

# **Surveillance and Prevention of healthcare- associated infections**

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# Preamble

The first ordinance aimed at organizing the fight against infections acquired in hospitals in France, promulgated at the end of the eighties, was an important event in terms of public health. At that time, the first version of the 100 recommendations for the surveillance and prevention of nosocomial infections (PNI), prepared under the aegis of the French Higher Council for Public Health, was designed to be used as a guide and to provide health professionals with priority actions to be implemented. We should be thankful to the pioneers of this combat against undesirable (and partially avoidable) infectious risks, for having provided a condensed version of this document, containing the measures considered to be the most efficient; they also underlined the necessity for it to be periodically updated. Towards the end of the nineties, whilst the initial regulations were being introduced into all public and private hospitals, the first national program for combating nosocomial infections was taking shape, and the initiative for continuous improvements in the quality and safety of healthcare (accreditation, then certification) was becoming more generalized.

This was accompanied by a first update of the “100 recos” in 1999 (note the abbreviation of the title, which reveals its appropriation by the professionals), allowing this program to be adapted within hospitals. The preparation of this third edition should be considered in the context of new sociological and technical developments. First of all, for the first time since 2004, the users had access to information allowing them to follow the initiatives taken by various health establishments, in the form of a “nosocomial infection dashboard”. In addition, new definitions for healthcare-associated infections had appeared in 2007, including any infectious event related to a process, structure, or healthcare procedure, and as a consequence enlarged the initial concept to the medico-social and liberal sectors. Then, the Higher Council for Public Health (HCSP) and its specialized commissions, including that for “patient safety: nosocomial infections and other undesirable healthcare- and practice-related events” the choice of a new title were created. Finally, two national plans took over from the program completed in 2008. These changes, accompanied by a considerable increase in the number of recommendations, explain the choice of a new title: *Surveillance and Prevention of healthcare-associated infections*. The present update was organized, as in the case of the previous versions, according to a recognized methodology and by a multidisciplinary and cross-cutting working group. The methods to be implemented, proposed by the expert writers, were based on the most recent scientific evidence, or, if unavailable, on a strong professional consensus. They were subjected to critical appraisal by professionals in the field, in order to evaluate their feasibility. The publication of this document, in particular in its electronic format, will simplify not only its diffusion among the professionals concerned, but also its regular revision, almost ‘on-the-fly’.

This publication has been long awaited, since infections acquired in hospitals represent a major burden, which is accepted with increasing difficulty by decision-makers, professionals and patients. The present document, through its quality and clarity, contributes towards the efforts undertaken to reduce their repercussions.

On behalf of the HCSP, I would like to thank the authors of this publication, in particular Joseph HAJJAR, the president of the editorial board. I would also like to thank the French Society for Hospital Hygiene, which agreed to fund the editing and publication costs of this document.

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# Foreword

Over the last twenty years, healthcare-associated infections (HAI) have become a serious source of concern for the safety of patients and a major issue for health professionals working either inside or outside hospitals. The prevention of these healthcare-associated infections has been incorporated into a classical approach, which has demonstrated its efficiency over the years: identification of the risk, informing and training the actors involved, applying validated measures and assessing their implementation.

The professional recommendations, placed within the context of this strategy, correspond to proposals developed according to a specific method, in order to: a) establish practice standards whose aim is to improve the quality of professional practices; b) provide a reference repository for the assessment of these practices.

The key aspect governing the preparation of recommendations based on scientific evidence is the need for them to be periodically revised. By integrating new knowledge, in the field of prevention in particular, the validity of these recommendations is ensured. The present document takes into account the scientific evidence which has been published since the last version, published in 1999, of *100 recommendations for the surveillance and prevention of nosocomial infections*. The recommendations it contains have been written by medical and paramedical professionals (from clinical units and operational hygiene teams), who are recognized for their expertise in this field, and for each respective specialty which is addressed. These professionals have referred to the most recent data available in the literature, proceeding by means of a critical and methodical analysis. Their production was submitted to careful reading by professionals in the field, who also contributed their remarks concerning the clarity and feasibility of the proposed measures. By adopting this standard, each hospital will be able to make selective use of these recommendations, when updating their own procedures.

The fundamental aspects of surveillance and prevention of healthcare-associated infections are presented in two main sections:

- The surveillance and reporting of nosocomial infections, and the practical aspects of managing an epidemic;
- The prevention of healthcare-associated infections both in general terms, and in its main infectious locations.

These should be considered as indispensable tools in both the initial and continuous training of professionals in healthcare units, and of those working in operational hygiene units. Although their list is not exhaustive, criteria have been proposed in nearly every chapter to facilitate the preparation of an assessment framework, for the evaluation of professional practices. The paragraph dealing with research allows professionals' attention to be drawn to a certain number of unresolved points, which will require more advanced studies.

