

# Education

Adult education for ICU management: a better way, *T. Dorman*

COmpetency-BASed Training programme (CoBaTrICE) in intensive care medicine for Europe and other world regions, *F. Rubulotta & P. Gruber*

Making critical care education BASIC, *W.T. Wong et al.*

Effective education for palliative care, *C.J. Hurd*

Free Open-Access Medical education (FOAM) and critical care, *C.P. Nickson*

Physiotherapy in the ICU e-learning programme, *M. Major-Helsloot et al.*

Benefits of CRM education and simulation in intensive care and emergency medicine, *J. Barré et al.*

## PLUS

Molecular diagnostics in severe respiratory virus infection, *B. Tang et al.*

Integration of nurse practitioners into the critical care team, *A.C. Dykstra & J.J. Marini*

Supply purchasing for intensive care centres, *R. Burgers & E. van Raaij*

Reducing avoidable harm and death from sepsis and acute kidney injury, *C. Hancock & A. Watkins*

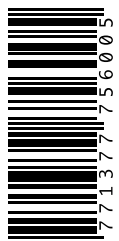
Implementation of early and structured rehabilitation in ICU, *D. McWilliams*

Process indicator-based plan-do-

act-check cycle in a single-centre quality improvement initiative, *J.A.M. Heijnen et al.*

Improving sepsis outcomes in Brazil, *F. Machado*

Bringing new technologies to anaesthesia, *M. Cannesson*



# Sepsis code implementation at Vall d'Hebron University Hospital

## Rapid diagnostics key to success

Implementation of a sepsis code, Código Sepsis, in October 2015 at the Vall d'Hebron University Hospital in Barcelona has led to better detection and a significant reduction in mortality. The hospital is the largest in Barcelona, with more than 1,100 beds and 7,000 employees.

The objectives of Código Sepsis are to increase suspicion of sepsis and septic shock, improve the early administration of initial antibiotic treatment, early and adequate resuscitation, facilitate early diagnosis of the infection source and place patients in different wards depending on clinical complexity. These objectives and the results obtained have been achieved with daily, fluid and efficient coordination among the physicians of Microbiology, Intensive Medicine and Emergency.

The new protocol was developed with the involvement of the departments of Intensive Care Medicine, Emergency, Microbiology and Nursing as well as the Laboratory.

Our group has established that for all patients with documented or suspected infection, Código Sepsis should be activated by at least one of the following two criteria:

- Criteria A: Acute alteration of the level of consciousness not explained by other causes.
- Criteria B: Hyperthermia or hypothermia and/or tachycardia and/or tachypnoea and/or desaturation (any of them) plus arterial hypotension.

### Sepsis bundle

In all patients in which the Código Sepsis is activated, we suggest to be performed that what we call the "bundle of the first 30 minutes", as follows:

1. Place two short and thick venous accesses and concomitantly perform the extraction of the first blood culture and blood samples for the laboratory. The second blood culture will be obtained 5-10 minutes later in a different anatomical location. We have developed a specific analytical profile for Código Sepsis in our hospital information system. This

profile includes haemogram, haemostasis, renal and liver profiles, ions, transaminases, bilirubin, lactates, biomarkers (procalcitonin and C-reactive protein), immunoglobulins, blood cultures and samples for the Sepsis Bank.

2. Oxygen therapy with an objective of  $SpO_2 > 90\%$ .
3. If hypotension or lactates are  $> 3$  mmol/L: Initiate immediate resuscitation with crystalloids (30 mL/kg), preferably with Ringer's lactate. Avoid administration of colloids (except seroalbumin). The existence of cardiac insufficiency may contraindicate fluid resuscitation.
4. Administration of the initial dose of antibiotic treatment in the first hour after the recognition of sepsis and if possible within the first 30 minutes. There is an empirical antibiotic treatment protocol based on syndromic diagnoses that aims to facilitate and expedite the antibiotic choice.
5. Priority is given to rapid antibiotic treatment in patients with sepsis/septic shock, so no diagnostic or therapeutic measures can delay the administration of the antibiotic.
6. Placement of a urinary catheter.
7. Perform a 12-lead ECG.
8. Sample potential source of sepsis.
9. Consider and perform the complementary examinations for the diagnosis of the source of infection (radiography, ultrasound, computed tomography).

### New laboratory workflow

In the microbiology laboratory, a new workflow for samples from patients with suspected sepsis ensures that these samples receive priority processing 24h/7d. In addition, the laboratory information system (LIS) has alerts to identify



**Ricard Ferrer, MD, PhD**  
Head of Intensive Care Department  
Vall d'Hebron University Hospital  
Head of Shock, Organ Dysfunction and Resuscitation Research Group  
Vall d'Hebron Research Institute  
Barcelona, Spain

r.ferrer@vhebron.net



**Juan Carlos Ruiz-Rodríguez, MD, PhD**  
Critical Care Department,  
Vall d'Hebron University Hospital  
Coordinator of Shock, Organ Dysfunction and Resuscitation Research Group  
Vall d'Hebron Research Institute  
Assistant Professor  
Universidad Autónoma de Barcelona  
Co-Director, Sepsis Bank  
Vall d'Hebron University Hospital  
Barcelona, Spain

jcruiz@vhebron.net

### Nieves Larrosa, MD, PhD

Clinical Microbiologist, Microbiology Department  
Vall d'Hebron University Hospital  
Microbiology Research Group, Vall d'Hebron Research Institute  
Assistant Professor, Universitat Autònoma de Barcelona  
Barcelona, Spain

