TECHNICAL DOCUMENT

Surveillance of healthcare-associated infections and prevention indicators in European intensive care units

HAI-Net ICU protocol, version 2.2

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Acknowledgements
ECDC would like to thank the HAI-Net ICU operational contact points and Member States experts for providing input during meetings (October 2013, February 2014, February 2015), as well as the European Society of Intensive Care Medicine (Infection Section) for reviewing and commenting on the structure and process indicators of the protocol (Members: Jean-Francois Timsit (France, Infection Section Chair), Christian Brun-Buisson (France), Massimo Antonelli (Italy), Despoina Koulenti (Greece/Australia), José Artur Paiva (Portugal), Stijn Blot (Belgium), Jan De Waele (Belgium, Chair from January 2015).

The current HAI-Net ICU protocol v2.2 is the final version of the new HAI-Net ICU protocol, slightly adapted after the pilot version 2.0 in the autumn of 2015.

Suggested citation: European Centre for Disease Prevention and Control. Surveillance of healthcare-associated infections and prevention indicators in European intensive care units. Stockholm: ECDC; 2017.

Stockholm, May 2017

PDF
ISBN 978-92-9498-059-5
doi: 10.2900/833186
Catalogue number TQ-04-17-432-EN-N

Contents

Abbreviations

AMR	Antimicrobial resistance
APACHE score	Acute physiology, age, chronic health evaluation score
BAL	Broncho-alveolar lavage
BSI	Bloodstream infection
CDC	Centers for Disease Control and Prevention (USA)
CFU	Colony-forming units
CRI	Catheter-related infection
CVC	Central vascular catheter
HAI	Healthcare-associated infection
HAI-Net	Healthcare-Associated Infections surveillance Network (at ECDC)
HELICS	Hospitals in Europe Link for Infection Control through Surveillance project
ICU	Intensive care unit
NHSN	National Healthcare Safety Network
PN	Pneumonia
SAPS	Simplified acute physiology score
SSI	Surgical site infection
UTI	Urinary tract infection
WBC	White blood cells

Introduction and objectives

The Council Recommendation of 9 June 2009 on patient safety (2009/C 151/01) including the prevention and control of healthcare-associated infections (HAIs), recommends 'performing the surveillance of the incidence of targeted infection types', 'using surveillance methods and indicators as recommended by ECDC and case definitions as agreed upon at Community level in accordance with the provisions of Decision No 2119/98/EC' [1–3].

In 2000–2002, harmonised methods for the surveillance of two targeted infection types, surgical site infections (SSI) and HAIs in intensive care units (ICUs), were developed by the network HELICS (Hospitals in Europe Link for Infection Control through Surveillance), funded by the European Commission's Directorate-General for Health and Consumers, and progressively implemented in Member States by HELICS and later as part of the Improving Patient Safety in Europe (IPSE) project. Surveillance of HAIs in intensive care units was previously chosen as a component for European surveillance based on the existence of such networks in several EU Member States, on the fact that patients admitted to intensive care are at 5 to 10 times higher risk of acquiring a HAI due to both intrinsic (e.g. immune-depression) and extrinsic (e.g. mechanical ventilation) risk factors, and because the ICU is often the epicentre of emerging problems of HAIs and antimicrobial resistance in the hospital.

In July 2008, the coordination of the European surveillance of HAIs was transferred to the European Centre for Disease Prevention and Control (ECDC) in accordance with ECDC's mandate. ECDC continued HAI surveillance as in HELICS in 2008 and 2009. Minor changes to the HELICS-ICU protocol were agreed with Member State experts in 2010 and led to the release of the first ECDC HAI-Net ICU protocol (Version 1.01) in December 2010 (later published as version 1.02 [4]).

In 2013, the European Commission requested that ECDC collect additional data on structure and process indicators for HAIs as well as data on mortality from HAIs, based on the ECDC PPS results and in accordance with the Council recommendation 2009/C 151/01 of 9 June 2009 on patient safety, including the prevention and control of HAIs. From October 2013 to February 2015, structure and process indicators for the prevention of HAIs and antimicrobial resistance in ICUs were developed by ECDC and HAI-Net ICU experts and agreed upon during the HAI-Net ICU network meeting in February 2015 (see Annex 7).

The current version 2.1 of the HAI-Net ICU protocol describes the methods to be used for the surveillance of HAIs and the prevention indicators in intensive care units as agreed in February 2015. Changes compared to protocol version 1.02 are described in Section 1. Changes in version 2.1 compared to version 2.0 which was piloted in 2015 are minor. All ICUs can participate to the surveillance. To do so, please contact the national HAI surveillance coordinating centre in your country or ECDC HAI-Net at HAI-Net@ecdc.europa.eu. A free software with the HAI-Net ICU (HelicsWin.Net) is available on the ECDC website [5].

The main objective of this protocol is to ensure standardisation of definitions, data collection and reporting procedures for hospitals participating in the national/regional surveillance of HAIs in ICUs across Europe, in order to contribute to the EU surveillance of HAIs, and to improve the quality of care in the ICU in a multicentre setting. The protocol aims at describing methods for the participating ICUs and the national coordinating centres for the surveillance of HAIs.

Specific objectives at the level of the intensive care unit and the hospital are:

- to monitor the size of the HAI problem in a unit and identify the areas where prevention activities are needed
- to compare the results of the unit with its previous ones, and for inter-unit comparison, and to compare groups of patients stratified for infection risk, in order to be able to identify areas where the quality of care can be improved
- to sensitise personnel to infection problems (microorganisms, antibiotic resistance, etc.) and set local targets for prevention
- to promote prevention of HAIs and antimicrobial resistance in European ICUs
- to compare and follow-up the implementation of key preventive measures
- to provide relevant information to monitor and target infection control policies, to measure compliance with existing guidelines and good practices, to correct or improve specific practices or to develop, implement and evaluate new practices.

Gains at the local level can be produced by international comparisons that can be made by participating in the European network. These comparisons may provide insights that would not be revealed by regional or national-level surveillance.

Specific objectives at the level of regional or national network coordination are:

- to provide the necessary reference data to make comparisons of risk-adjusted rates between units/hospitals
- to follow-up epidemiological trends in time
- identification of important healthcare-associated pathogens
- epidemiology of emerging infections, antimicrobial resistance
- to identify and follow-up risk factors of HAIs
- to promote HAI/ antimicrobial resistance (AMR) prevention through surveillance
- to compare and follow-up the implementation of key preventive measures between ICUs and between EU/EEA countries
- to improve the quality of data collection.

Specific objectives at the European level are:

- to promote prevention of HAIs and antimicrobial resistance in European ICUs by providing European reference data for adjusted HAI rates and compliance with key preventive measures
- to monitor the burden of HAIs and antimicrobial resistance in European ICUs, in terms of incidence and attributable mortality
- to monitor and describe the epidemiology of HAIs in European ICUs
- to identify emerging healthcare-associated pathogens in the ICU
- to follow-up the incidence and the geographical spread of HAIs by type and pathogen in the ICU
- to identify regions or countries at higher need of EU support with regard to surveillance and control of HAIs
- to ensure communication of relevant data on HAIs to the European Commission as a complement to data transmissions by national health authorities
- to facilitate the communication and exchange of experience between national/regional networks for the surveillance of HAIs
- to stimulate the creation of national/regional coordination centres for the surveillance of HAIs in the ICU where these centres/networks do not exist
- to provide methodological and technical support to the national/regional HAI surveillance coordination centres
- to improve surveillance methodology, data validation and utilisation.

1. HAI-Net ICU protocol v2.2: summary of main changes

The main changes compared to the previous protocol (HAI-Net ICU protocol v1.02) can be summarised as follows:

Ward data: addition of structure and process indicators of prevention of HAIs and antimicrobial resistance, measured at the unit level in both standard and light surveillance options (see Annex 7 for rationale and references):

- alcohol hand rub consumption in previous year
- staffing levels (in a period of 7 days) of registered nurses and nurse aides in the ICU
- audit in approximately 30 patients for following indicators:
  - post-prescription review within 72 hours after prescription
  - prevention of pneumonia in intubated patients: control of cuff pressure, oral decontamination, patient position
  - CVC maintenance care: catheter site dressing is not damp, loose or visibly soiled.

Patient data (standard surveillance option only): addition of a variable allowing to select a second severity score (from a list, in addition to SAPS II) and enter its value, deletion of: APACHE II, date of hospital admission, coronary care, site of previous surgery, parenteral nutrition, addition of birth weight and gestational age for neonates (optional).

Exposure and antimicrobial use data (standard surveillance option only): removal of exposure to parenteral nutrition; antimicrobial use: updated ATC code list, optional specification of indication and anatomical site (diagnosis) according to HAI-Net PPS categories.

HAI data (standard and light surveillance options):

- addition of PDR (pandrug resistance) in the antimicrobial resistance data:
  - no PDR: susceptible to at least one antimicrobial
  - possible PDR: resistant to all antimicrobials tested in the hospital
  - confirmed PDR: resistant to all antimicrobials confirmed by the reference laboratory.
- other minor changes to the 'target' antimicrobial resistance list for HAIs in ICUs: addition of colistin (COL) as AMR marker for Enterobacteriaceae, removal of ESBL for Enterobacteriaceae (not well reported, therefore no added value over susceptibility to third generation cephalosporins), replacement of 'PIP' (piperacillin) by 'TZP' (piperacillin-tazobactam) for *P. aeruginosa* and re-introduction of 'CAZ' (ceftazidime) for *Acinetobacter* spp. (removed in 2010 revision of HAI-Net ICU protocol);
- relationship of death to HAI in patients with an ICU-acquired infection that die – further details regarding methodology are addressed in a specific study on validity and reproducibility of HAI mortality review data.
- addition of *Candida auris* to the microorganism list
- possibility to report other HAI infection types (optional).

Variables to improve consistency/quality of the data: indication at the level of (each) ICU:

- HAI types included in the surveillance: this information replaces the information about the included HAI types that was collected at the national (DataSource) level
- optional antimicrobial use data collected or not at the patient level (standard option only).

2. Patient-based (standard option) versus unit-based (light option) surveillance of ICU-acquired infections

Since 2001–2002, the protocol for the surveillance of ICU-acquired infections includes two options, a patient-based and a unit-based option. The patient-based surveillance option, also referred to as the 'standard' option, allows advanced risk adjustment of HAI rates for inter-hospital comparisons. The unit-based, or 'light' option, provides a less labour-intensive solution, producing partially the same indicators as the patient-based option for follow-up of trends, as well as the same descriptive results about infections and antimicrobial resistance, but with less possibility for risk-adjusted comparisons.

Case definitions and included patients are the same for both options, but in the patient-based option, risk factors are collected for each patient (infected or not) whereas in the light option, denominator data are aggregated at the unit (ICU) level. Infection data, including antimicrobial resistance data and mortality review data, structure and process indicators (collected at the unit level) are also identical in both options.

Table 1. Comparison between patient-based (standard) and unit-based (light) surveillance options

	Patient-based (standard option)	Unit-based (light option)
Hospital/unit data **(minimum for pilot testing)**	Hospital characteristics ICU characteristics Aggregated denominator data (optional) Structure and process indicators (Form HU)	Hospital characteristics ICU characteristics Aggregated denominator data (required) Structure and process indicators (Form HU)
Patient data	For all patients staying > two days: • risk factors on admission • exposure to invasive devices • antimicrobial use data (optional) (Form PT)	For HAI cases only: demographic data (no separate form, integrated in infection data, form INFb)
Infection data	Case-based HAI and AMR data Relationship death to HAI (optional) (Form INFa)	Case-based HAI and AMR data Relationship death to HAI (optional) (Form INFb)

3. Case definitions of ICU-acquired infections

The minimal requirement for HAI-Net surveillance of ICU-acquired infections is to include bloodstream infection (BSI) and/or pneumonia (PN). It is strongly recommended to include both BSI and PN. Urinary tract infections and catheter-related infections may be added optionally.

3.1 Definition of key terms

3.1.1 ICU-acquired

An infection is considered as ICU-acquired – i.e. healthcare-associated in the ICU - if it occurs in the ICU after more than 48 hours. In practice, all infections with onset from day three onwards in the ICU should be reported. The day of admission to the ICU is counted as day 1.

3.1.2 Second infection episode

To consider an infection as a new infection episode, the combination of a) new signs and symptoms and b) radiographic evidence (for pneumonia) or other diagnostic testing is required.

3.1.3 Device-associated HAI

A device-associated, healthcare-associated infection is an HAI in a patient with a (relevant) device that was used within the 48-hour period before onset of infection (even if it was used only intermittently) [6]. The term 'device-associated' is only used for pneumonia, bloodstream infections, and urinary tract infections. 'Relevant device' refers to intubation, a central vascular catheter or an indwelling urinary catheter. If the interval is longer than 48 hours, there must be compelling evidence that the infection was associated with device use. For catheter-associated UTI, an indwelling urinary catheter must have been in place within seven days before positive laboratory results or signs and symptoms meeting the criteria for UTI were evident.

Example: Pneumonia is defined as intubation-associated pneumonia (IAP) if an invasive respiratory device was present (even intermittently) in the 48 hours preceding the onset of infection.

3.2 Bloodstream infection

3.2.1 Case definition

Patient has at least one positive blood culture for a recognised pathogen

– or –

Patient has at least one of the following signs or symptoms: fever (> 38 °C), chills, or hypotension

And

two positive blood cultures for a common skin contaminant (from two separate blood samples, usually within 48 hours).

Skin contaminants = coagulase-negative staphylococci*, Micrococcus* spp., *Propionibacterium acnes, Bacillus* spp., *Corynebacterium* spp.

3.2.2 Origin of bloodstream infection (BSI)

Both primary (bloodstream infection of unknown origin or catheter-related) and secondary BSI (secondary to another infection site) should be reported. The origin of the BSI should be reported in a different variable:

- Catheter-related: the same microorganism was cultured from the catheter or symptoms improve within 48 hours after removal of the catheter.
  - C-CVC: central venous catheter
  - C-PVC: peripheral venous catheter
  - C-ART: arterial catheter

Note: if microbiologically confirmed, report BSI with origin C-CVC as a CRI3-CVC (see CRI3 definition); if catheter-related infections (CRI) are not included in the surveillance, or if catheter tip culture was not done (only clinical evidence), then report as BSI with origin C-CVC.

- Secondary to another infection: the same microorganism was isolated from another infection site or strong clinical evidence exists that bloodstream infection was secondary to another infection site, invasive diagnostic procedure or foreign body.
  - Pulmonary (S-PUL)
  - Urinary tract infection (S-UTI)
  - Digestive tract infection (S-DIG)
  - Surgical site infection (S-SSI)
  - Skin and soft tissue (S-SST)
  - Other (S-OTH): e.g. central nervous system infection, bone infection (e.g. osteomyelitis, etc.), invasive diagnostic procedure, foreign body
- Unknown (UO): BSI of unknown origin (origin was verified but no source could be found for the BSI).
- Missing, data unavailable (UNK): only use this code if data on the BSI origin is missing.

Notes:

- 'Primary' bloodstream infections include catheter-related BSI and BSI of unknown origin.
- A central line-associated bloodstream infection (CLABSI) according to CDC/NHSN definitions (different from CVC-related BSI) is a primary BSI with central vascular catheter use (even intermittent) in the 48 hours preceding the onset of the infection. Therefore the presence of 'the relevant device' in the 48 hours before onset of infection is collected even in the absence of microbiological confirmation.

3.3 Pneumonia (PN 1–PN 5)

X-ray

Two or more serial chest X-rays or CT-scans with a suggestive image of pneumonia for patients with underlying cardiac or pulmonary disease* (in patients without underlying cardiac or pulmonary disease, one definitive chest X-ray or CT-scan is sufficient).

Symptoms

and at least one of the following:

- fever > 38 °C with no other cause
- leukopenia (< 4 000 WBC/mm3) or leucocytosis (≥ 12 000 WBC/mm3).

and at least one of the following (or at least two, if clinical pneumonia only = PN 4 and PN 5):

- new onset of purulent sputum, or change in character of sputum (colour, odour, quantity, consistency)
- cough or dyspnea or tachypnea
- suggestive auscultation (rales or bronchial breath sounds), rhonchi, wheezing
- worsening gas exchange (e.g. O_2 desaturation or increased oxygen requirements or increased ventilation demand)

and

according to the used diagnostic method:

Microbiology

a) Bacteriologic diagnostic performed by:

Positive quantitative culture from minimally contaminated LRT specimen **(PN 1)**

- broncho-alveolar lavage (BAL) with a threshold of ≥ 10^4 colony forming units (CFU)/ml or ≥ 5% of BAL-obtained cells contain intracellular bacteria on direct microscopic exam (classified on the diagnostic category BAL)
- protected brush (PB Wimberley) with a threshold of ≥ 10^3 CFU/ml
- distal protected aspirate (DPA) with a threshold of ≥ 10^3 CFU/ml.

