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## Organization of intensive care units in Europe: lessons from the EPIC study

Received: 7 February 1997  
Accepted: 8 July 1997

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**Abstract** *Objective:* To study differences related to intensive care unit (ICU) structure and patient demography between the various countries of Western Europe.

*Design:* Application of data collected by the European Prevalence of Infection in Intensive Care (EPIC) study, a one-day prevalence study.

*Setting:* Voluntary participation of all Western European ICUs. A total of 1417 ICUs responded.

*Patients:* All patients, older than 10 years of age, occupying a bed in the participating ICUs over a 24-h period. 10038 patient case reports were submitted.

*Results:* The study revealed important differences. In particular, there seems to be a north/south divide

with fewer ICU beds and more severely ill patients in the south. The United Kingdom seemed more similar to southern European countries than to the north.

*Conclusion:* While there are similarities between European countries, large differences still remain and are important to identify to enable us to work together to create a more uniform system of intensive care, which will in turn give more effective and efficient patient care.

**Key words** ICU structure · ICU size · Resource allocation · Bed availability · ICU director

### Introduction

Within Europe, each country has developed its own medical system, independent of, but related to, those of surrounding countries. As communication between countries improves, so we are seeing changes in the structure of hospital practice and organization as new details on clinical and scientific improvements are exchanged. Putting into practice the concept of the 'European intensive care unit' (ICU), with harmonious unit structure, staff training, and technical and therapeutic protocols would enable us all to manage our ICUs more effectively, treat patients optimally, and perform clinical studies with comparable data. To this end, suggestions have been made regarding guidelines for ICU organization [1] and training [2] that could be applied throughout Europe.

However, despite some move towards homogeneity, important differences still remain in the organization of individual hospital units. Some of these were highlighted in an ethical questionnaire [3] circulated several years ago. In particular, a north/south gradient was apparent, in that ICU admission was more often limited by lower bed availability in the south than in the north, although the United Kingdom was more comparable to southern European countries than to the north. Differences in health care expenditure clearly account, in part, for this variability.

To evaluate these differences more closely, we extracted relevant data from the so-called EPIC (European Prevalence of Infection in Intensive Care) study [4] that was recently performed to evaluate the prevalence of nosocomial infections in Western European ICUs. This study collected data on more than 1400 Wes-

**Table 1** Geographical distribution of participating intensive care units (ICUs) and patients

Country	No. of ICUs	No. of Patients
Austria	75	420
Belgium	72	669
France	264	2359
Germany	268	2010
Greece	37	200
Ireland (Republic of)	15	91
Italy	110	617
Luxembourg	5	29
The Netherlands	78	472
Portugal	19	120
Spain	137	1233
Scandinavia	94	649
Switzerland	49	329
United Kingdom	194	840
Total	1417	10038

tern European ICUs and more than 10000 patients hospitalized in them. Much of the data is relevant to the analysis of the variability of ICU organization in these countries.

## Materials and methods

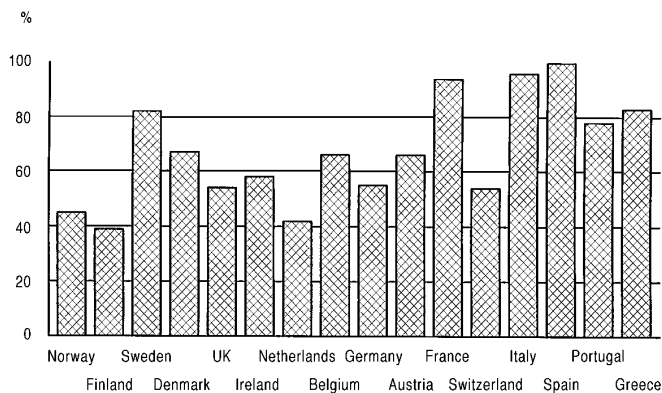
The EPIC study was a 1-day point-prevalence survey of infections in all patients hospitalized in ICUs in 17 Western European countries on 29 April 1992. A list of Western European ICUs was established from various sources, participating ICUs recruited by a series of mailings, and survey record forms distributed. Involvement in the study was voluntary. Coronary care units, specialized pediatric units, and special care baby units were not included. Data were collected by a nominated ICU clinician and included information on the organization and format of each unit, as well as relevant patient details. Among other data, the ICU questionnaire sought to define the type of unit and the number of beds, the number of admissions per week, and the presence or not of an ICU director and/or dedicated ICU clinical staff. Patient-oriented information included the primary diagnosis, duration of ICU stay, and the requirement for mechanical ventilation and certain interventions, e. g., for tracheostomy.