mnlarrosa@vhebron.net

### Jordi Llaneras, MD

Emergency Department, Internal Medicine  
Vall d'Hebron University Hospital  
Barcelona, Spain

jllanera@vhebron.es

### Emma Molas, MD

Emergency Department, Internal Medicine  
Vall d'Hebron University Hospital  
Barcelona, Spain

emamolas@hotmail.com

### Juanjo González-López, MD, PhD

Clinical Microbiologist, Vall d'Hebron University Hospital  
Microbiology Research Group, Vall d'Hebron Research Institute  
Assistant Professor, Universitat Autònoma de Barcelona  
Co-Director, Sepsis Bank, Vall d'Hebron University Hospital  
Barcelona, Spain

jgonzalez@vhebron.net

\* corresponding author

patients with a sepsis code and warn of the positivity of blood cultures. The most modern technology available is used to obtain a rapid aetiological diagnosis and antibiotic susceptibility profile of the causative agent(s) of sepsis. The close collaboration between the microbiology laboratory, the sepsis code team and the physician responsible for the septic patient makes it possible for an early evaluation of empirical treatment to be made and adapted if needed.

### Microbiological diagnosis

Mass spectrometry is used, from colony and direct blood culture, for bacterial identification. Direct antibiogram of positive blood culture is performed (without waiting for the growth of the microorganism) in order to obtain the results sooner.

Obtaining rapid initial antimicrobial susceptibility results allows follow-up testing of reserved drugs not initially included in the standard antibiogram to quickly follow in cases where multiresistance is detected. Combinations of antimicrobials are also evaluated in the most complicated scenarios. As we have a multidisciplinary sepsis group, a clinician is available to receive microbiological results at any time of day. This has allowed de-escalation of treatment if needed and also extension of coverage to yeasts if the microbiological results point in that direction.

### Optimisation of antibiotic treatment

It is important to know the minimum inhibitory concentration (MIC) value, as one of the essential aspects of treatment is to keep the antibiotics at adequate plasma levels. Alterations in distribution volumes may cause suboptimal plasma levels. Knowledge of the MIC value in sepsis and septic shock is of particular importance since it may be a factor that modifies the choice of antibiotic to be used. It is also important to correctly infer the possible mechanisms of antimicrobial resistance produced by the organism responsible for the infection.

Implementation of Código Sepsis has increased the number of patients with a confirmed microbiological diagnosis, thus allowing the clinicians to make informed decisions about antimicrobial treatment. Prioritisation of samples in the lab has reduced time to final diagnosis, thus helping clinicians to make faster decisions.

We have seen an improvement in some

**Table 1.** Code Sepsis implementation 15 October 2015-17 February 2017

Total codes	712
Average codes per month	46
Where activated	Emergency Department (39.6%) Critical Care Department (21.6%) Hospitalisation wards and other units (38.8%)
Patient status	78.9% had sepsis 27.1% sepsis 51.8% septic shock
False positives	21% 8% in patients with no infection 13% in patients with infection but without sepsis
Source sites for infection	abdominal (32.4%) respiratory (27.8%) urinary (21.6%).
Microorganisms	<i>Escherichia coli</i> (28.2%) <i>Staphylococcus epidermidis</i> (7.7%) <i>Klebsiella pneumoniae</i> (7.2%) <i>Staphylococcus aureus</i> (5.1%) <i>Proteus mirabilis</i> (3.6%) <i>Staphylococcus sp.</i> (3.1%) <i>Enterococcus faecium</i> (3.1%) <i>Pseudomonas aeruginosa</i> (3.1%)
Mortality	41.7% (2005) 26.7% (2016) *

\*the analysis of mortality in 2005 only includes patients admitted to the ICU for sepsis and current data correspond to all the septic patients who were activated by the sepsis code in the hospital.

## sepsis is an authentic medical emergency and a time-dependent pathology

process-of-care indicators such as faster time to appropriate antibiotic therapy or a reduction in DDDs per 1,000 occupied bed days of carbapenems. We expect to see improvements in resistance patterns, better outcomes and lower costs over time.

### Multidisciplinary group

A multidisciplinary group, which includes the sepsis team of Intensive Care Medicine, Emergency and Microbiology, is responsible for the daily control of Código Sepsis. Each working day and by the first hour, the microbiology sepsis team identifies the patients activated by the sepsis code, analyses their microbiological samples (not only the current ones but also the previous ones) and reports them to the rest of the group. The emergency sepsis team is responsible for the clinical evaluation and follow-up of activated patients who remain

in the ER, while the Intensive Care Medicine sepsis team is responsible for the same function in the rest of the hospital. The Intensive Care Medicine sepsis team also records all patient data in a database shared by all members of the code sepsis team.

### Sepsis Bank

The Sepsis Bank of the Vall d'Hebron University Hospital Biobank is composed of more than 500 septic patients. It holds samples taken at the sepsis onset, that is when Código Sepsis is activated, and also pre-sepsis samples which have been taken 24h prior to the Código Sepsis activation as well as post-sepsis samples, taken 24h, 72h and 7 days after the onset. It also contains samples from non-infectious systemic inflammatory response syndrome patients as well healthy people, which would represent a disease control group. The Sepsis Bank is conceived for biomedical research and to facilitate clinical research of sepsis not only at our centre but also to the entire scientific community. ■

**This article was prepared in partnership with Accelerate Diagnostics. To find out more about rapid MIC diagnosis, visit <http://acceleratediagnostics.com>.**