Positive quantitative culture from possibly contaminated LRT specimen **(PN 2)**

- Quantitative culture of LRT specimen (e.g. endotracheal aspirate) with a threshold of 10^6 CFU/ml.

b) Alternative microbiology methods **(PN 3)**

- positive blood culture not related to another source of infection
- positive growth in culture of pleural fluid
- pleural or pulmonary abscess with positive needle aspiration
- histologic pulmonary exam shows evidence of pneumonia
- positive exams for pneumonia with virus or particular germs (e.g. Legionella, Aspergillus, mycobacteria, mycoplasma, *Pneumocystis jiroveci [previously P. carinii]*):
  - positive detection of viral antigen or antibody from respiratory secretions (e.g. EIA, FAMA, shell vial assay, PCR)
  - positive direct exam or positive culture from bronchial secretions or tissue
  - seroconversion (example: influenza viruses, *Legionella, Chlamydia*)
  - detection of antigens in urine (*Legionella)*.

c) Others

- positive sputum culture or non-quantitative LRT specimen culture **(PN 4)**
- no positive microbiology **(PN 5).**

Notes:

- PN 1 and PN 2 criteria were validated without previous antimicrobial therapy. However, this does not exclude the diagnosis of PN 1 or PN 2 in the case of previous antimicrobial use
- *In case recent chest X-rays are available for patients with underlying cardiac or pulmonary disease, one definitive chest X-ray or CT-scan during the current ICU stay may be sufficient.

Comment

The five subcategories of the definition of pneumonia allow for the comparison of similar types of pneumonia within and between networks (For scientific literature regarding the diagnostic categories, see references [7–8]). It is essential that all ICUs and networks also report PN 4 and PN 5 (clinical pneumonia without microbiological evidence) in order to achieve overall comparability, even if microbiological exams yielded negative results (PN 5). It is also advised, both for clinical and surveillance purposes, that networks promote microbiological confirmation (PN 1–3) as a routine practice in ICUs.

3.4 Urinary tract infection

3.4.1 UTI-A: microbiologically confirmed symptomatic urinary tract infection (UTI)

- Patient has at least one of the following symptoms with no other recognised cause: fever (> 38 °C), urgency, frequency, dysuria, or suprapubic tenderness

and

- Patient has a positive urine culture, i.e. ≥ 10^5 microorganisms per ml of urine with no more than two species of microorganisms.

3.4.2 UTI-B: not microbiologically confirmed symptomatic UTI

- Patient has at least two of the following, with no other recognised cause: fever (> 38 °C), urgency, frequency, dysuria, or suprapubic tenderness;

And at least one of the following:

- positive dipstick for leukocyte esterase and/or nitrate
- pyuria urine specimen with ≥ 10 WBC/ml or ≥ 3 WBC/high-power field of unspun urine
- organisms seen on Gram stain of unspun urine
- at least two urine cultures with repeated isolation of the same uropathogen (Gram-negative bacteria or *S. saprophyticus*) with ≥ 10^2 colonies/ml urine in non-voided specimens
- ≤ 10^5 colonies/ml of a single uropathogen (Gram-negative bacteria or *S. saprophyticus*) in a patient being treated with effective antimicrobial agent for a urinary infection
- physician diagnosis of a urinary tract infection
- physician institutes appropriate therapy for a urinary infection.

Note: UTI-C (asymptomatic bacteriuria) is now excluded from the surveillance of ICU-acquired infections. However, bloodstream infections secondary to asymptomatic bacteriuria are reported as BSI with source (origin) S-UTI.

3.5 Catheter-related infection (CRI)

3.5.1 CRI1-CVC: local CVC-related infection (no positive blood culture)

- Quantitative CVC culture ≥ 10^3 CFU/ml [9] or semi-quantitative CVC culture > 15 CFU [10]

and

- pus/inflammation at the insertion site or tunnel.

3.5.2 CRI2-CVC: general CVC-related infection (no positive blood culture)

- Quantitative CVC culture ≥ 10^3 CFU/ml or semi-quantitative CVC culture > 15 CFU

and

- clinical signs improve within 48 hours after catheter removal.

3.5.3 CRI3-CVC: microbiologically confirmed CVC-related bloodstream infection

- BSI occurring 48 hours before or after catheter removal (if any)

and positive culture with the same microorganism of either:

- quantitative CVC culture ≥ 10^3 CFU/ml or semi-quantitative CVC culture > 15 CFU

or

- quantitative blood culture ratio CVC blood sample/peripheral blood sample > 5 [11,12]
- differential delay of positivity of blood cultures [10]: CVC blood sample culture positive two hours or more before peripheral blood culture (blood samples drawn at the same time) [11,13]
- positive culture with the same microorganism from pus from insertion site.

Notes

- The inclusion of CRIs is optional in the HAI-Net ICU protocol, and the inclusion (or not) should be indicated for each ICU; when CRIs are included, all 3 types of CRI-CVC should be reported
- Central vascular catheter colonisation should not be reported
- A CRI3-CVC is also a bloodstream infection with source C-CVC; however, when a CRI3 is reported, the BSI should not be reported separately; microbiologically confirmed catheter-related BSI should be reported as CRI3
- If CRIs are not included in the (national) surveillance protocol, always report CRI3-CVC as BSI with origin C-CVC
- Infections related to peripheral vascular catheters (arterial or venous) may be reported as CRI1-PVC, CRI2-PVC and CRI3-PVC if case definitions [14,15] are met, or as BSI with origin C-PVC or C-ART.

3.6 Other HAI types

Other HAI types can optionally be included in HAI-Net ICU surveillance. Case definitions for other HAI types (including neonatal case definitions) are published in the HAI-Net point prevalence survey protocol [14] and in the Commission Implementing Decision laying down case definitions for reporting communicable diseases [15]. The code list for other HAI types is provided in Annex 3.

3.7 Other definitions

3.6.1 Central vascular catheter

A central vascular catheter (or central line) is an intravascular catheter that terminates at, or close to, the heart or in one of the great vessels, which is used for infusion, withdrawal of blood or hemodynamic monitoring [16]. The following are considered great vessels for the purpose of reporting central-line BSI and counting central-line days in the NHSN system: aorta, pulmonary artery, superior vena cava, inferior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, external iliac veins, common iliac veins, common femoral veins, and in neonates, the umbilical artery/vein.

Notes

- Neither the insertion site nor the type of device may be used to determine if a line qualifies as a central line. The device must terminate in one of these vessels or in or near the heart to qualify as a central line.
- An introducer is considered an intravascular catheter.
- Pacemaker wires and other non-lumened devices inserted into central blood vessels or the heart are not considered central lines, because fluids are not infused, pushed, nor withdrawn through such devices.

Infusion

The introduction of a solution through a blood vessel via a catheter lumen. This may include continuous infusions such as nutritional fluids or medications, or it may include intermittent infusions such as flushes or IV antimicrobial administration, or blood, in the case of transfusion or haemodialysis.

Umbilical catheter

A central vascular device inserted through the umbilical artery or vein in a neonate.

Temporary central line

A non-tunneled catheter

Permanent central line

This includes tunneled catheters, including certain dialysis catheters; and implanted catheters (including ports).

3.6.2 Type of hospital

Primary

- often referred to as 'district hospital' or 'first-level referral'
- often corresponds to general hospital without teaching function
- few specialities (mainly internal medicine, obstetrics-gynaecology, paediatrics, general surgery or only general practice)
- limited laboratory services are available for general, but not for specialised pathological analysis.

Secondary

- often referred to as 'provincial hospital'
- often corresponds to general hospital with teaching function
- highly differentiated hospital by function with five to 10 clinical specialities, such as haematology, oncology, nephrology, ICU
- takes some referrals from other (primary) hospitals

Tertiary

- often referred to as 'central', 'regional' or 'tertiary-level' hospital
- often corresponds to University hospitals
- highly specialised staff and technical equipment (ICU, haematology, transplantation, cardio-thoracic surgery, neurosurgery)
- clinical services are highly differentiated by function
- specialised imaging units
- provides regional services and regularly takes referrals from other (primary and secondary) hospitals.

Specialised hospital

- single clinical specialty, possibly with sub-specialties
- highly specialised staff and technical equipment
- examples: paediatric hospital, infectious diseases hospital.

4. Data collection

4.1 Eligibility criteria for intensive care units

The intensive care units admitted to the surveillance networks must fit the definition established by the European Society of Intensive Care Medicine [17]:

> 'An ICU is a geographically defined area in the hospital providing care for critically ill patients with specialised personnel and complex equipment. […]
> The ICU is staffed with a specific group of specially trained doctors, nurses and other allied personnel (e.g. physiotherapists, technicians) in appropriate numbers. […]
> The ICU should provide at least facilities for temporary cardiac pacing and invasive haemodynamic monitoring, ventilation supports and pump-controlled administration of infusions. Facilities for blood gas, haemoglobin and electrolyte measurements should be provided in the ICU or in the immediate vicinity. An ICU should function 24 hours a day, seven days a week. There must be at least one doctor immediately available at all times who can deal with all emergencies.'

Neonatal and paediatric ICUs can be included in the network, but results should be separately identified in the analysis.

The aim should be to include as many units as possible. Since the range of units that fall within the definition is too wide, clearly defined subgroups should be established which allow meaningful comparisons between the various ICUs. Criteria for defining these subgroups will be developed through a questionnaire to be filled in by all participating ICUs.

4.2 Inclusion of patients

Only patients staying more than two calendar days are included in the surveillance, according to the following algorithm:

Date of discharge from the ICU – Date of admission to the ICU + 1 > 2

Patients who stay less than three days in the ICU are excluded. These patients add many patient- and device-days to the denominator, but are not at risk of developing an infection after two days in the ICU. Infections which appear after discharge from the ICU (post-discharge) are excluded. Post-discharge surveillance is time-consuming, adds little to the performance of the surveillance system and, in practice, is rarely done.

In the light option (unit-based surveillance), patient-days are included in the denominator if patients have been present for more than two days within the time window of the surveillance, even if they were admitted before the beginning of that period.

In the standard option (patient-based surveillance), patients may be included as follows:

- Prospective inclusion: patients are included if the ICU admission date falls within the time window of the surveillance. After the end of the surveillance period, patients still under follow-up are 'censored' (arbitrarily discharged) at the last day of the month following the end of the surveillance period (e.g. 31 July if surveillance runs from 1 January to 30 June) in order to allow for data encoding and transmission to the national/regional coordination centre. The follow-up of these patients may be completed, and data are sent in for correction, for example at the end of the next surveillance period.
- Retrospective inclusion: patients are included if the ICU discharge date falls within the time window of the surveillance. Censoring is not an issue in this case.

Note: The different inclusion methods result in slightly different denominator data for the same unit during the same surveillance period. In practice, however, these differences are very small. Approximately 2–3% of patients stay longer than 30 days in the ICU, and less than 0.05% stay more than three months. The difference between unit-based and patient-based denominator data, such as patient-days, will decrease as the surveillance period increases.

4.3 Infections under surveillance

All infections with date of onset after day two and later in the ICU should be reported and be regarded as ICU-acquired infections, even if there are reasons to believe that the infection was acquired in another ward or in the community. Infections occurring before day three may be recorded, but will not be included in the analysis. It is recommended to include, as a minimum, data on ICU-acquired bloodstream infection and pneumonia. Urinary tract infections and catheter-related infections are optional.

The HAI types included in the surveillance should be indicated at the ICU surveillance year level. Usually the inclusion of HAI types is defined by the national/regional surveillance protocol, however some countries may leave the choice to the ICUs. At the request of several Member States, the possibility to report other HAI types (other than BSI, PN, UTI and CRI) has been added to the protocol and the HelicsWin.Net software.

In unit-based (light) surveillance, all ICU-acquired infections occurring (date of onset) within the time window of the surveillance period are included, even if the patient was admitted to the ICU before the start of the surveillance period. In patient-based surveillance, infections may occur outside the time window, since the inclusion criterion is either the ICU admission or discharge date of the patient.

4.4 Methods and data sources

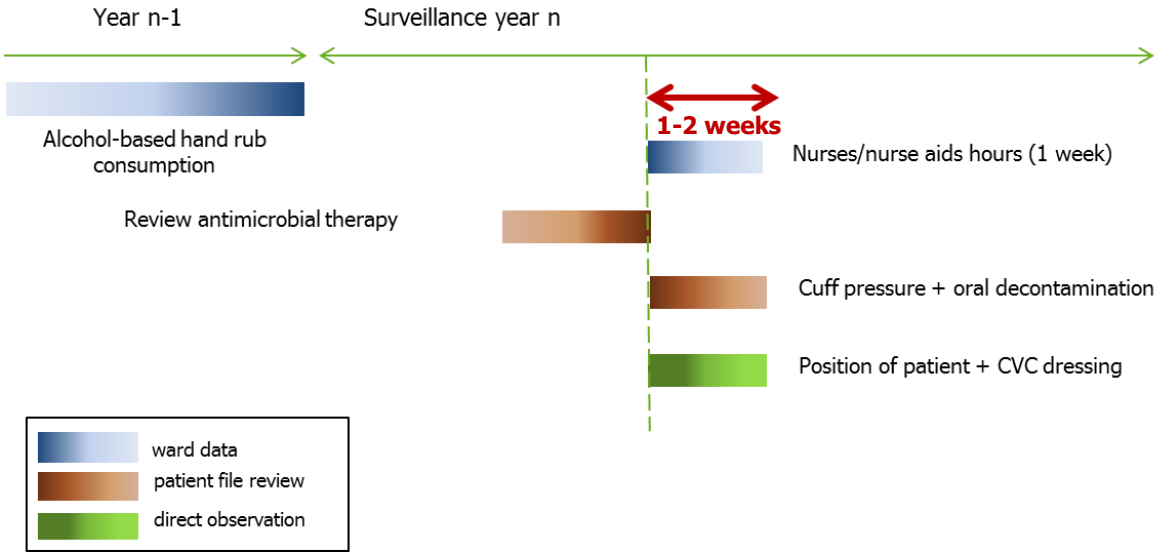
4.4.1 Structure and process indicators

Structure and process indicators should be collected at least once per year for each ICU participating in the surveillance. Data are collected at the unit level (or unit-surveillance period level) in both the standard and the light surveillance options. The data collection for the indicators is estimated to last approximately two weeks, depending on the size of the ICU.

The following priority topics and indicators were selected for the HAI-Net ICU protocol. Methods and data sources differ according to the indicator.

- **Hand hygiene**: **alcohol hand rub consumption during the previous year in the ICU**. The consumption of alcohol-based hand rubs in intensive care units is collected from the hospital pharmacy records for the year prior to the surveillance year.
- **ICU staffing**: registered nurse-to-patient ratio and nursing assistant to patient ratio, calculated based on the actual planning for seven days during the evaluation period.
- **Antimicrobial stewardship**: systematic review of prescribed antimicrobials within 72 hours. The percentage of reviewed antimicrobial therapies within 72 hours is based on a retrospective study of 30 (minimum 20) consecutive antimicrobial prescriptions of more than three days (before the evaluation period).
- Prevention of intubation-associated pneumonia (IAP):
  - endotracheal cuff pressure controlled and/or corrected at least twice a day
  - oral decontamination using oral antiseptics at least twice a day. The percentage of correct cuff pressure and oral decontamination records is collected by 30 consecutive reviews of the files of intubated patients (each patient is observed once per day, the same patient is observed for several consecutive days) during the evaluation period
  - position of the patient not supine (direct observation).
- **Prevention of central line associated bloodstream infection (CLABSI):** CVC maintenance – Catheter site dressing is not damp, loose or visibly soiled (direct observation). The position of the patient and the dressing of the central vascular catheter (CVC) are evaluated through 30 direct observations of patients with intubation and/or a CVC in place respectively (each patient is observed once per day, the same patient may be observed for several consecutive days) during the evaluation period.

Figure 1. Time frame of the data collection for structure and process indicators of HAI/AMR prevention in the ICU



4.4.2. Patient and HAI data

Different data sources should be consulted to determine whether a patient has an infection, such as the patient file (medical and nursing notes), microbiological laboratory and pharmacy databases, X-ray data, ward rounds, clarification of signs and symptoms with the nursing/medical team etc. The need to consult different data sources also depends on whether ICU staff is involved in the data collection as opposed to data collection by the infection prevention and control staff only. For the standard surveillance option, it is recommended that ICU physicians are involved or at least consulted for the collection of patient risk factors on admission. In case automated systems are set up to flag possible infections, it is recommended to confirm with the ICU physician in charge of the patient whether signs and symptoms of an HAI are met. In order to determine the relationship of death to an HAI, it is recommended to consult two physicians.

