday direct patient care and the nursing workloads, thus increasing the time spent in HAIs surveillance activities.

## Conclusion

The most evident threats to patient safety associated with nursing care occur in hospital inpatient units, especially among critically ill subjects. The strategies of prevention of many NI are well established, however those rules are not currently applied by the health care workers in their everyday work [14]. Nursing administration and policy most urgently need research conducted with standardized data collected at the patient care unit level.

Some authors observed that excessive nursing workload may represent a risk factor for acquiring HAI, followed by severity of clinical condition [15]. In the Spanish ICU, these activities were performed in accordance with the government project “Bacteremia zero” [13], which is part of a protocol of global strategy of HAI prevention in the ICUs supported by the Joint Commission.

We observed that the presence of nursing assistants, in the Spanish ICU, allows nurses to spend more time in NI surveillance activities and, probably, to be more effective in reducing the risk of infection and colonization through evidence-based aseptic work practices.

This study has important limitations. It involved two cardiac surgery ICUs, consequently, our findings cannot be generalized to all patients undergoing critical care. We did not assess the rate of HAIs occurred during the observation, nor the mean time of stay in hospital due to complications. In addition, our observation was limited to the nursing activities during the first shift of work.

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**Citation:** Palma E, Lizzi A, Marini A (2015) Preventing Postoperative Healthcare Associated Infections: The Experience of Two European Cardiac Surgery Intensive Care Units. *Arch Nurs Pract Care* 1(1): 001-004. DOI: <http://dx.doi.org/10.17352/anpc.000001>