The record forms were collected centrally, and all data were entered twice and validated by a series of computer tests to identify inconsistencies. Any errors identified were corrected where possible, or the data were recorded as "missing".

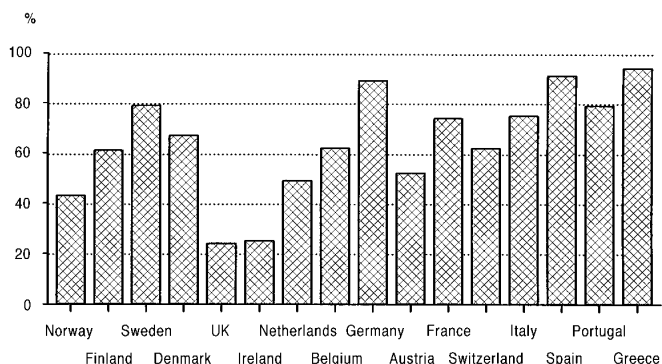
## Results

A total of 1417 ICUs, containing 10038 patients on the day of the study, participated, with the geographical distribution shown in Table 1.

Basic unit organization. The ICUs were situated in university hospitals (35%), university-affiliated hospitals (14%), or community hospitals (51%). The major-



**Fig. 1** Geographical variations in the presence of committed 24-h clinical cover. Countries are listed according to their position in Europe, roughly from north to south



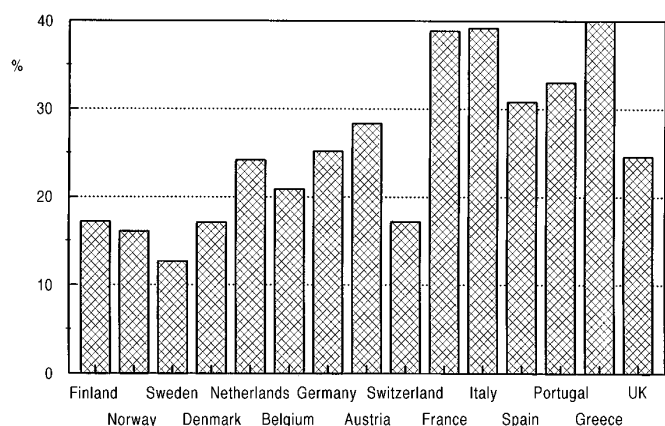
**Fig. 2** Geographical variations in the presence of a medical director. Countries are listed according to their position in Europe, roughly from north to south

ity of units (74.4%) defined their caseload as mixed medical and surgical, and there was no significant difference between countries in this respect. In 25% of units there were more than ten beds, 57% had between six and ten, and 18% had fewer than six. The proportion of small ICUs was greatest in the UK, with 48% having fewer than six beds.