4.5 Data processing

Each country is at liberty to organise its own system for data collection and processing. The standard surveillance option, however, foresees that data should be collected on forms (see examples provided in this protocol) and subsequently be entered in a computer system by the hospital staff after data verification. Countries may choose to develop and use their own software system to do this. Alternatively, ECDC supports a free software tool (HelicsWin.Net) for data entering at the hospital level [5]. If HelicsWin.Net is used, data should be exported by the hospitals and transferred to the national coordination centre. Data from different hospitals/ICUs can be appended in HelicsWin.Net. National centres will submit the national database to ECDC, using the European Surveillance System (TESSy) system, or make data available to ECDC via other agreed methods. National centres may also submit data from individual hospital/ICUs one by one to TESSy.

4.6 Levels of data requirement

In ECDC's TESSy system, variables are classified according to three levels of requirement:

- **Required true (error) (E):** data will be rejected if this variable is missing (also called 'mandatory')
- **Required true (warning) (W):** variables are required for the correct interpretation of the results and/or for routine analysis; a warning will be produced if this variable is missing (also called 'required')
- **Required false (F):** no error if data are missing; data used for additional analysis (also called 'optional').

5. Hospital/unit data (standard and light options)

Hospital and unit (ICU) data are the same for the standard and light surveillance options and use the same form (Form HU). The only difference is that the aggregated ICU denominator data for patients staying more than two days are optional for the standard option, but mandatory for the light option.

In the TESSy database, hospital and unit data are divided into data to be collected once per surveillance year (first level) and data to be collected for each surveillance period (second level).

5.1 Hospital and unit characteristics – Form HU

Hospital and unit characteristics should be collected once per year.

Hospital code (required): hospital identifier/code is assigned by the national/regional CDI surveillance coordinator. Hospital codes should be unique within each surveillance network, and, if possible, kept constant between the ECDC Antimicrobial Resistance and Healthcare-Associated Infections (ARHAI) surveillance protocols and from one year to the next.

Year (required): surveillance year.

Hospital size (required): total number of beds in the hospital.

Hospital type (required): type of hospital, definition see section 3.6.2. PRIM = Primary; SEC = Secondary; TERT = Tertiary; SPEC = Specialised; UNK = Unknown hospital type.

ICU Id (required): unique identifier for each intensive care unit within a hospital, should remain identical in different surveillance periods/years.

ICU size (required): number of beds in the ICU.

ICU specialty (required): if 80% of the patients belong to a particular category, the ICU falls within that category, otherwise the specialty is 'Mixed'. MIX = Mixed; MED = Medical; SURG = Surgical; CORO = Coronary; BURN = Burns; NEUR = Neurosurgical; PED = Paediatric; NEON = Neonatal; O = Other; UNK = Unknown.

Percentage of intubated patients in the ICU (required): percentage of intubated patients over the past year in the ICU. Measured or estimated average percentage (not: proportion) of patients with an invasive respiratory device over the last year in the current ICU. Number from 0.00 to 100.00. This variable is used as a proxy for severity of ICU case-mix and should also be collected if pneumonia is not included in the surveillance.

HAI types included in the surveillance: indicate which of four HAI types are included in the current ICU surveillance year. Included HAI types should remain constant between different surveillance periods within the same surveillance year. The information is stored in five separate yes/no variables for the inclusion of respectively pneumonia, bloodstream infections, urinary tract infections, catheter-related infections and other HAI types.

5.2 ICU denominator data – Form HU

ICU denominator data should be collected for each surveillance period. Aggregated denominator data are optional except for denominator data for patients staying more than two days in the ICU, which are absolutely required in the light surveillance option.

Surveillance period (required): start and end date of the ICU surveillance period. The recommended minimal surveillance period is three months, maximum one year.

Number of admissions for patients staying more than two days in the ICU: number of new admissions of patients staying more than two days in the intensive care unit during the period. Main denominator for the indicator 'cumulative incidence of HAIs', required for light surveillance; in the standard surveillance option, this variable is optional and allows verifying the exhaustiveness of the entered patient-based data.

Number of patient-days for patients staying more than two days in the ICU: number of patient-days for patients staying more than two days in the intensive care unit during the period. Main denominator for the indicator 'incidence density of HAIs', required for light surveillance; in the standard surveillance option, this variable is optional and allows verifying the sum of patient-days reported on patient level.

Number of admissions, all ICU patients: total number of new admissions in the intensive care unit during the period. Used for burden estimates of HAIs in ICUs, assessing the ICU workload for patients staying one or two days in the ICU and comparing some indicators with ICU surveillance systems that include all ICU patients. Optional, but strongly recommended.

Number of patient-days, all ICU patients: total number of patient-days in the intensive care unit during the period. Used for burden estimates of HAIs in ICUs, assessing the ICU workload for patients staying one or two days in the ICU, comparing some indicators with ICU surveillance systems that include all ICU patients and cross-checking the plausibility of the denominator of the alcohol hand rub consumption and nurse-to-patient ratio indicators. Optional, but strongly recommended.

5.3 Structure and process indicators – Form HU

Structure and process indicators can be collected once per surveillance period (minimum once per year), except for the alcohol hand rub consumption which is always collected once per year, for the previous year.

The indicators included in the current protocol are the selection proposed for the pilot study of the HAI-Net ICU surveillance protocol v2.0. The main objective of the pilot study is to test the feasibility of these indicators.

Alcohol hand rub consumption during the previous year: total number of litres of alcohol-based hand rub delivered to the intensive care unit (usually by the hospital pharmacy) during the previous year.

Total number of patient-days during the previous year: total number of patient-days during the year prior to the current surveillance year (patient-days for all patients, not only for patients staying more than two days in the ICU). Short interruptions are not taken into account. Partial days count as one patient day. This variable is the denominator of the indicator 'alcohol-based hand rub consumption in the ICU per 1 000 patient-days'.

Total number of registered nurse hours in ICU over seven day period: total number of hours of real presence of registered nurses during a period of seven days, including hours of presence during the night (presence of 1 full-time nurse 24/7=168 hours). Only include registered nurses involved in bedside patient care. Students are not included. A 'registered nurse' is a nurse who has graduated from a college's nursing program or from a school of nursing and has passed a national licensing exam to obtain a nursing license. Also include 'agency nurses', 'bank nurses', 'interim nurses' or other registered nurses who are not permanently employed for that position in the hospital.

Total number of nursing assistant hours in ICU over seven day period: total number of hours of real presence of nursing assistants during a period of seven days, including hours of presence during the night (presence of one full-time nursing assistant 24/7=168 hours). Only include nursing assistants involved in bedside patient care. Students are not included. A 'nursing assistant' is also referred to as 'nurses' aide', 'healthcare assistant', 'nursing auxiliary', 'auxiliary nurse', 'patient care assistant' or similar terms. Also include nursing assistants who are not permanently employed for that position in the hospital.

Total number of patient-days over the same seven day period: total number of patient-days (all patients) over the same seven days used for the number of (registered/assistant) nurse hours. Short interruptions are not taken into account. Partial days count as one patient day.

Practice evaluation period: start date and end date of the period during which HAI prevention and antimicrobial stewardship practices are evaluated.

For all indicators assessed by chart review or by direct observations during the practice evaluation period:

- Number of files/observations (# observations) = denominator
- Number of compliant observations (# compliant) = numerator

Antimicrobial stewardship: review antimicrobial therapy within 72 hours (chart review): verify, for 30 (minimum 20) consecutive patients with antimicrobial therapy whether the therapy was evaluated within 72 hours after the start of the antimicrobial and has been documented in the patient file. Only consider first empiric or documented antimicrobial therapies that were started in the current ICU. Only systemic antimicrobial therapy (IV, IM, SC, oral) started since more than 72 hours are eligible for evaluation. Number of observations (denominator) = total number of audited antimicrobial therapies that were started more than three days ago; number compliant (numerator) = number of antimicrobial therapies that were started more than three days ago and were re-assessed within 72 hours after start of the antimicrobial.

Intubation: endotracheal cuff pressure controlled and/or corrected at least twice a day (chart review): Numerator=Number of intubation days (days of patients with intubation) during which the endotracheal cuff pressure was verified and maintained between 20 and 30 cm H_2O (and documented in the patient file) at least twice per day; denominator=Total number of observed intubation days. source: medical or nurse patient file, prospective review of 30 patient-days with intubation. One patient with intubation is included only once a day, but the same patient can be included for several consecutive days.

Intubation: oral decontamination using oral antiseptics at least twice a day (chart review): numerator=number of intubation days (days of patients with intubation) during which oral decontamination with oral antiseptics has been performed (and documented in the patient file) at least twice per day; Denominator=total number of observed intubation days. Source: medical or nurse patient file, prospective review of 30 patient-days with intubation. One patient with intubation is included only once a day, but the same patient can be included for several consecutive days.

Intubation: position of the patient not supine (direct observation): numerator=number of days of patients with intubation during which the patient's position was not supine (= was either prone or recumbent); Denominator=total number of observed intubation days. Source: direct observation of the position of the patient with intubation (in bed), up to 30 patient observations. One patient with intubation is included only once a day, but the same patient can be included for several consecutive days. Observations should as much as possible be perform at the same time during the day (e.g. at 16:00 in the afternoon). Patients in strict supine (dorsal decubitus) position for specific indications (e.g. certain trauma patients) should be excluded.

CVC: Catheter site dressing is not damp, loose or visibly soiled (direct observation): numerator = number of days of patients with a central vascular catheter during which the dressing of the CVC was not loose, damp or visibly soiled; Denominator = total number of observed CVC days. Source: direct observation of 30 patients with at least one CVC in place, up to 30 patient observations. One patient with one or several CVCs is included only once a day, but the same patient can be included for several consecutive days. Observations should as much as possible be perform at the same time during the day (e.g. at 16:00 in the afternoon). For patients with several CVCs in place, all CVC dressings need to be ok (not loose, damp nor visibly soiled).

European Surveillance of ICU-acquired infections
Form HU. Hospital / ICU data (Standard & light option)

Hospital data

Hospital Code ____ **Year:** ____ **Hospital size** (n of beds) ____

Hospital Type: O primary O secondary O tertiary O specialised

ICU characteristics

ICU Id ____ Unique identifier for each intensive care unit within an hospital

ICU size ____ Number of beds in the ICU

ICU specialty O Mixed O Medical O Surgical O Coronary O Burns O Neurosurgical O Pediatric O Neonatal O Other O Unknown

Percentage of intubated patients in year (true or estimated %): ____ %

HAI types included in surveillance: O Pneumonia (PN) O Bloodstream Infections (BSI) O Urinary tract infections (UTI) O Catheter-related infections (CRI) O Other HAI types

ICU indicators and denominators

Surveillance period		All patients		Patients staying >2 days	
Start date	**End date**	N of admissions	N of patient-days	N of admissions	N of patient-days

Recommended minimal surveillance period = 3 months, maximum 1 year; add one form for each period

STRUCTURE AND PROCESS INDICATORS

Alcohol hand rub consumption during the previous year ____ litres

Total number of patient-days during the previous year ____ patient-days

ICU staffing ratio

Total number of registered nurse hours in ICU over 7 day period ____ nurse hours

Total number of nursing assistant hours in ICU over 7 day period ____ nurse hours

Total number of patient-days over the same 7 day period ____ patient-days

Practice evaluation: Start date __ / __ / _____ End date __ / __ / _____

	N of files / observations	**N of compliant observations**
Antimicrobial stewardship: review antimicrobial therapy within 72 hours (chart review)		
Intubation: endotracheal cuff pressure controlled and/or corrected at least twice a day (chart review)		
Intubation: oral decontamination using oral antiseptics at least twice a day (chart review)		
Intubation: position of the patient not supine (direct observation)		
CVC: catheter site dressing is not damp, loose or visibly soiled (direct observation)		

6. Patient-based data (standard option) – Form PT

Patient-based data should be collected in the standard surveillance option, for each patient admitted to the ICU during the surveillance period AND staying more than two days in the ICU.

6.1. ICU admission and discharge data (second level)

Patient counter: numeric Code for each patient, unique within hospital, anonymous. In the HelicsWin.Net software, the patient counter is automatically generated and a second field, which is not exported by default, allows entering an internal patient code. Required.

Age: age of the patient on the date of admission to the ICU (in years). Required.

Gender: gender of the patient. M = Male; F = Female; O = Other; UNK = Unknown. Required.

Date of ICU admission: date of admission in the ICU. Required.

Date of ICU discharge: date the patient was discharged from the ICU or date of in-ICU death or date of last follow-up in the ICU. Required.

ICU discharge outcome: patient status at discharge from the ICU or at end of follow-up in the ICU. A = Alive; D = Dead in ICU; UNK = Unknown. Required.

Origin of the patient: origin of the patient at the time he/she was admitted at the ICU HOSP = Ward in this/other hospital. OICU = Other ICU; COM = Community (patient came from his home, via emergency or not); LTC = Long-term care/nursing home; O = Other; UNK = Unknown.

Type of ICU admission: type of admission as defined in SAPS II score: (medical: no surgery within one week of admission to ICU; scheduled surgical: surgery was scheduled at least 24 hours in advance +/- 7 days ICU admission; unscheduled surgical: patients added to the operating room schedule within 24 hours of the operation. MED = Medical; SSUR = Scheduled surgical; USUR = Unscheduled surgical; UNK = Unknown.

Trauma patient: intensive care unit admission resulted from blunt or penetrating traumatic injury to the patient, with or without surgical intervention. Y = Yes; N = NO; UNK = Unknown.

Impaired immunity: impaired immunity as defined in APACHE II score: impaired immunity due to treatment (chemotherapy, radiotherapy, immune suppression, corticosteroids long duration or high doses recently), due to disease (leukaemia, lymphoma, AIDS), or < 500 PMN/mm3. Y = Yes; N = NO; UNK = Unknown.

Antibiotic treatment in 48 hours before or after ICU admission: specify 'yes' if any antibiotic therapy in the 48 hours preceding ICU admission and/or during the first two days of ICU stay (=antibiotic therapy for an infectious event around ICU admission, excl. antifungal and antiviral treatment) has been given; not: antimicrobial prophylaxis, SDD, local treatment. Y = Yes; N = NO; UNK = Unknown

SAPS II score: simplified Acute Physiology Score II on admission (first 24h of ICU stay). Severity of illness score developed to predict mortality. Integer number from 0 to 163.

Other severity score name and value: add another severity of illness score and the corresponding value. Possible scores [and possible values]: APACHE = Acute Physiology and Chronic Health Evaluation score (APACHE II [0-71], APACHE III [0-299], APACHE IV [0-286]), MPM = Mortality Prediction Model (MPM II [0-100], MPM III [0-100]), McCabe score [0=non-fatal (survival >= 5 years); 1=ultimately fatal (survival < 5 years), 2=rapidly fatal (survival<1 year); 9=unknown], SAPS 3 [0-217]; ASA = Physical Status Classification System of the American Society of Anesthesiology [1=normally healthy patient, 2=patient with mild systemic disease, 3=patient with severe systemic disease that is not incapacitating, 4=patient with an incapacitating systemic disease that is a constant threat to life, 5=moribund patient who is not expected to survive for 24 hours with or without operation]; Paediatric scores: PIM = Paediatric Index of Mortality (PIM [0-100], PIM II [0-100]); PRISM = Paediatric Risk of Mortality score (PRISM [0-75], PRISM III, PRISM IV); Neonatal score: CRIB = Clinical Risk Index for Babies (CRIB [0-23], CRIB II [0-27]), SNAP = Score for Neonatal Acute Physiology [0-127]; PDEATH = Predicted mortality probability derived from any score [0-100].

Optional variables for neonates (infants less than one month old):

- **Birth weight:** birth weight in grams; the birth weight is the weight of the infant at the time of birth and should not be changed as the infant gains or loses weight.
- **Gestational age:** gestational age in weeks (at time of birth)

Central vascular catheter in ICU: patient had a central vascular catheter during the current ICU stay; if yes, fill dates in corresponding exposure data. Y = Yes; N = NO; UNK = Unknown. Required.

Intubation in ICU: patient was intubated (invasive respiratory device) during the current ICU stay; if yes, fill dates in corresponding exposure data. Y = Yes; N = NO; UNK = Unknown. Required.

Urinary catheter in ICU: patient had indwelling urinary catheter during the current ICU stay; if yes, fill dates in corresponding exposure data. Y = Yes; N = NO; UNK = Unknown. Required if UTI is included in surveillance.

Antimicrobial received during ICU stay: patient received any antimicrobial during ICU stay. If yes, fill corresponding antimicrobial use data. Y = Yes; N = NO; UNK = Unknown. Optional.

Patient has at least one HAI included in surveillance: patient has at least one healthcare-associated infection (with onset on day three or later, see definition) included in the current surveillance-year. If yes, fill out an HAI form for each infection. Y = Yes; N = NO; UNK = Unknown. Required.

6.2 Exposure data (third level)

In the standard surveillance option, different types of data are attached to the patient (ICU admission) level. Exposure data (RecordType HAIICUPTEXP) contain information on invasive device use and are collected by episode and by type of invasive device.

ParentId/patient counter: numeric Code for each patient, unique within hospital, anonymous. Necessary to make the link between infections and patient data (second level). In the HelicsWin.Net software, the patient counter is automatically generated and should not be entered again for the exposure data. Required.

Type of exposure: type of exposure (invasive device) for this exposure episode entry. In case of stop and restart of an exposure type on the same day (e.g. re-intubation), start a new exposure episode. Overlapping exposure episodes are allowed for CVC (more than one CVC on the same day), but not for intubation or indwelling urinary catheters. Urinary catheter episodes are only required when UTIs are included in the surveillance year. In HelicsWin.Net, the type of exposure is automatically generated. CVC = Central vascular catheter; INT = Intubation; UC = Urinary catheter.

Exposure start date: start date exposure episode within the ICU.

Exposure end date: end date exposure episode within the ICU.

6.3 Antimicrobial use data (third level)

Patient-based data on antimicrobial use in the ICU (RecordType HAIICUPTAM) are optional in the HAI-Net ICU protocol and can only be collected in the standard surveillance option. They are collected by episode and for each antimicrobial agent and indication.

ParentId/patient counter: numeric Code for each patient, unique within hospital, anonymous. Necessary to make the link between infections and patient data (second level). In the HelicsWin.Net software, the patient counter is automatically generated and should not be entered again. Required.

Antimicrobial start date: start date within the ICU of this antimicrobial agent/indication (days before ICU admission should not be reported). For antimicrobials present on admission, enter date of ICU admission.

Antimicrobial end date:end date within the ICU of this antimicrobial agent/indication (days after ICU discharge should not be reported). For antimicrobials continued after discharge, enter date of ICU discharge.

Antimicrobial ATC5 code: antimicrobial coded as ATC5 code, include ATC2 classes J01 antibacterials, J02 antifungals and ATC4 A07AA, P01AB, D01BA and ATC5 J04AB02. See ATC5 list in Annex.

Indication for antimicrobial use: indication for use of this antimicrobial episode. Mandatory if antimicrobial use data are reported. If the indication changes (e.g. from empiric treatment to documented treatment), enter a new line, even if the antimicrobial has not changed. If the same antimicrobial (ATC5 code) is used for different indications, enter a line for each indication. P=Prophylaxis; E=Empiric treatment (not based on microbiological results); M=Documented treatment (based on microbiological results with or without antimicrobial susceptibility results); S=Selective digestive decontamination; O=Other; UNK=Unknown.

Indication specification: optional specification of indication for antimicrobial use according to HAI-Net PPS categories. Patient receives systemic antimicrobials for:

- treatment intention: CI: community-acquired infection; LI: infection acquired in long-term care facility (e.g. nursing home) or chronic-care hospital; HI: acute-hospital-acquired infection.
- surgical prophylaxis: SP1: single dose; SP2: one day; SP3: > 1 day: check if given in the 24 hours prior to ICU admission – if yes, check if given on the day before as well.
- MP. Medical prophylaxis.
- O. Other indication (e.g. erythromycin use as a prokinetic agent).
- UI. Unknown indication/reason (verified during PPS).
- UNK. Unknown/missing, information on indication was not verified during PPS.

Diagnosis site: anatomical site of treated infection (diagnosis) or target infection site for prophylaxis: see site code list. Optional.

European Surveillance of ICU-acquired infections
Form PT. Patient-based data (Standard option)

Hospital code ____ Patient Counter ____

ICU code (abbr name) ____

Patient data

Age in years: ____ yrs **Gender:** M F UNK **Date of ICU admission:** ___ / ___ / _____

Date of ICU discharge ___ / ___ / _____ **ICU discharge outcome:** O Alive O Dead O UNK

Origin of the patient O Ward this/oth hosp O Other ICU O Community O LTCF O Other O UNK

Type of admission: O medical O scheduled surgical O unscheduled surgical O UNK

Trauma: O Yes O No O UNK **Impaired immunity:** O Yes O No O UNK

Antimicrobial treatment *+/- 48 Hrs around admission* : O Yes O No O UNK

SAPS II score: ____ **Other severity score name*:** ____

Other severity score value: ____

** Other severity scores: APACHE II-IV, SAPS 3, MPM II-III, ASA score, McCabe score, PIM, PIM II, PRISM, PRISM III-IV, CRIB, CRIB II, SNAP, PDEATH (predicted mortality probability 0-100)*

Neonates (optional) : **Birth weight:** _____ grams **Gestational age:** _____ weeks

Exposure to invasive devices in the ICU

Central vascular catheter in ICU: O Yes O No O Unk
If Yes: Start Date 1 : ___ / ___ / _____ End Date 1: ___ / ___ / _____
Start Date 2 : ___ / ___ / _____ End Date 2: ___ / ___ / _____

Intubation in ICU: O Yes O No O Unk
If Yes: Start Date 1 : ___ / ___ / _____ End Date 1: ___ / ___ / _____
Start Date 2 : ___ / ___ / _____ End Date 2: ___ / ___ / _____

Urinary catheter in ICU: O Yes O No O Unk
If Yes: Start Date 1 : ___ / ___ / _____ End Date 1: ___ / ___ / _____
Start Date 2 : ___ / ___ / _____ End Date 2: ___ / ___ / _____

Patient received antimicrobial(s) during ICU stay (optional) O Yes O No O Unkown

Antimicrobial name or ATC5	Ind1	Start date	End Date	Ind2	Site

Ind1: Indication (required): **P:** prophylaxis **E:** empiric treatment **M:** documented treatment **S:** SDD (Selective Digestive Decontamination); **Ind2**: Indication specification (HAI-Net PPS categories), optional: treatment intention for community (CI), long-term care (LI) or acute hospital (HI) infection; surgical prophylaxis: SP1: single dose, SP2: one day, SP3: >1 day; MP: medical prophylaxis; O: other; UI: Unknown indication; **Site**: site of diagnosed infection or target infection site for prophylaxis, optional (see site list in annex).

Patient has at least one HAI included in surveillance O Yes O No O Unknown

if yes, fill out heathcare-associated infection (HAI) form

7. HAI data (standard and light options) – Form INF

7.1. Infection data (third level)

Healthcare-associated infection (HAI) data (RecordTypes HAIICUPTINF and HAIICULIGHT$DENO$INF) are collected for each infection episode, by type of infection. More information can be found in Section 3.1 for distinguishing between different infection episodes. HAI data are the same in the standard (Form INFa) and light (Form INFb) surveillance options, except for a few demographic patient variables that are added for each HAI in light surveillance.

ParentId/patient counter: anonymous patient number. Necessary to make the link between infections and second level data. In the HelicsWin.Net software, the patient counter is automatically generated and should not be entered again. Required.

Demographic variables (Light surveillance option only):

- **Age**: age of the patient on the date of admission to the ICU (in years). Required.
- **Gender**: gender of the patient. M = Male; F = Female; O = Other; UNK = Unknown. Required.
- **Date of ICU admission**: date of admission in the ICU. Required.
- **Date of ICU discharge**: date the patient was discharged from the ICU or date of in-ICU death or date of last follow-up in the ICU. Required.

Date of infection onset: date of onset of symptoms or, if unknown, date treatment was started or date first diagnostic examination was done. Required.

Case definition code (Site of infection): required. Site of infection according the case definition (including subcategory), taking into account signs and symptoms of the entire infection episode (not just day one of the HAI). See Chapter 3 for case definitions. BSI = Bloodstream infection; PN = Pneumonia (unknown subcategory); PN1 = Pneumonia (protected sample + quantitative culture); PN2 = Pneumonia (non-protected sample (ETA) + quantitative culture); PN3 = Pneumonia (alternative microbiological criteria); PN4 = Pneumonia (sputum bacteriology or non-quantitative ETA); PN5 = Pneumonia (no microbiology); UTI = Symptomatic urinary tract infection (unknown subcategory); UTI-A = Symptomatic urinary tract infection (microbiologically confirmed); UTI-B = Symptomatic urinary tract infection (not microbiologically confirmed); CRI1-CVC = CVC-related infection (local); CRI2-CVC = CVC-related infection (generalised no positive haemoculture); CRI3-CVC = CVC-related infection (generalised with positive haemoculture); [optional: infections related to peripheral vascular catheters: CRI1-PVC = PVC-related infection (local); CRI2-PVC = PVC-related infection (generalised no positive haemoculture); CRI3-PVC = PVC-related infection (generalised with positive haemoculture)]. If catheter-related infections (CRIs) are included in the surveillance, report a CVC-related BSI corresponding to the case definition of CRI3-CVC as CRI3-CVC (do not report twice); OTH=Other HAI type. Other infection sites can be included in the HelicsWin.Net software.

Other case definition code: optional. Specify other case definition code, see list in Annex.

Relevant invasive device in situ before onset: relevant invasive device was present (even intermittently) in the 48 hours preceding the infection (seven days for UTIs): intubation for pneumonia, central vascular catheter for bloodstream infection, urinary catheter for urinary tract infections. Necessary to distinguish device-associated infections. Y = Yes; N = No; UNK = Unknown. Required.

BSI: source of BSI: source/origin of the bloodstream infection, required if the case definition code is BSI. C = The same microorganism was cultured from the catheter or symptoms improve within 48 hours after removal of the catheter. Exception: Report microbiologically confirmed CVC-related BSI as CRI3-CVC if optional CRIs are included in the surveillance. C = Catheter, catheter type unknown; C-CVC = Central venous catheter; C-PVC = Peripheral venous catheter; C-ART = Arterial catheter; S = Secondary to another site, primary site unknown; S-PUL = Pulmonary infection; S-UTI = Urinary tract infection; S-SSI = Surgical site infection; S-DIG = Digestive tract infection; S-SST = Skin/Soft Tissue infection; S-OTH = Other infection or procedure; UO= None of the above, BSI of unknown origin; UNK=Unknown/Missing.

Patient ICU outcome (relationship to HAI): relationship of HAI to ICU outcome in patients with HAI.

- **Discharged alive:** patient was discharged alive; OR patient was still in the hospital and alive at end of follow-up during this hospital stay.
- **Death, HAI definitely contributed to death:** use this category if a causal link between CDI and death can be demonstrated.
- **Death, HAI possibly contributed to death:** use this category if no causal link between CDI and this case's death can be demonstrated, but it is still plausible that CDI was at least a contributory factor.
- **Death, unrelated to HAI:** use this category if the cause of death can be demonstrated not to be related to CDI.
- **Death, relationship to HAI unknown:** use this category if no evidence of contributory factors to the cause of death is available.
- **Unknown**: unknown patient outcome.

7.2 Microorganism and antimicrobial resistance data (fourth level)

Microorganisms and antimicrobial resistance data (RecordType HAIICUPTINF$RES) for a given infection episode are reported at the fourth level. Although the data format allows reporting of any bug-drug combination in a flexible way, the protocol defines a list of minimal and recommended markers (target list) for antimicrobial resistance in ICU-acquired infections. Networks may also choose to report extended antimicrobial resistance data, which allows for a more detailed description of the AMR epidemiology (e.g. combined resistance, etc.). However, the main emphasis should be on the target AMR list given below. See Annex 4 for extended AMR test codes.

Microorganism (isolate result): microorganism (MO) six letter code or negative code including reason why the isolate result is not available. _NA = Results not available; _NOEXA = Examination not done; _NONID = Microorganism not identified; _STERI = Sterile examination. See Code list in Annexes 2 and 3. It is recommended to use the extended microorganism list, even though minimal list codes are also allowed. Minimum one code per HAI is required, the recommended maximum per HAI is three microorganisms.

Antibiotic: antibiotic code. Antimicrobial drug for which susceptibility was tested, depends on the microorganism. In the HelicsWin.Net software, recommended antimicrobial codes are automatically generated. _NOTEST=No antimicrobial susceptibility data available.

Minimal and recommended antimicrobial resistance markers in the ICU

Staphylococcus aureus (STAAUR)

- Oxacillin (OXA) – **required (minimal)**

Note: following antibiotics are equivalent to oxacillin as markers of MRSA and can also be reported: meticillin (MET), cloxacillin (CLO), dicloxacillin (DIC), flucloxacillin (FLC) and cefoxitin (FOX)

- Glycopeptides (GLY) (vancomycin/VAN, teicoplanin/TEC) **– required (minimal)**

Enterococci

- Aminopenicillins (AMP) (ampicillin/AMP and/or amoxicillin/AMX) – recommended
- Glycopeptides (GLY) (vancomycin/VAN, teicoplanin/TEC) **– required (minimal)**

Enterobacteriaceae *(Escherichia coli, Klebsiella* spp.*, Enterobacter* spp.*, Proteus* spp.*, Citrobacter* spp.*, Serratia* spp., *Morganella* spp.*)*

- Amoxicillin-clavulanic acid (AMC) - recommended
- Third-generation cephalosporins (C3G) (cefotaxim/CTX, ceftriaxone/CRO, ceftazidime/CAZ) – **required (minimal)**
- Carbapenems (CAR) (imipenem/IPM, meropenem/MEM, doripenem/DOR) – required (minimal)
- Colistin (COL) – recommended

P. aeruginosa

- Piperacillin-tazobactam (TZP) - recommended
- Ceftazidime (CAZ) - recommended
- Carbapenems (CAR) (imipenem/IPM, meropenem/MEM, doripenem/DOR) **– required (minimal)**
- Colistin (COL) - recommended

Acinetobacter spp.

- Sulbactam (SUL) - recommended
- Ceftazidime (CAZ) - recommended
- Carbapenems (CAR) (imipenem/IPM, meropenem/MEM, doripenem/DOR) **– required (minimal)**
- Colistin (COL) - recommended

SIR: Final interpretation result of all different susceptibility tests performed. If antibiotic code is _NOTEST, SIR=NA.S = Susceptible; I = Intermediate; R = Resistant; UNK = Unknown; NA = Not applicable. Required.

PDR: Pandrug-resistant microorganism [18].