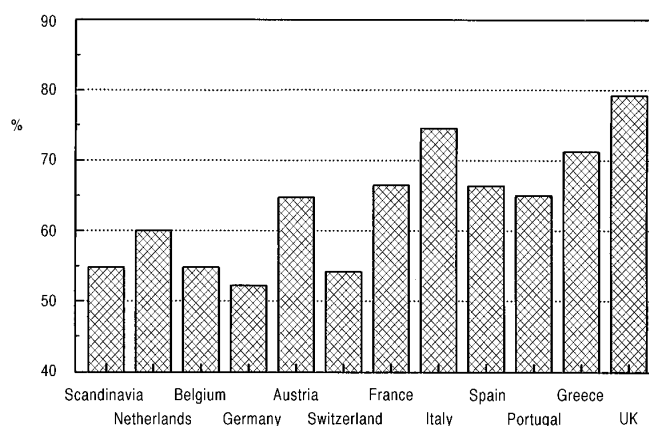
In 71.7% of the ICUs a committed 24-h doctor was on duty (Fig. 1). Italy and Spain had the highest number of ICUs with a full-time doctor, while The Netherlands and Finland had the lowest number. In 67.2% of the ICUs there was an ICU director (Fig. 2), Greece and Spain having the highest number and the United Kingdom and Ireland the lowest.

Bed occupancy. In 37% of units there were fewer than 7 admissions per week, 37% had 8 to 14, 15% had 15 to 21, and 11% more than 21. On the day of the study, the bed occupancy rate averaged 78.5%, the highest being in Belgium (94%).

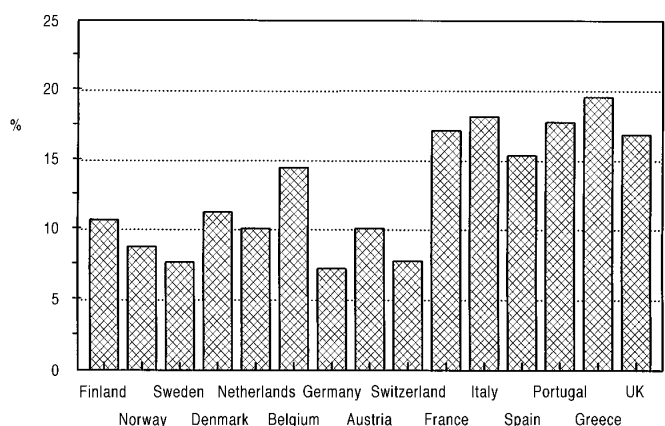
Duration of ICU stay. Patients usually stayed longer in the southern European ICUs, more than 40% of pa-



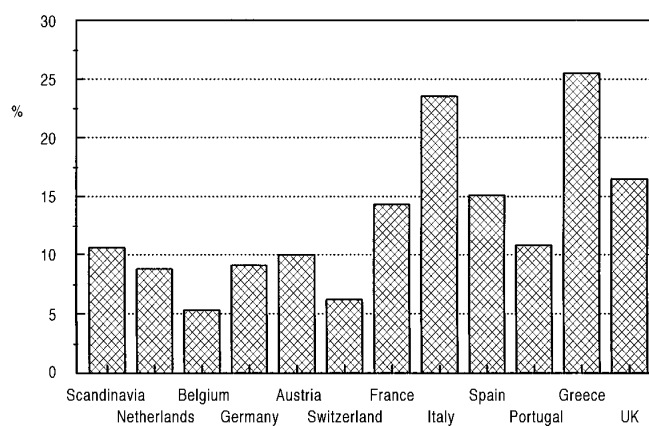
**Fig. 3** Geographical variations in the percentage of patients staying on the ICU for more than 21 days. Countries are listed according to their position in Europe, roughly from north to south, with the United Kingdom at the extreme right



**Fig. 5** Geographical variations in the requirement for mechanical ventilation. Countries are listed according to their position in Europe, roughly from north to south, with the United Kingdom at the extreme right



**Fig. 4** Geographical variations in patient disease severity as indicated by APACHE II scores. Countries are listed according to their position in Europe, roughly from north to south, with the United Kingdom at the extreme right



**Fig. 6** Geographical variations in the numbers of patients requiring tracheostomy. Countries are listed according to their position in Europe, roughly from north to south, with the United Kingdom at the extreme right

tients staying longer than 21 days in Greece. By comparison, in Sweden this figure was less than 15% (Fig. 3).