- N = not PDR: susceptible to at least one antimicrobial agent tested
- P = possible PDR: non-susceptible (intermediate or resistant) to all antimicrobial agents tested in the hospital
- C = confirmed PDR: non-susceptible (intermediate or resistant) to all agents in all antimicrobial categories, confirmed by a reference or other clinical microbiology laboratory testing a supplemental panel of antimicrobial agents beyond those routinely tested, in accordance with the definitions by microorganism published in reference [18]
- UNK=unknown

European Surveillance of ICU-acquired infections
Form INFa. HAI and AMR data (Standard option)

Patient Counter

ICU-acquired infections

	HAI 1		HAI 2		HAI 3	
Case definition code						
Relevant device in situ before onset*	O Yes O No O Unknown		O Yes O No O Unknown		O Yes O No O Unknown	
Date of onset	___ / ___ / _____		___ / ___ / _____		___ / ___ / _____	
BSI: source of BSI**						
	MO-code	PDR	MO-code	PDR	MO-code	PDR
Micro-organism 1						
Micro-organism 2						
Micro-organism 3						

*relevant device use (intubation for PN, CVC for BSI, urinary catheter for UTI) in 48 hours before onset of infection (even intermittent use), 7 days for UTI; ** C-CVC, C-PVC, C-ART, S-PUL, S-UTI, S-DIG, S-SSI, S-SST, S-OTH, UNK; MO-code: microorganism code; PDR: pandrug-resistant: Not PDR =N (susceptible to at least 1 antimicrobial), Possible PDR = P (I or R to all antimicrobials tested in hospital), Confirmed PDR = C (I/R to all antimicrobials confirmed by reflab), U=Unknown)

Patient ICU outcome: O discharged alive O death, HAI definitely contributed to death
O death, HAI possibly contributed to death O death, no relation to HAI O death, relationship to HAI unknown

Target antimicrobial resistance data in ICU-acquired infections

HAI1:	MO-Code	AB1	SIR1	AB2	SIR2	AB3	SIR3	AB4	SIR4	**PDR**
Staphylococcus aureus		**OXA**		**GLY**						
Enterococcus spp.		AMP		**GLY**						
Enterobacteriaceae		AMC		**C3G**		**CAR**		COL		
		AMC		**C3G**		**CAR**		COL		
P.aeruginosa		TZP		CAZ		**CAR**		COL		
Acinetobacter spp.		SUL		CAZ		**CAR**		COL		

SIR: S,I,R or U; PDR: N,P,C or U

HAI2:	MO-Code	AB1	SIR1	AB2	SIR2	AB3	SIR3	AB4	SIR4	**PDR**
Staphylococcus aureus		**OXA**		**GLY**						
Enterococcus spp.		AMP		**GLY**						
Enterobacteriaceae		AMC		**C3G**		**CAR**		COL		
		AMC		**C3G**		**CAR**		COL		
P.aeruginosa		TZP		CAZ		**CAR**		COL		
Acinetobacter spp.		SUL		CAZ		**CAR**		COL		

SIR: S,I,R or U; PDR: N,P,C or U

HAI3:	MO-Code	AB1	SIR1	AB2	SIR2	AB3	SIR3	AB4	SIR4	**PDR**
Staphylococcus aureus		**OXA**		**GLY**						
Enterococcus spp.		AMP		**GLY**						
Enterobacteriaceae		AMC		**C3G**		**CAR**		COL		
		AMC		**C3G**		**CAR**		COL		
P.aeruginosa		TZP		CAZ		**CAR**		COL		
Acinetobacter spp.		SUL		CAZ		**CAR**		COL		

Bold=minimal resistance data; SIR: S=susceptible, I=intermediate resistance, R=resistant, U=unknown
Antibiotic codes: AMC: amoxicillin-clavulanic acid, AMP: ampicillin, C3G: third-generation cephalosporins (cefotaxim/ cetriaxone/ceftazidim), CAR: carbapenems (imipenem/meropenem/doripenem), CAZ: ceftazidime, COL: colistin, GLY: glycopeptides (vancomycin, teicoplanin), OXA: oxacillin, SUL: Sulbactam; TZP: piperacillin-tazobactam;
PDR: pandrug resistance: N=not PDR, P=possible, C=confirmed, U=unknown

European Surveillance of ICU-acquired infections
Form INFb. HAI and AMR form (Light option)

Patient counter:

Date of admission in ICU: ___ / ___ / _____

Age in years: ____ yrs **Gender:** M F UNK **Date of ICU discharge:** ___ / ___ / _____

Patient ICU outcome: O discharged alive O death, HAI definitely contributed to death
O death, HAI possibly contributed to death O death, no relation to HAI O death, relationship to HAI unknown

ICU-acquired infections

	HAI 1		**HAI 2**		**HAI 3**	
Case definition code						
Relevant device in situ before onset*	O Yes O No O Unknown		O Yes O No O Unknown		O Yes O No O Unknown	
Date of onset	___ / ___ / _____		___ / ___ / _____		___ / ___ / _____	
BSI: source of BSI**						
	MO-code	PDR	MO-code	PDR	MO-code	PDR
Micro-organism 1						
Micro-organism 2						
Micro-organism 3						

*relevant device use (intubation for PN, CVC for BSI, urinary catheter for UTI) in 48 hours before onset of infection (even intermittent use), 7 days for UTI; ** C-CVC, C-PVC, C-ART, S-PUL, S-UTI, S-DIG, S-SSI, S-SST, S-OTH, UNK; MO-code: microorganism code; PDR: pandrug-resistant: Not PDR =N (susceptible to at least 1 antimicrobial), Possible PDR = P (I or R to all antimicrobials tested in hospital), Confirmed PDR = C (I/R to all antimicrobials confirmed by reflab), U=Unknown)

Target antimicrobial resistance data in ICU-acquired infections

HAI1:	MO-Code	AB1	SIR1	AB2	SIR2	AB3	SIR3	AB4	SIR4	**PDR**
Staphylococcus aureus		**OXA**		**GLY**						
Enterococcus spp.		AMP		**GLY**						
Enterobacteriaceae		AMC		**C3G**		**CAR**		COL		
		AMC		**C3G**		**CAR**		COL		
P.aeruginosa		TZP		CAZ		**CAR**		COL		
Acinetobacter spp.		SUL		CAZ		**CAR**		COL		

SIR: S,I,R or U; PDR: N,P,C or U

HAI2:	MO-Code	AB1	SIR1	AB2	SIR2	AB3	SIR3	AB4	SIR4	**PDR**
Staphylococcus aureus		**OXA**		**GLY**						
Enterococcus spp.		AMP		**GLY**						
Enterobacteriaceae		AMC		**C3G**		**CAR**		COL		
		AMC		**C3G**		**CAR**		COL		
P.aeruginosa		TZP		CAZ		**CAR**		COL		
Acinetobacter spp.		SUL		CAZ		**CAR**		COL		

SIR: S,I,R or U; PDR: N,P,C or U

HAI3:	MO-Code	AB1	SIR1	AB2	SIR2	AB3	SIR3	AB4	SIR4	**PDR**
Staphylococcus aureus		**OXA**		**GLY**						
Enterococcus spp.		AMP		**GLY**						
Enterobacteriaceae		AMC		**C3G**		**CAR**		COL		
		AMC		**C3G**		**CAR**		COL		
P.aeruginosa		TZP		CAZ		**CAR**		COL		
Acinetobacter spp.		SUL		CAZ		**CAR**		COL		

Bold=minimal resistance data; SIR: S susceptible, I intermediate resistance, R resistant, U unknown
Antibiotic codes: AMC: amoxicillin-clavulanic acid, AMP: ampicillin, C3G: third-generation cephalosporins (cefotaxim/ cetriaxone/ceftazidim), CAR: carbapenems (imipenem/meropenem/doripenem), CAZ: ceftazidime, COL: colistin, GLY: glycopeptides (vancomycin, teicoplanin), OXA: oxacillin, SUL: Sulbactam; TZP: piperacillin-tazobactam; PDR: pandrug resistance: N=not PDR, P=possible, C=confirmed, U=unknown

8. Outcome indicators of ICU-acquired infections

Unit-based (light) surveillance represents the minimal dataset to be collected and is intended for continuous surveillance. The denominator is collected at the level of the unit and consists in the number of patient-days for patients staying longer than two days in the ICU (unit-based surveillance).

Unit indicators are intended for the follow-up of indicators within the same unit and for regional, national and international follow-up of infection trends and possibly for pathogen-specific infection rates, such as incidence density by type of ICU or by percentage of intubated patients in the ICU (proxy for case-mix severity). They offer limited inter-unit comparability but only when stratified by type of ICU or by the case-mix severity, approximated by the percentage of intubated patients.

Patient-based (standard option) surveillance is intended for advanced risk-adjusted comparisons of infection rates between ICUs, such as the device-associated infection rate and the standardised infection ratio, as a measure of quality of care in terms of infection control. Risk factors are collected for every patient staying more than two days in the ICU, whether infected or not. In order to obtain sufficient precision of indicators for a single ICU, a surveillance period of three to six months is recommended, depending on the size of the ICU.

The list of HAI outcome indicators (comparing standard vs. light surveillance options) can be found in Annex 6.

9. Confidentiality

9.1 Patient confidentiality

It will not be possible to identify individual ICU patients with or without an HAI in the European database through coding of patient information at the hospital level or at the level of the official networks in the countries. However, for validation purposes, the hospitals should be able to trace back patients based on anonymous unique patient numbers.

9.2 Hospital and unit confidentiality

A unique code is assigned to each hospital (unit) by the national surveillance system. This unique code will be used for correspondence and feedback. The key, which links each hospital (unit) to the code submitted to ECDC remains strictly within the national surveillance system to guarantee confidentiality. It is not to be transmitted to any other organisation under any circumstance.

9.3 Publication policy

Data will be published in ECDC's online infectious disease surveillance summaries (replacing the previously published Annual Epidemiological Reports), in disease-specific reports on HAI surveillance and as scientific publications. If requested by a national surveillance network, publications have to acknowledge the data source (i.e. the national surveillance networks) and provide contact information.

References

1. Official Journal of the European Union. Council recommendation of 9 June 2009 on patient safety, including the prevention and control of healthcare-associated infections (HAI) (2009/C 151/01). Available from http://ec.europa.eu/health//sites/health/files/patient_safety/docs/council_2009_en.pdf
2. Official Journal of the European Communities Decision No. 2119/98/EC of the European Parliament and of the Council of 24 September 1998 setting up a network for the epidemiological surveillance and control of communicable diseases in the Community. 1998:L268/1-6.
3. Official Journal of the European Communities Decision No 1082/2013/EU of the European Parliament and of the Council of 22 October 2013 on serious cross-border threats to health and repealing Decision No 2119/98/EC. 2013:L293/1-15.
4. European Centre for Disease Prevention and Control. European surveillance of healthcare-associated infections in intensive care units – HAI-Net ICU protocol, version 1.02. Stockholm: ECDC; 2015. Available from http://ecdc.europa.eu/en/publications/Publications/healthcare-associated-infections-HAI-ICU-protocol.pdf
5. European Centre for Disease Prevention and Control. HelicsWin.Net software. Available from http://ecdc.europa.eu/en/healthtopics/healthcare-associated_infections/helicswin-net/Pages/HELICSWinNet-download-page-HWN.aspx
6. Horan TC, Emori TG. Definitions of key terms used in the NNIS System. Am J Infect Control. 1997 Apr;25(2):112-6.
7. Chastre J, Fagon JY, Bornet-Lecso M, Calvat S, Dombret MC, al Khani R et al.. Evaluation of bronchoscopic techniques for the diagnosis of nosocomial pneumonia. Am J Respir Crit Care Med. 1995
8. Rea-Neto A, Youssef NC, Tuche F, Brunkhorst F, Ranieri VM, Reinhart K et al.. Diagnosis of ventilator-associated pneumonia: a systematic review of the literature. Crit Care. 2008; 12(2):R56.
9. Brun-Buisson C, Abrouk F, Legrand P, Huet Y, Larabi S, Rapin M. Diagnosis of central venous catheter-related sepsis. Critical level of quantitative tip cultures. Arch Intern Med 1987; 147(5):873-877.
10. Maki DG, Weise C, Sarafin H. A semiquantitative culture method for identifying intravenous-catheter-related infection. N Engl J Med 1977; 296:1305-1309.
11. Blot F, Nitenberg G, Brun-Buisson C. New tools in diagnosing catheter-related infections. Support Care Cancer 2000; 8(4):287-292.
12. Quilici N, Audibert G, Conroy MC, Bollaert PE, Guillemin F, Welfringer P et al. Differential quantitative blood cultures in the diagnosis of catheter-related sepsis in intensive care units. Clin Infect Dis 1997; 25(5):1066-1070.
13. Raad I, Hanna HA, Alakech B, Chatzinikolaou I, Johnson MM, Tarrand J. Differential time to positivity: a useful method for diagnosing catheter-related bloodstream infections. Ann Intern Med. 2004 Jan 6; 140(1):18-25.
14. European Centre for Disease Prevention and Control. Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals – protocol version 5.3. Stockholm: ECDC; 2016.
15. Commission Implementing Decision 2012/506/EU of 8 August amending Decision 2002/253/EC laying down case definitions for reporting communicable diseases to the Community network under Decision No 2119/98/EC of the European Parliament and of the Council. OJ L 262/1; 27.9.2012
16. National Healthcare Safety Network (NHSN), Centers for Disease Control and Prevention. Guidelines and procedures for monitoring CLABSI. Atlanta: CDC; 2010. Available from: http://www.cdc.gov/nhsn/PDFs/pscManual/4PSC_CLABScurrent.pdf
17. European Society of Intensive Care Medicine Guidelines for the utilisation of intensive care units.. Intensive Care Med. 1994; 20(2):163-4.
18. Magiorakos AP, Srinivasan A, Carey RB, Carmeli Y, Falagas ME, Giske CG,et al.. Multidrug-resistant, extensively drug-resistant and pandrug-resistant bacteria: an international expert proposal for interim standard definitions for acquired resistance. Clin Microbiol Infect. 2012 Mar; 18(3):268-81.

Annex 1. Microorganisms code list

The microorganism code list is a selection of microorganisms based on their frequency of occurrence in HAIs and/or on their public health importance. The minimal list represents the minimal level of detail that should be provided by every network.

Microorganism selection and minimal list

	Microorganism	Code	Minimal list
Gram-positive cocci	*Staphylococcus aureus*	STAAUR	**STAAUR**
	Staphylococcus epidermidis	STAEPI	**STACNS**
	Staphylococcus haemolyticus	STAHAE	
	Coag-neg. staphylococci, not specified	STACNS	
	Other coagulase-negative staphylococci (CNS)	STAOTH	
	Staphylococcus spp., not specified	STANSP	**GPCTOT**
	Streptococcus pneumoniae	STRPNE	**STRSPP**
	Streptococcus agalactiae (B)	STRAGA	
	Streptococcus pyogenes (A)	STRPYO	
	Other haemol. Streptococcae (C, G)	STRHCG	
	Streptococcus spp., other	STROTH	
	Streptococcus spp., not specified	STRNSP	
	Enterococcus faecalis	ENCFAE	**ENCSPP**
	Enterococcus faecium	ENCFAI	
	Enterococcus spp., other	ENCOTH	
	Enterococcus spp., not specified	ENCNSP	
	Gram-positive cocci, not specified	GPCNSP	**GPCTOT**
	Other Gram-positive cocci	GPCOTH	
Gram-negative cocci	*Moraxella catarrhalis*	MORCAT	**GNCTOT**
	Moraxella spp., *other*	MOROTH	
	Moraxella spp., *not specified*	MORNSP	
	Neisseria meningitidis	NEIMEN	
	Neisseria spp., other	NEIOTH	
	Neisseria spp., not specified	NEINSP	
	Gram-negative cocci, not specified	GNCNSP	
	Other Gram-negative cocci	GNCOTH	
Gram-positive bacilli	*Corynebacterium* spp.	CORSPP	**GPBTOT**
	Bacillus spp.	BACSPP	
	Lactobacillus spp.	LACSPP	
	Listeria monocytogenes	LISMON	
	Gram-positive bacilli, not specified	GPBNSP	
	Other Gram-positive bacilli	GPBOTH	
Enterobacteriaceae	*Citrobacter freundii*	CITFRE	**CITSPP**
	Citrobacter koseri (e.g. *diversus*)	CITDIV	
	Citrobacter spp., other	CITOTH	
	Citrobacter spp., not specified	CITNSP	
	Enterobacter cloacae	ENBCLO	**ENBSPP**
	Enterobacter aerogenes	ENBAER	
	Enterobacter agglomerans	ENBAGG	
	Enterobacter sakazakii	ENBSAK	
	Enterobacter gergoviae	ENBGER	
	Enterobacter spp., other	ENBOTH	
	Enterobacter spp., not specified	ENBNSP	
	Escherichia coli	ESCCOL	**ESCCOL**
	Klebsiella pneumoniae	KLEPNE	**KLESPP**
	Klebsiella oxytoca	KLEOXY	
	Klebsiella spp., other	KLEOTH	
	Klebsiella spp., not specified	KLENSP	
	Proteus mirabilis	PRTMIR	**PRTSPP**

	Microorganism	Code	Minimal list
	Proteus vulgaris	PRTVUL	
	Proteus spp., other	PRTOTH	
	Proteus spp., not specified	PRTNSP	
	Serratia marcescens	SERMAR	**SERSPP**
	Serratia liquefaciens	SERLIQ	
	Serratia spp., other	SEROTH	
	Serratia spp., not specified	SERNSP	
	Hafnia spp.	HAFSPP	**ETBTOT**
	Morganella spp.	MOGSPP	
	Providencia spp.	PRVSPP	
	Salmonella Enteritidis	SALENT	
	Salmonella Typhi or Paratyphi	SALTYP	
	Salmonella Typhimurium	SALTYM	
	Salmonella spp., not specified	SALNSP	
	Salmonella spp., other	SALOTH	
	Shigella spp.	SHISPP	
	Yersinia spp.	YERSPP	
	Other Enterobacteriaceae	ETBOTH	
	Enterobacteriaceae, not specified	ETBNSP	
Gram-negative bacilli	*Acinetobacter baumannii*	ACIBAU	**ACISPP**
	Acinetobacter calcoaceticus	ACICAL	
	Acinetobacter haemolyticus	ACIHAE	
	Acinetobacter lwoffii	ACILWO	
	Acinetobacter spp., other	ACIOTH	
	Acinetobacter spp., not specified	ACINSP	
	Pseudomonas aeruginosa	PSEAER	**PSEAER**
	Stenotrophomonas maltophilia	STEMAL	**STEMAL**
	Burkholderia cepacia	BURCEP	**PSETOT**
	Pseudomonadaceae family, other	PSEOTH	
	Pseudomonadaceae family, not specified	PSENSP	
	Haemophilus influenzae	HAEINF	**HAESPP**
	Haemophilus parainfluenzae	HAEPAI	
	Haemophilus spp., other	HAEOTH	
	Haemophilus spp., not specified	HAENSP	
Gram-negative bacilli (continuation)	*Legionella* spp.	LEGSPP	**LEGSPP**
	Achromobacter spp.	ACHSPP	**GNBTOT**
	Aeromonas spp.	AEMSPP	
	Agrobacterium spp.	AGRSPP	
	Alcaligenes spp.	ALCSPP	
	Campylobacter spp.	CAMSPP	
	Flavobacterium spp.	FLASPP	
	Gardnerella spp.	GARSPP	
	Helicobacter pylori	HELPYL	
	Pasteurella spp.	PASSPP	
	Gram-negative bacilli, not specified	GNBNSP	
	Other Gram-negative bacilli, non enterobacteriaceae	GNBOTH	
Anaerobes	*Bacteroides fragilis*	BATFRA	**BATSPP**
	Bacteroides other	BATOTH	
	Bacteroides spp., not specified	BATNSP	
	Clostridium difficile	CLODIF	**ANATOT**
	Clostridium other	CLOOTH	
	Propionibacterium spp.	PROSPP	
	Prevotella spp.	PRESPP	
	Anaerobes, not specified	ANANSP	
	Other anaerobes	ANAOTH	
Other bacteria	Mycobacterium, atypical	MYCATY	**BCTTOT**