**Disease severity.** This was estimated by using the Acute Physiology and Chronic Health Evaluation (APACHE II) scoring system. Again disease severity, illustrated by an APACHE II score greater than 20, was usually greater in the south and in the United Kingdom, 15 to 20% of patients in these countries having such a score (Fig. 4).

**Requirements for mechanical ventilation.** Mechanical ventilation was also more common in the south and in the United Kingdom (Fig. 5).

**Use of tracheostomy.** Tracheostomy was particularly common in Italy, Greece, and the United Kingdom (Fig. 6).

## Discussion

From data available on file from the European Society of Intensive Care Medicine (ESICM), we estimate that there are between 3000 and 4000 ICUs in Europe. The 1417 units included in the EPIC study [4], therefore, certainly represent at least one-third of the total number of units, with a fair distribution between primary, secondary, and tertiary centers. While we believe this to be a representative cross-section of Western European ICUs, voluntary surveys by questionnaire always carry certain limitations, including the fact that replies tend to be furnished by the most motivated units. However, as this is likely to occur across the board, comparisons between countries can still be made. The use of an anonymous system helps to ensure genuine and accurate responses.

A particular limitation of this study was that we had to rely on estimates by the selected physician as the data collection was not monitored; but, as this was the same for all countries, the comparisons should still be valid.

Interestingly, 75 % of the 1417 ICUs were classified as mixed medical-surgical units. Very often, medical and surgical ICUs developed separately within the same hospital and many still remain separate. This may be more often the case in North America than in Europe. Consensus is emerging that the problems presented by medical and surgical patients are similar, so that separate units should merge and mixed medical-surgical departments become the standard [1].

It is also interesting that some ICUs are relatively small. It can be difficult to manage an ICU with fewer than six beds, and such units are certainly not cost-effective [5], yet almost half of the ICUs in the United Kingdom are of such a small size.

The current recommendation is to have a doctor available 24 h a day, and for each unit to have a medical director [2]. Although this was the case in many ICUs, unfortunately, it is not yet a global finding, with some countries, in particular the United Kingdom and Ireland, having large numbers of ICUs without a dedicated leading clinician or director. This may of course relate to the high percentage of very small ICUs in these countries, where it would simply not be cost-efficient for the unit to have its own director.

Bed availability is usually greater in north Europe, a finding consistent with that of other recent studies [3]. The number of ICU admissions was usually smaller in the south and the UK, but patients generally stayed longer in these units. There seem to be more severely ill patients in these countries, which was indicated by several factors. First, the APACHE II score was usually higher in units from these areas. In the EPIC study

APACHE II scores may have been underestimated because of the relatively high number of missing values, which must therefore be considered as normal. However, this limitation again applied equally to all centers, so we were still able to draw comparisons. Second, the duration of ICU stay was longer in the south and the UK. Third, mechanical ventilation was more commonly used in these countries, which is obviously a reflection of the severity of the disease processes. Fourth, there were more patients with tracheostomy. This is at least partly related to the duration of ICU stay, since tracheostomies are usually performed after a patient has already had a long period of mechanical ventilation. Our results probably also reflected different practice policies, since Italian and Greek ICUs include more patients with tracheostomies than those in other European countries.

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## Conclusion

Within Western Europe differences remain in basic ICU structure as well as in the type of patients admitted to such units, two aspects which are necessarily linked. In particular, the United Kingdom and southern countries have smaller units with sicker patients requiring longer stays. Many units now have 24-h clinical cover and an ICU director but 25 % still do not.

Allowing for the limitations associated with information obtained from voluntary questionnaires, the EPIC study provides interesting information concerning Western European ICU organization. Such comparisons can help in the implementation of attempts to standardize units and may help staff of individual ICUs to obtain the appropriate resources in their country to bring their unit in line with the current recommendations.

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