	Microorganism	Code	Minimal list
	Mycobacterium tuberculosis complex	MYCTUB	
	Chlamydia spp.	CHLSPP	
	Mycoplasma spp.	MYPSPP	
	Actinomyces spp.	ACTSPP	
	Nocardia spp.	NOCSPP	
	Other bacteria	BCTOTH	
	Other bacteria, not specified	BCTNSP	
Fungi	*Candida albicans*	CANALB	**CANSPP**
	Candida auris	CANAUR	
	Candida glabrata	CANGLA	
	Candida krusei	CANKRU	
	Candida tropicalis	CANTRO	
	Candida parapsilosis	CANPAR	
	Candida spp., other	CANOTH	
	Candida spp., not specified	CANNSP	
	Aspergillus fumigatus	ASPFUM	**ASPSPP**
	Aspergillus niger	ASPNIG	
	Aspergillus spp., other	ASPOTH	
	Aspergillus spp., not specified	ASPNSP	
	Other yeasts	YEAOTH	**PARTOT**
	Fungi other	FUNOTH	
	Fungi, not specified	FUNNSP	
	Filaments other	FILOTH	
	Other parasites	PAROTH	
Viruses	Adenovirus	VIRADV	**VIRTOT**
	Cytomegalovirus (CMV)	VIRCMV	
	Enterovirus (polio, coxsackie, echo)	VIRENT	
	Hepatitis A virus	VIRHAV	
	Hepatitis B virus	VIRHBV	
	Hepatitis C virus	VIRHCV	
	Herpes simplex virus	VIRHSV	
	Human immunodeficiency virus (HIV)	VIRHIV	
	Influenza A virus	VIRINA	
	Influenza B virus	VIRINB	
	Influenza C virus	VIRINC	
	Norovirus	VIRNOR	
	Parainfluenzavirus	VIRPIV	
	Respiratory syncytial virus (RSV)	VIRRSV	
	Rhinovirus	VIRRHI	
	Rotavirus	VIRROT	
	SARS virus	VIRSAR	
	Varicella-zoster virus	VIRVZV	
	Virus, not specified	VIRNSP	
	Other virus	VIROTH	
Microorganism not identified or not found		_NONID	**_NONID**
Examination not done		_NOEXA	**_NOEXA**
Sterile examination		_STERI	**_STERI**
Result not (yet) available or missing		_NA	**_NA**

_NONID: evidence exists that a microbiological examination has been done, but the microorganism cannot be correctly classified or the result of the examination cannot be found; _NOEXA: no diagnostic sample taken, no microbiological examination done; _STERI: a microbiological examination has been done, but the result was negative (e.g. negative culture), _NA Result not (yet) available or missing.

Annex 2. Extended antimicrobial resistance data for ICU-acquired infections

Networks may report extended antimicrobial resistance (AMR) data for a more detailed description of the AMR epidemiology (e.g. combined resistance). However, priority should be given to the target AMR list given above.

The allowed AMR codes (in the 'Antibiotic' field) are:

AMB = Amphotericin B	GEH = Gentamicin-High
AMC = Amoxicillin-clavulanic acid	GEN = Gentamicin
AMK = Amikacin	GLY = Glycopeptides (vancomycin, teicoplanin)
AMP = Ampicillin	IPM = Imipenem
AMX = Amoxicillin	ITR = Itraconazole
AZM = Azithromycin	KET = Ketoconazole
C1G = Cephalosporins, first-generation (cefalotin or cefazolin)	LNZ = Linezolid
C2G = Cephalosporins, second-generation (cefuroxime, cefamandole, cefoxitin)	LVX = Levofloxacin
C3G = Cephalosporins, third-generation (cefotaxime, ceftriaxone)	MEM = Meropenem
C4G = Cephalosporins, fourth-generation (cefepime, cefpirome)	MET = Meticillin
CAR = Carbapenems (imipenem, meropenem, doripenem)	MFX = Moxifloxacin
CAS = Caspofungin	NAL = Nalidic acid
CAZ = Ceftazidime	NET = Netilmicin
CIP = Ciprofloxacin	NOR = Norfloxacin
CLI = Clindamycin	OFX = Ofloxacin
CLO = Cloxacillin	OXA = Oxacillin
CLR = Clarithromycin	PEN = Penicillin
COL = Colistin	PIP = Piperacillin
CRO = Ceftriaxone	PIT = Piperacillin or ticarcillin
CTX = Cefotaxime	POL = Polymyxin B
DIC = Dicloxacillin	QDA = Quinupristin-dalfopristin
DAP = Daptomycin	RIF = Rifampin
DOR = Doripenem	SUL = Sulbactam
ETP = Ertapenem	SXT = Sulfamethoxazole-trimethoprim (cotrimoxazole)
ERY = Erythromycin	TCY = Tetracycline
ESBL = Extended beta-lactamase producing	TEC = Teicoplanin
FCT = Flucytosine (5-fluorocytosine)	TIG = Tigecycline
FEP = Cefepime	TOB = Tobramycin
FLC = Flucloxacillin	TZP = Piperacillin-tazobactam
FLU = Fluconazole	VAN = Vancomycin
FOS = Fosfomycin	
FOX = Cefoxitin	
FUS = Fusidic acid	

Annex 3. Healthcare-associated infections code list

HAI code	HAI label
PN1	Pneumonia, clinical + positive quantitative culture from minimally contaminated lower respiratory tract specimen
PN2	Pneumonia, clinical + positive quantitative culture from possibly contaminated lower respiratory tract specimen
PN3	Pneumonia, clinical + microbiological diagnosis by alternative microbiology methods
PN4	Pneumonia, clinical + positive sputum culture or non-quantitative culture from lower respiratory tract specimen
PN5	Pneumonia: clinical signs of pneumonia without positive microbiology
UTI-A	symptomatic urinary tract infection, microbiologically confirmed
UTI-B	symptomatic urinary tract infection, not microbiologically confirmed
BSI	Bloodstream infection (laboratory-confirmed), other than CRI3
CRI1-CVC	Local CVC-related infection (no positive blood culture)
CRI2-CVC	General CVC-related infection (no positive blood culture)
CRI3-CVC	Microbiologically confirmed CVC-related bloodstream infection
CRI1-PVC	Local PVC-related infection (no positive blood culture)
CRI2-PVC	General PVC-related infection (no positive blood culture)
CRI3-PVC	Microbiologically confirmed PVC-related bloodstream infection
Other HAI codes (optional)	
BJ-BONE	Osteomyelitis
BJ-JNT	Joint or bursa
BJ-DISC	Disc-space infection
CNS-IC	Intracranial infection
CNS-MEN	Meningitis or ventriculitis
CNS-SA	Spinal abscess without meningitis
CVS-VASC	Arterial or venous infection
CVS-ENDO	Endocarditis
CVS-CARD	Myocarditis or pericarditis
CVS-MED	Mediastinitis
EENT-CONJ	Conjunctivitis
EENT-EYE	Eye, other than conjunctivitis
EENT-EAR	Ear mastoid
EENT-ORAL	Oral cavity (mouth, tongue, or gums)
EENT-SINU	Sinusitis
EENT-UR	Upper respiratory tract, pharyngitis, laryngitis, epiglottitis
GI-CDI	*Clostridium difficile* infection
GI-GE	Gastroenteritis (excluding CDI)
GI-GIT	Gastrointestinal tract (esophagus, stomach, small and large bowel, and rectum), excluding GE, CDI
GI-HEP	Hepatitis
GI-IAB	Intra-abdominal infection, not specified elsewhere
LRI-BRON	Bronchitis, tracheobronchitis, bronchiolitis, tracheitis, without evidence of pneumonia
LRI-LUNG	Other infections of the lower respiratory tract
REPR-EMET	Endometritis
REPR-EPIS	Episiotomy
REPR-VCUF	Vaginal cuff
REPR-OREP	Other infections of the male or female reproductive tract
SSI-S	Surgical site infection, superficial incisional
SSI-D	Surgical site infection, deep incisional
SSI-O	Surgical site infection, organ/space
SST-SKIN	Skin infection
SST-ST	Soft tissue (necrotizing fascitis, infectious gangrene, necrotizing cellulitis, infectious myositis, lymphadenitis, or lymphangitis)
SST-DECU	Decubitus ulcer, including both superficial and deep infections
SST-BURN	Burn
SST-BRST	Breast abscess or mastitis
SYS-DI	Disseminated infection
SYS-CSEP	Treated unidentified severe infection in adults and children
NEO-CSEP	Clinical sepsis in neonates
NEO-LCBI	Laboratory-confirmed bloodstream infection in neonates, non-CNS
NEO-CNSB	Laboratory-confirmed bloodstream infection with coagulase-negative staphylococci in neonates
NEO-PNEU	Pneumonia in neonates
NEO-NEC	Necrotising enterocolitis

Annex 4. Antimicrobial ATC codes

Antimicrobial agent: generic name	ATC 5th level code
Amikacin	J01GB06
Amoxicillin	J01CA04
Amoxicillin and enzyme inhibitor	J01CR02
Amphotericin B (oral)	A07AA07
Amphotericin B (parenteral)	J02AA01
Ampicillin	J01CA01
Ampicillin and enzyme inhibitor	J01CR01
Ampicillin, combinations	J01CA51
Anidulafungin	J02AX06
Arbekacin	J01GB12
Aspoxicillin	J01CA19
Azanidazole	P01AB04
Azidocillin	J01CE04
Azithromycin	J01FA10
Azithromycin, fluconazole and secnidazole	J01RA07
Azlocillin	J01CA09
Aztreonam	J01DF01
Bacampicillin	J01CA06
Bacitracin	J01XX10
Bekanamycin	J01GB13
Benzathine benzylpenicillin	J01CE08
Benzathine phenoxymethylpenicillin	J01CE10
Benzylpenicillin	J01CE01
Biapenem	J01DH05
Brodimoprim	J01EA02
Carbenicillin	J01CA03
Carindacillin	J01CA05
Carumonam	J01DF02
Caspofungin	J02AX04
Cefacetrile	J01DB10
Cefaclor	J01DC04
Cefadroxil	J01DB05
Cefalexin	J01DB01
Cefaloridine	J01DB02
Cefalotin	J01DB03
Cefamandole	J01DC03
Cefapirin	J01DB08
Cefatrizine	J01DB07
Cefazedone	J01DB06
Cefazolin	J01DB04
Cefbuperazone	J01DC13
Cefcapene	J01DD17
Cefdinir	J01DD15
Cefditoren	J01DD16
Cefepime	J01DE01
Cefepime and amikacin	J01RA06
Cefetamet	J01DD10
Cefixime	J01DD08
Cefmenoxime	J01DD05
Cefmetazole	J01DC09
Cefminox	J01DC12
Cefodizime	J01DD09
Cefonicide	J01DC06

Antimicrobial agent: generic name	ATC 5th level code
Cefoperazone	J01DD12
Cefoperazone, combinations	J01DD62
Ceforanide	J01DC11
Cefotaxime	J01DD01
Cefotaxime, combinations	J01DD51
Cefotetan	J01DC05
Cefotiam	J01DC07
Cefoxitin	J01DC01
Cefozopran	J01DE03
Cefpiramide	J01DD11
Cefpirome	J01DE02
Cefpodoxime	J01DD13
Cefprozil	J01DC10
Cefradine	J01DB09
Cefroxadine	J01DB11
Cefsulodin	J01DD03
Ceftaroline fosamil	J01DI02
Ceftazidime	J01DD02
Ceftazidime, combinations	J01DD52
Ceftezole	J01DB12
Ceftibuten	J01DD14
Ceftizoxime	J01DD07
Ceftobiprole medocaril	J01DI01
Ceftolozane and enzyme inhibitor	J01DI54
Ceftriaxone	J01DD04
Ceftriaxone, combinations	J01DD54
Cefuroxime	J01DC02
Cefuroxime and metronidazole	J01RA03
Chloramphenicol	J01BA01
Chlortetracycline	J01AA03
Cinoxacin	J01MB06
Ciprofloxacin	J01MA02
Ciprofloxacin and metronidazole	J01RA10
Ciprofloxacin and ornidazole	J01RA12
Ciprofloxacin and tinidazole	J01RA11
Clarithromycin	J01FA09
Clindamycin	J01FF01
Clofoctol	J01XX03
Clometocillin	J01CE07
Clomocycline	J01AA11
Cloxacillin	J01CF02
Colistin (injection, infusion)	J01XB01
Colistin (oral)	A07AA10
Combinations of beta-lactamase sensitive penicillins	J01CE30
Combinations of intermediate-acting sulphonamides	J01EC20
Combinations of long-acting sulphonamides	J01ED20
Combinations of penicillins	J01CR50
Combinations of penicillins with extended spectrum	J01CA20
Combinations of short-acting sulphonamides	J01EB20
Combinations of tetracyclines	J01AA20
Cycloserine	J04AB01
Dalbavancin	J01XA04
Daptomycin	J01XX09
Demeclocycline	J01AA01
Dibekacin	J01GB09
Dicloxacillin	J01CF01

Antimicrobial agent: generic name	ATC 5th level code
Dirithromycin	J01FA13
Doripenem	J01DH04
Doxycycline	J01AA02
Enoxacin	J01MA04
Epicillin	J01CA07
Ertapenem	J01DH03
Erythromycin	J01FA01
Ethambutol	J04AK02
Ethionamide	J04AD03
Faropenem	J01DI03
Fidaxomicin	A07AA12
Fleroxacin	J01MA08
Flomoxef	J01DC14
Flucloxacillin	J01CF05
Fluconazole	J02AC01
Flucytosine	J02AX01
Flumequine	J01MB07
Flurithromycin	J01FA14
Fosfomycin	J01XX01
Furazidin	J01XE03
Fusidic acid	J01XC01
Garenoxacin	J01MA19
Gatifloxacin	J01MA16
Gemifloxacin	J01MA15
Gentamicin	J01GB03
Grepafloxacin	J01MA11
Griseofulvin	D01BA01
Hachimycin	J02AA02
Hetacillin	J01CA18
Iclaprim	J01EA03
Imipenem and enzyme inhibitor	J01DH51
Isavuconazole	J02AC05
Isepamicin	J01GB11
Isoniazid	J04AC01
Itraconazole	J02AC02
Josamycin	J01FA07
Kanamycin	A07AA08
Kanamycin	J01GB04
Ketoconazole	J02AB02
Latamoxef	J01DD06
Levofloxacin	J01MA12
Levofloxacin, combinations with other antibacterials	J01RA05
Lincomycin	J01FF02
Linezolid	J01XX08
Lomefloxacin	J01MA07
Loracarbef	J01DC08
Lymecycline	J01AA04
Mandelic acid	J01XX06
Mecillinam	J01CA11
Meropenem	J01DH02
Metacycline	J01AA05
Metampicillin	J01CA14
Methenamine	J01XX05
Meticillin	J01CF03
Metronidazole (oral, rectal)	P01AB01
Metronidazole (parenteral)	J01XD01

Antimicrobial agent: generic name	ATC 5th level code
Metronidazole, combinations	P01AB51
Mezlocillin	J01CA10
Micafungin	J02AX05
Miconazole	J02AB01
Midecamycin	J01FA03
Minocycline	J01AA08
Miocamycin	J01FA11
Moxifloxacin	J01MA14
Nafcillin	J01CF06
Nalidixic acid	J01MB02
Natamycin	A07AA03
Nemonoxacin	J01MB08
Neomycin (injection, infusion)	J01GB05
Neomycin (oral)	A07AA01
Neomycin, combinations (oral)	A07AA51
Netilmicin	J01GB07
Nifurtoinol	J01XE02
Nimorazole	P01AB06
Nitrofurantoin	J01XE01
Nitrofurantoin, combinations	J01XE51
Nitroxoline	J01XX07
Norfloxacin	J01MA06
Norfloxacin and tinidazole	J01RA13
Nystatin	A07AA02
Ofloxacin	J01MA01
Ofloxacin and ornidazole	J01RA09
Oleandomycin	J01FA05
Oritavancin	J01XA05
Ornidazole (oral)	P01AB03
Ornidazole (parenteral)	J01XD03
Oxacillin	J01CF04
Oxolinic acid	J01MB05
Oxytetracycline	J01AA06
Oxytetracycline, combinations	J01AA56
Panipenem and betamipron	J01DH55
Paromomycin	A07AA06
Pazufloxacin	J01MA18
Pefloxacin	J01MA03
Penamecillin	J01CE06
Penicillins, combinations with other antibacterials	J01RA01
Penimepicycline	J01AA10
Pheneticillin	J01CE05
Phenoxymethylpenicillin	J01CE02
Pipemidic acid	J01MB04
Piperacillin	J01CA12
Piperacillin and enzyme inhibitor	J01CR05
Piromidic acid	J01MB03
Pivampicillin	J01CA02
Pivmecillinam	J01CA08
Polymyxin B	A07AA05
Polymyxin B	J01XB02
Posaconazole	J02AC04
Pristinamycin	J01FG01
Procaine benzylpenicillin	J01CE09
Propenidazole	P01AB05
Propicillin	J01CE03

Antimicrobial agent: generic name	ATC 5th level code
Prulifloxacin	J01MA17
Pyrazinamide	J04AK01
Quinupristin/dalfopristin	J01FG02
Ribostamycin	J01GB10
Rifabutin	J04AB04
Rifampicin	J04AB02
Rifaximin	A07AA11
Rokitamycin	J01FA12
Rolitetracycline	J01AA09
Rosoxacin	J01MB01
Roxithromycin	J01FA06
Rufloxacin	J01MA10
Secnidazole	P01AB07
Sisomicin	J01GB08
Sitafloxacin	J01MA21
Solithromycin	J01FA16
Sparfloxacin	J01MA09
Spectinomycin	J01XX04
Spiramycin	J01FA02
Spiramycin and metronidazole	J01RA04
Streptoduocin	J01GA02
Streptomycin (oral)	A07AA04
Streptomycin (parenteral)	J01GA01
Streptomycin, combinations	A07AA54
Sulbactam	J01CG01
Sulbenicillin	J01CA16
Sulfadiazine	J01EC02
Sulfadiazine and tetroxoprim	J01EE06
Sulfadiazine and trimethoprim	J01EE02
Sulfadimethoxine	J01ED01
Sulfadimidine	J01EB03
Sulfadimidine and trimethoprim	J01EE05
Sulfafurazole	J01EB05
Sulfaisodimidine	J01EB01
Sulfalene	J01ED02
Sulfamazone	J01ED09
Sulfamerazine	J01ED07
Sulfamerazine and trimethoprim	J01EE07
Sulfamethizole	J01EB02
Sulfamethoxazole	J01EC01
Sulfamethoxazole and trimethoprim	J01EE01
Sulfamethoxypyridazine	J01ED05
Sulfametomidine	J01ED03
Sulfametoxydiazine	J01ED04
Sulfametrole and trimethoprim	J01EE03
Sulfamoxole	J01EC03
Sulfamoxole and trimethoprim	J01EE04
Sulfanilamide	J01EB06
Sulfaperin	J01ED06
Sulfaphenazole	J01ED08
Sulfapyridine	J01EB04
Sulfathiazole	J01EB07
Sulfathiourea	J01EB08
Sulfonamides, combinations with other antibacterials (excl. trimethoprim)	J01RA02
Sultamicillin	J01CR04
Talampicillin	J01CA15

Antimicrobial agent: generic name	ATC 5th level code
Tazobactam	J01CG02
Tedizolid	J01XX11
Teicoplanin	J01XA02
Telavancin	J01XA03
Telithromycin	J01FA15
Temafloxacin	J01MA05
Temocillin	J01CA17
Terbinafine	D01BA02
Tetracycline	J01AA07
Tetracycline and oleandomycin	J01RA08
Thiamphenicol	J01BA02
Thiamphenicol, combinations	J01BA52
Ticarcillin	J01CA13
Ticarcillin and enzyme inhibitor	J01CR03
Tigecycline	J01AA12
Tinidazole (oral, rectal)	P01AB02
Tinidazole (parenteral)	J01XD02
Tobramycin	J01GB01
Trimethoprim	J01EA01
Troleandomycin	J01FA08
Trovafloxacin	J01MA13
Vancomycin (oral)	A07AA09
Vancomycin (parenteral)	J01XA01
Voriconazole	J02AC03
Xibornol	J01XX02

Diagnosis (site) code list for antimicrobial use

Diagnosis	Examples
CNS	Infections of the central nervous system
EYE	Endophthalmitis
ENT	Infections of ear, nose, throat, larynx and mouth
BRON	Acute bronchitis or exacerbations of chronic bronchitis
PNEU	Pneumonia
CF	Cystic fibrosis
CVS	Cardiovascular infections: endocarditis, vascular graft
GI	Gastrointestinal infections (e.g. salmonellosis, antibiotic-associated diarrhoea)
IA	Intra-abdominal sepsis, including hepatobiliary
SST-SSI	Surgical site infection involving skin or soft tissue but not bone
SST-O	Cellulitis, wound, deep soft tissue not involving bone, not related to surgery
BJ-SSI	Septic arthritis, osteomyelitis of surgical site
BJ-O	Septic arthritis, osteomyelitis, not related to surgery
CYS	Symptomatic lower urinary tract infection (e.g. cystitis)
PYE	Symptomatic upper urinary tract infection (e.g. pyelonephritis)
ASB	Asymptomatic bacteriuria
OBGY	Obstetric or gynaecological infections, STD in women
GUM	Prostatitis, epididymo-orchitis, STD in men
BAC	Laboratory-confirmed bacteraemia
CSEP	Clinical sepsis (suspected bloodstream infection without lab confirmation/results are not available, no blood cultures collected or negative blood culture), excluding febrile neutropenia
FN	Febrile neutropenia or other form of manifestation of infection in immunocompromised host (e.g. HIV, chemotherapy, etc.) with no clear anatomical site
SIRS	Systemic inflammatory response with no clear anatomical site
UND	Completely undefined; site with no systemic inflammation
NA	Not applicable; for antimicrobial use other than treatment

Annex 5. Risk scores definitions: SAPS II, APACHE II, Glasgow

SAPS II score[i]

The Simplified Acute Physiology Score II (SAPS II) is one of the most frequently used tools to predict hospital mortality in ICUs and serves as a starting point for the evaluation of ICU efficiency. It includes 17 variables: 12 physiology variables and three underlying disease variables.

Variable	Definition	Comments
SAPS II	The SAPS II components should be measured 24 hours after admission to the ICU. The worst values within those 24 hours are to be recorded; each category of values has a weighted value in points	The total score must be computed adding the weighted values
Age	Use the patient's age (in years) at his last birthday	
Heart rate	Use the worst value in 24 hours, either low or high heart rate; if it varied from cardiac arrest (11 points) to extreme tachycardia (7 points), assign 11 points	
Systolic blood pressure	Use the same method as for heart rate: e.g. if it varied from 60 mm Hg to 205 mm Hg, assign 13 points	
Body temperature	Use the highest temperature in degrees centigrade or Fahrenheit	
PaO_2/FiO_2 ratio	If ventilated or continuous pulmonary artery pressure, use the lowest value of the ratio	Only if the patient has been mechanically ventilated
Urinary output	Total urinary output in 24 hours	
Serum urea or serum urea nitrogen level	Use the highest value in mmol/L for serum urea, in mg/dL for serum urea nitrogen	
WBC count	Use the worst (high or low) WBC count according to the scoring sheet	
Serum potassium level	Use the worst (high or low) in mmol/L, according to the scoring sheet	
Serum sodium level	Use the worst (high or low) in mmol/L, according to the scoring sheet	
Serum bicarbonate level	Use the lowest value in mEq/L	
Bilirubin level	Use the highest value in µmol/L or mg/dL	
Glasgow Coma score*	Use the lowest value; if the patient is sedated, record the estimated Glasgow Coma Score before sedation.	This variable must be repeated on the HELICS form
Type of admission	• Unscheduled surgical • Scheduled surgical • Medical	• Patients added to the operating room schedule within 24 hours of the operation • Patient whose surgery was scheduled at least 24 hours in advance • Patients having no surgery within one week of admission to ICU
AIDS	Select YES if HIV-positive with clinical complications such as *Pneumocystis carinnii* pneumonia, Kaposi's sarcoma, lymphoma, tuberculosis, or toxoplasma infection	
Haematologic malignancy	Select YES, if lymphoma, acute leukaemia or multiple myeloma	
Metastatic cancer	Select YES, if proven metastasis by surgery, computed tomographic scan, or any other method	

[i] Le Gall JR, Lemeshow S, Saulnier F. A new simplified acute physiology score (SAPS II) based on a European/North American Multicenter Study. JAMA 1993; 270:2957–2963.

SAPS II weights

Age (in years)	< 40[0]	40–59[7]	60–69[12]	70–74[15]	75–79[16]	≥ 80[18]
Heart rate (beats/min)	< 40[11]	40–69[2]	70–119 [0]	120–159[4]	≥ 160[7]	
Systolic BP (mm Hg)	<70[13]	70–99[5]	100–199[0]	≥ 200 [2]		
Body temperature (°C)	< 39[0]	≥ 39[3]				
Only if ventilated or positive airway pressure (BPAP/CPAP)						
– PaO_2(mmHg)/FiO_2 ratio – PaO_2(Kpa)/FiO_2 ratio	< 100[11] (< 13.3)	100–199[9] (13.2–26.4)	≥ 200[6] (≥ 26.5)	e.g. 70 mmHg /0.5 = 140 10 Kpa/0.5 = 20		
Urinary output (ml/day)	< 500[12]	500–999[4]	≥ 1000[0]			
Serum urea (mg/dl) (mmol/L)	< 60[0] (< 10.0)	< 60–179[6] (10.0–29.9)	≥ 180[10] (≥ 30.0)			
WBC count (10^3/mm^3)	< 1.0[12]	1.0–19.9[0]	≥ 20.0[3]			
Serum potassium (mEq/L)	< 3.0[3]	3.0–4.9[0]	≥ 5.0[3]			
Serum sodium (mEq/L)	< 125[5]	125–144 [0]	≥ 145[1]			
Bicarbonate (mEq/L)	< 15[6]	15–20[3]	≥ 20[0]			
Bilirubin (mg/dl) (µmol/L)	< 4.0[0] (<68.4)	< 4.0–5.9[4] (68.4-102.5)	≥ 6.0[9] (≥ 102.6)			
Glasgow coma score (if patient is sedated, estimate status before sedation)	< 6[26]	6–8[13]	9–10 [7]	11–13[5]	14–15[0]	
Chronic diseases	metastatic cancer[9]		haematol. malignancy[10]		AIDS[17]	
Type of admission	medical[6]		scheduled surgical[0]		unscheduled surgical[8]	

The superscript numbers in the SAPS score table are the sub-scores associated with each variable category.

APACHE II score[ii]

The APACHE II severity of disease classification system

Physiologic variable	High abnormal range					Low abnormal range			
	+ 4	+ 3	+ 2	+ 1	0	+ 1	+ 2	+ 3	+ 4
TEMPERATURE – rectal (C°)	≥ 41°	39°–40.9°		38.5°–38.9°	36°–38.4°	34°–35.9°	323°–33.9°	30°–31.9°	≤ 29.9°
MEAN ARTERIAL PRESSURE – mm Hg	≥ 160	130–159	110–129		70–109		50–69		≤ 49
HEART RATE (ventricular response)	≥ 180	140 – 179	110–139		70–109		55 – 69	40–54	≤ 39
RESPIRATORY RATE – (non-ventilated or ventilated)	≥ 50	35–49		25–34	12–24	10–11	6–9		≤ 5
OXYGENATION: A aDO_2 or PaO_2 (mm Hg) a. FIO_2 ≥ 0.5 record a A aDO_2 b. FIO_2 < 0.5 record only PaO_2	≥ 500	350–499	200–349		<200				
					O PO_2 > 70	O PO_2 61–70		O PO_2 55–60	O PO_2 < 55
ARTERIAL pH	≥ 7.7	7.6–7.69		7.5–7.59	7.33–7.49		7.25–7.32	7.15–7.24	< 7.15
SERUM SODIUM (mMol/L)	≥ 180	160–179	155–159	150–154	130–149		120–129	111–119	≤ 110
SERUM POTASIUM (mMol/L)	≥ 7	6–6.9		5.9–5.9	3.5–5.4	3–3.4	2.5–2.9		< 2.5
SERUM CREATININE (mg/100ml) (Double point score for acute renal failure)	≥ 3.5	2–3.4	1.5–1.9		0.6–1.4		< 0.6		
HEMATOCRIT (%)	≥ 60		50–59.9	46–49.9	30–45.9		20–29.9		< 20

[ii] From Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: A severity of disease classification system. Critical Care Medicine 1985;13(10):818–29.

Physiologic variable	High abnormal range					Low abnormal range			
	+ 4	+ 3	+ 2	+ 1	0	+ 1	+ 2	+ 3	+ 4
WHITE BLOOD COUNT (total/mm3) (in 1.000s)	≥ 40		20–39.9	15–19.9	3–14.9		1–2.9		< 1
GLASGOW COMA SCORE (GCS) Score = 15 minus actual GCS									
A Total ACUTE PSYSIOLOGIC SCORE (APS) Sum of the 12 individual variable points									
Serum HCO2 (venous mMol/L) (Not preferred, use if no ABGs)	≥ 52	41–51.9		32–40.9	22–31.9		18–21.9	15–17.9	< 15

AGE POINTS

Assign points to age as follows:

Age (yrs)	Points
≤ 44	0
45–54	2
55–64	3
65–74	5
≥ 75	6

CHRONIC HEALTH POINTS

If the patient has a history of severe organ system insufficiency or is immunocompromised, assign points as follows:

- for nonoperative or emergency postoperative patients – 5 points
- for elective postoperative patients – 2 points

DEFINITIONS

Organ insufficiency or immunocompromised state must have been evident prior to hospital admission and conform to the following criteria:

- LIVER: biopsy proven cirrhosis and documented portal hypertension, episodes of past upper GI bleeding attributed to portal hypertension or prior episodes of hepatic failure/encephalopathy/coma
- CARDIOVASCULAR: New York Heart Association Class IV
- RESPIRATORY: chronic restrictive, obstructive or vascular disease resulting in severe exercise restriction, i.e. unable to climb stairs or perform household duties; or documented chronic hypoxia, hypercapnia, secondary polycythaemia, severe pulmonary hypertension (> 40mmHg); or respirator dependency
- RENAL: receiving chronic dialysis
- IMMUNOCOMPROMISED: the patient has received therapy that suppresses resistance to infection, e.g. immunosuppression, chemotherapy, radiation, long-term or recent high dose steroids, or has a disease that is sufficiently advanced to suppress resistance to infection, e.g. leukaemia, lymphoma, AIDS.

APACHE II score calculation

A + B + C

A APS points

B Age points

C Chronic Health points

Total = APACHE II

Glasgow Coma Score[iii]

Score Glasgow = Y + V + M

Best Eye Response (Y)	Best Verbal Response (V)	Best Motor Response (M)
1. No eye opening 2. Eye opening to pain 3. Eye opening to verbal command 4. Eyes open spontaneously	1. No verbal response 2. Incomprehensible sounds 3. Inappropriate words 4. Confused 5. Orientated	1. No motor response 2. Extension to pain 3. Flexion to pain 4. Withdrawal from pain 5. Localising pain 6. Obeys commands

Please note that, for example, the phrase 'GCS of 11' is essentially meaningless. It is important to relate the complete formula, e.g. Y3 V3 M5 = GCS 11. A Glasgow Coma Score of 13 or higher correlates with a mild brain injury; 9 to 12 is a moderate injury; and 8 or less, a severe brain injury.

Glasgow Paediatric Coma Score[iv]

The Paediatric GCS is scored between 3 and 15, with 3 being the worst and 15 the best. It is composed of three parameters: Best Eye Response, Best Verbal Response and Best Motor Response:

- Best Eye Response (4)
  - no eye opening
  - eye opening to pain
  - eye opening to verbal command
  - eyes open spontaneously
- Best Verbal Response (5)
  - no vocal response
  - inconsolable, agitated
  - inconsistently consolable, moaning
  - cries but is consolable, inappropriate interactions
  - smiles, oriented to sounds, follows objects, interacts
- Best Motor Response (6)
  - no motor response
  - extension to pain
  - flexion to pain
  - withdrawal from pain
  - localising pain
  - obeys commands

Please note that, for example, the phrase 'GCS of 11' is essentially meaningless. It is important to relate the complete formula, such as E3 V3 M5 = GCS 11. A Glasgow Paediatric Coma Score of 13 or higher correlates with a mild brain injury; 9 to 12 is a moderate injury; and 8 or less, a severe brain injury.

[iii] Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. Lancet 1974;13(2)7872:81–4.

[iv] http://www.trauma.org/scores/gpcs.html

Other scoring systems

The list of other scoring systems may be adapted in the future as a function of new scientific developments. Currently the HelicsWin.Net software and the TESSy metadata allow for following scores, to be measured on ICU admission or within the first 24 hours:

- APACHE = Acute Physiology and Chronic Health Evaluation score: APACHE II, APACHE III, APACHE IV
- ASA = Physical Status Classification System of the American Society of Anesthesiology
- MCCABE = McCabe score
- MPM = Mortality Prediction Model: MPM II, MPM III
- SAPS = Simplified Acute Physiology Score: SAPS II (separate variable, standard score for adult patients), SAPS 3
- Paediatric scores:
  - PIM: Paediatric Index of Mortality: PIM, PIM II
  - PRISM: Paediatric Risk of Mortality score: PRISM, PRISM III, PRISM IV
- Neonatal scores:
  - CRIB = Clinical Risk Index for Babies: CRIB, CRIB II
  - SNAP = Score for Neonatal Acute Physiology
- Predicted mortality (PDEATH): 0-100 (%), any severity score converted in its predicted mortality on ICU admission (or first 24 hours)

References and calculators for severity scores can be found at Société Française d'Anesthésie et de Réanimation (SFAR). Scoring systems for ICU and surgical patients. Available from http://test-app.sfar.org/welcome-the-sfar-website/scoring-systems-for-icu-and-surgical-patients/ .

Scores not included in this overview are e.g. APACHE III http://www.ncbi.nlm.nih.gov/pubmed/1959406, APACHE IV http://www.ncbi.nlm.nih.gov/pubmed/16540951 , MPM III: http://www.ncbi.nlm.nih.gov/pubmed/17255863 and SAPS 3 http://www.ncbi.nlm.nih.gov/pubmed/16132892 .

Annex 6. List of HAI outcome indicators

Indicator	Definition	Unit-based (Light)	Patient-based (Standard)
Bloodstream infection (BSI)			
Incidence density of healthcare-associated BSI in the ICU	# BSI (of all origin) >D2*1000/n of patient-days	X	X
Pathogen-specific BSI incidence rate	# BSI (of all origin, by pathogen) >D2*1000/n of patient-days	X	X
Standardised BSI ratio	Observed n of patients with BSI/Expected n of patients with bloodstream infection	-	X
Stratification of device-adjusted infection rates	Infection rates by ICU type Infection rates by risk factors	X -	X X
Pneumonia			
Incidence density of healthcare-associated pneumonia (clinical + microbiologically confirmed) in the ICU	# pneumonia (of all origin) >D2*1000/n of patient-days	X	X
% microbiologically confirmed pneumonia	# PN with microbiologically documentation by semi-quantitative (BAL,PB…) or quantitative culture of endotracheal aspirate/total PN	X	X
Pathogen-specific pneumonia incidence rate	# pneumonia (of all origin, by pathogen) >D2*1000/n of patient-days	X	X
Intubator-associated pneumonia rate in the ICU	# device-associated pneumonia*1000/n of intubation days	-	X
Standardised pneumonia ratio	Observed n of patients with pneumonia/Expected n of patients with pneumonia	-	X
Stratification of infection rates	Infection rates by ICU type Infection rates by risk factors	X -	X X
Urinary tract infection			
Incidence density of healthcare-associated UTI in the ICU	# UTI >D2*1000/n of patient-days	X	X
Pathogen-specific UTI incidence rate	# UTI (of all origin, by pathogen) >D2*1000/n of patient-days	X	X
Catheter-associated UTI rate in the ICU	# device-associated UTI*1000/n of urinary catheter days	-	X
Stratification of infection rates	Infection rates by risk factors	X	X
Catheter infection			
Incidence density of catheter infections in the ICU	# catheter-associated infections*1000/n of central line days (catheter-total)	-	X
Antimicrobial use in the ICU			
Antimicrobial treatment utilisation rate	N of antibiotic treatment days/N of patient-days	-	X
Ratio documented treatment/empiric treatment	N of documented AB treatment days/N of empiric AB treatment days	-	X
Stratified AM use	N of antibiotic treatment days/N of patient-days by risk factors	-	X
Device use in the ICU			
Central line utilisation rate	N of central line days/N of patient-days	-	X
Intubation utilisation rate	N of days with intubation/N of patient-days	-	X
Urinary catheter utilisation rate	N of urinary catheter days/N of patient-days	-	X

Annex 7. Structure and process prevention indicators: definition, rationale and references

Prevention indicators for surveillance of HAIs in intensive care units (HAI-Net ICU) were developed during meetings held on 24 October 2013 and on 19-20 February 2014 and by a HAI-Net ICU working group (Antonella Agodi, Michael Hiesmayr, Alain Lepape, Mercedes Palomar, Anne Savey, Carl Suetens). Indicators were also discussed with the Infection Section of the European Society of Intensive Care Medicine (ESICM Conference, 27-30 September 2014, Barcelona), reviewed by the ESICM Infection Section Members in October 2014 and suggestions integrated by the working group. The proposal was discussed and agreed during the HAI-Net ICU sessions of the Third Joint Meeting of the ARHAI Networks in Stockholm, 11-13 February 2015.

Hand hygiene: Consumption of alcohol-based hand rub solution

Definition

Number of litres of alcohol-based hand rub consumed during the previous year x 1 000/number of patient-days in the ICU during the previous year

Rationale

The importance of hand hygiene as cornerstone of standard precautions for infection prevention and control has been demonstrated since more than one century. The consumption of alcohol-based hand rubs (AHR) in litres per 1 000 patient-days is regarded as a good proxy indicator of hand hygiene compliance of healthcare workers. In a review of literature, Boyce found that in 77% of studies looking at both indicators, AHR consumption and hand hygiene compliance were correlated. Lack of correlation may occur for example when both indicators are measured for different time period(s) and correlations within the same setting/institution (repeated measurement over time) are stronger than correlations across institutions, e.g. because of inter-hospital variation in the type or concentration of used products. Inter-hospital compliance/AHR use correlations may also be more subject to bias, such as the Hawthorne effect bias of the compliance measurement (HCWs perform better when observed) on the one hand, and the use of AHR for other purposes than hand hygiene (e.g. surface disinfection) or differences in AHR volumes used per hand hygiene procedure on the other hand. Despite these limitations however, AHR consumption was found to be associated with reduction of MRSA and HAI rates in several studies.

Bibliography

1. Allegranzi B, Pittet D. Role of hand hygiene in healthcare-associated infection prevention. J Hosp Infect. 2009 Dec;73(4):305-15.
2. Behnke M, Gastmeier P, Geffers C, Mönch N, Reichardt C. Establishment of a national surveillance system for alcohol-based hand rub consumption and change in consumption over 4 years. Infect Control Hosp Epidemiol. 2012 Jun;33(6):618-20.
3. Boyce JM. Measuring healthcare worker hand hygiene activity: current practices and emerging technologies. Infect Control Hosp Epidemiol. 2011 Oct;32(10):1016-28.
4. Sroka S, Gastmeier P, Meyer E. Impact of alcohol hand-rub use on meticillin-resistant *Staphylococcus aureus*: an analysis of the literature. J Hosp Infect. 2010 Mar;74(3):204-11.
5. Marimuthu K, Pittet D, Harbarth S. The effect of improved hand hygiene on nosocomial MRSA control. Antimicrobial Resistance and Infection Control 2014, 3:34
6. Pittet D, Hugonnet S, Harbarth S, Mourouga P, Sauvan V, Touveneau S, Perneger TV. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. Infection Control Programme. Lancet. 2000 Oct 14;356(9238):1307-12.
7. Chen YC, Sheng WH, Wang JT, Chang SC, Lin HC, Tien KL, Hsu LY, Tsai KS. Effectiveness and limitations of hand hygiene promotion on decreasing healthcare-associated infections. PLoS One. 2011;6(11):e27163.

ICU staffing: staff to patient ratio

Definition

Sum of the number of registered nurse hours and number of nursing assistant hours in the ICU over a period of seven days * 100 / number of patient-days in 7 days * 24 hours

Rationale

Understaffing is one of the main reasons for low quality of care due to a lack of organisation, stress, lack of time and increase of urgent interventions and subsequent non-compliance with infection control procedures. It is one of the indicators with the strongest evidence of an association with an increased risk of HAI incidence or cross-transmission of nosocomial pathogens.

Bibliography

1. Schwab F, Meyer E, Geffers C, Gastmeier P. Understaffing, overcrowding, inappropriate nurse: ventilated patient ratio and nosocomial infections: which parameter is the best reflection of deficits? J Hosp Infect 2012, 80(2): 133-139.
2. West E, Mays N, Rafferty AM, Rowan K, Sanderson C. Nursing resources and patient outcomes in intensive care: a systematic review of the literature. Int J Nurs Stud 2009, 46(7): 993-1011.

Antimicrobial stewardship: Re-assess antimicrobial therapy after 48–72 hours

Definition

Number of antimicrobial therapies that were started more than three days ago and were re-assessed within 72 hours after start of the antimicrobial * 100/Total number of audited antimicrobial therapies that were started more than three days ago

Source: medical or nurse patient file, retrospective review of 30 files patients receiving systemic antimicrobials for therapeutic reasons.

Rationale

Re-assessing antimicrobial therapy after 48 to 72 hours using serial clinical and microbiological evaluations is crucial to ensure appropriate treatment of the infection, de-escalate where possible and discontinue the therapy if infection is unlikely. Reducing the duration of antimicrobial use and using narrower spectrum antimicrobials or switching to monotherapy when possible limit the emergence and dissemination of drug-resistant strains and minimise antibiotic-related toxicity. Post-prescription review by a physician, pharmacist or other staff member of an antimicrobial after 48 hours from the initial order was also selected as a core Indicators for hospital antimicrobial stewardship programs by the Transatlantic Taskforce on Antimicrobial Resistance (TATFAR).

Bibliography

1. Garnacho-Montero J et al. De-escalation of empirical therapy is associated with lower mortality in patients with severe sepsis and septic shock. Intensive Care Med 2014, 40(1): 32-40.
2. Dellinger RP et al. Surviving Sepsis Campaign Guidelines Committee including The Pediatric Subgroup. Surviving Sepsis Campaign: international guidelines for management of severe sepsis and septic shock, 2012. Intensive Care Med 2013, 39(2): 165-228.
3. Luyt CE, Bréchot N, Trouillet JL, Chastre J. Antibiotic stewardship in the intensive care unit. Crit Care. 2014 Aug 13;18(5):480.
4. Transatlantic Taskforce on Antimicrobial Resistance (TATFAR). Report on the modified Delphi process for common structure and process indicators for hospital antimicrobial stewardship programmes. Preliminary version. Aug 2014.

Intubation: cuff pressure

Definition

Number of intubation days (days of patients with intubation) during which the endotracheal cuff pressure was verified and maintained between 20 and 30 cm H_2O (and documented in the patient file) at least twice per day * 100 / total number of observed intubation days.

Rationale

Maintaining the endotracheal cuff pressure in the recommended range limits micro-inhalations while preserving the mucosal integrity. The recommended range for the pressure varies between studies and guidelines: 25–30 cm H_2O, 20–30 cm H_2O or 15–22 mm Hg.

Bibliography

1. Guidelines for the management of adults with hospital acquired ventilator-associated, and healthcare-associated pneumonia. Am J Respir Crit Care Med 2005,171:388-416.
2. Bouadma L, Wolff M, Lucet JC. Ventilator-associated pneumonia and its prevention. Curr Opin Infect Dis 2012, 25(4): 395-404.
3. ML Sole. Evaluation of an intervention to maintain endotracheal tube cuff pressure within therapeutic range. Am J Critical Care 2011, 20: 109-118.
4. Klompas M, Branson R, Eichenwald EC, Greene LR, Howell MD, Lee G, Magill SS, Maragakis LL, Priebe GP, Speck K, Yokoe DS, Berenholtz SM. Strategies to prevent ventilator-associated pneumonia in acute care hospitals: 2014 update. Infect Control Hosp Epidemiol. 2014 Aug;35(8):915-36.

Intubation: oral decontamination

Definition

Number of intubation days (days of patients with intubation) during which oral decontamination with oral antiseptics has been performed (and documented in the patient file) at least twice per day * 100/total number of observed intubation days.

Rationale

Regular oropharyngeal decontamination with chlorhexidine or povidone-iodine reduces the number of microorganisms colonising oropharyngeal secretions, which are involved in the development of ventilator-associated pneumonia through aspiration in the lower respiratory tract in intubated patients.

Bibliography

1. Labeau SO, Van de Vyver K, Brusselaers N, Vogelaers D, Blot SI. Prevention of ventilator-associated pneumonia with oral antiseptics: a systematic review and meta-analysis. Lancet Infect Dis 2011, 11: 845–854
2. Shi Z, Xie H, Wang P, Zhang Q, Wu Y, Chen E, Ng L, Worthington HV, Needleman I, Furness S. Oral hygiene care for critically ill patients to prevent ventilator-associated pneumonia. Cochrane Database Syst Rev. 2013 Aug 13;8:CD008367.
3. Klompas M, Branson R, Eichenwald EC, Greene LR, Howell MD, Lee G, Magill SS, Maragakis LL, Priebe GP, Speck K, Yokoe DS, Berenholtz SM. Strategies to prevent ventilator-associated pneumonia in acute care hospitals: 2014 update. Infect Control Hosp Epidemiol. 2014 Aug;35(8):915-36.

Intubation: patient position

Definition

Number of days of patients with intubation during which the patient's position was not supine (= was either prone or recumbent) * 100 / total number of observed intubation days.

Rationale

Patients should not be maintained in supine position (except in case of specific indications) in order to reduce micro-aspiration. The existing evidence mainly supports an elevated head of the bed to 30–45 degrees, the prone positioning of the patient to prevent VAP is much more debated.

Bibliography

1. Klompas M, Branson R, Eichenwald EC, Greene LR, Howell MD, Lee G, Magill SS, Maragakis LL, Priebe GP, Speck K, Yokoe DS, Berenholtz SM. Strategies to prevent ventilator-associated pneumonia in acute care hospitals: 2014 update. Infect Control Hosp Epidemiol. 2014 Aug;35(8):915-36.
2. Alexiou VG, Ierodiakonou V, Dimopoulos G, Falagas ME. Impact of patient position on the incidence of ventilator-associated pneumonia: a meta-analysis of randomized controlled trials. J Crit Care. 2009 Dec;24(4):515-22.

CVC: catheter dressing observation

Definition

Number of days of patients with a central vascular catheter during which the dressing of the CVC was not loose, damp or visibly soiled * 100/total number of observed CVC days.

Rationale

Daily clinical surveillance of CVC dressings is important to prevent CVC-related infections. SHEA recommendations state

"For non-tunneled CVCs in adults and adolescents, change transparent dressings and perform site care with a chlorhexidine-based antiseptic every 5-7 days or more frequently if the dressing is soiled, loose, or damp; change gauze dressings every 2 days or more frequently if the dressing is soiled, loose, or damp."

An indicator of CVC maintenance was preferred over an indicator of CVC insertion because of feasibility, in particular the number of observation opportunities is much higher for CVC maintenance (CVC days for all patients with CVC in the ICU) than for CVC insertion (only newly inserted CVCs, CVC insertion often done outside the ICU).

Bibliography

1. Marschall J, Mermel LA, Fakih M, Hadaway L, Kallen A, O'Grady NP, Pettis AM, Rupp ME, Sandora T, Maragakis LL, Yokoe DS. Strategies to prevent central line-associated bloodstream infections in acute care hospitals: 2014 update. Infect Control Hosp Epidemiol. 2014 Sep;35 Suppl 2:S89-107.

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