The perimeter of these recommendations excludes publications which are recent or in press, dealing for example with some specific microorganisms such as glycopeptide-resistant enterococcus, extended-spectrum betalactamase-producing enterobacteria or other pathogens (*Clostridium difficile* for example); for such cases, it is recommended that the reader refer to these specific publications.

Similarly, the integration of training assessment into clinical practice, as described by the French Higher Council for Public Health, on the basis of the check-list concept developed in the World Health Organisation (WHO) world program on patient safety, is not described in detail here. Its implementation is recent and currently limited to operating rooms. However, other check-lists are already in preparation.

The integration, within the shortest possible time, of progress made in the prevention of healthcare-associated infections, represents an important aspect of the “life” of this document; it requires a dedicated organization, to allow such updating associated with a preliminary collection of suggestions from professionals. This follow-up could be entrusted with the Regional Nosocomial Infection Control Coordinating Centres (CCLIN), under the auspices of the specialized commission for patient safety (CsSP) of the Higher Council for Public Health (HCSP).

**JOSEPH HAJJAR**

STEERING COMMITTEE COORDINATOR

# Acronyms and abbreviations

AAP/ <i>PCA</i>	Additional Air Precautions / <i>Précautions complémentaires air</i>
ABHR / <i>FHA</i>	Alcohol-based handrub / <i>Friction hydro-alcoolique</i>
ABP/ <i>PHA</i>	Alcohol-Based Products (gel or solution) / <i>Produits hydro-alcooliques</i>
ACP/ <i>PCC</i>	Additional Contact Precautions / <i>Précautions complémentaires contact</i>
ADP/ <i>PCG</i>	Additional Droplet Precautions / <i>Précautions complémentaires gouttelettes</i>
AFSSA	French Agency for Food / <i>Agence française de sécurité des aliments</i>
AFSSAPS	French Agency for Health Products Safety / <i>Agence française de sécurité sanitaire des produits de santé</i>
AP/ <i>PC</i>	Additional precautions / <i>Précautions complémentaires</i>
ARLIN	Regional Nosocomial Infection Control Branch / <i>Antenne régionale de la lutte contre les infections nosocomiales</i>
ARS	Regional Agency for Health / <i>Agence régionale de la santé</i>
BAAR	Acid-alcohol Resistant Bacillus / <i>Bacille Acido-alcool-résistant</i>
BBFE/ <i>AES</i>	Blood and Body Fluid Exposure / <i>Accident exposant au sang</i>
BCG	Bacillus Calmette/Guerin / <i>Bacille de Calmette et Guérin</i>
CCAM	French Common Classification of Procedures / <i>Classification Commune des Actes Médicaux</i>
CCLIN	Regional Nosocomial Infection Control Coordinating Center / <i>Centre de coordination de la lutte contre les infections nosocomiales</i>
CDC	Centers for Disease Control and Prevention (USA)
CDI/ <i>ICD</i>	<i>Clostridium Difficile</i> Infection / <i>Infection à Clostridium difficile</i>
CEN	European Committee for Standardization / <i>Comité européen de normalisation</i>
CHSCT	Health and Safety at Work Committee / <i>Comité d'hygiène, de sécurité et des conditions de travail</i>
CHSPF	French High Council for Public Hygiene / <i>Conseil supérieur d'hygiène publique de France</i>
CLAT	Tuberculosis Control Committee / <i>Comité de lutte anti-tuberculeuse</i>
CLIN	Committee for Nosocomial Infection Control (Consultative and follow-up body) / <i>Comité de lutte contre les infections nosocomiales (instance de consultation et de suivi)</i>
CNR	National Reference Centers / <i>Centre nationaux de référence</i>
CA-MRSA /	Community-associated Methicillin Resistant <i>Staphylococcus Aureus</i> /



SARM-Co	<i>Staphylococcus aureus résistant à la méticilline communautaires</i>
CSP	French Public Health Code / <i>Code de la Santé Publique</i>
CSSP	Patient Safety Specialized Committee: Nosocomial Infections and desirable care and practice-related effects / <i>Commission spécialisée sécurité des patients : infections nosocomiales et autres événements indésirables liés aux soins et aux pratiques</i>
CTIN	Technical Committee for Nosocomial Infections / <i>Comité technique des infections nosocomiales</i>
CTINILS	Technical Committee for Nosocomial and Healthcare-Associated Infections / <i>Comité technique des infections nosocomiales et des infections liées aux soins</i>
CVC	Central Venous Catheter / <i>Cathéter Veineux Central</i>
DDD / <i>DDJ</i>	Defined Daily Dose / <i>Dose délivrée journalière</i>
DMD/ <i>DLUO</i>	Date of minimum durabilité / <i>Date limite d'utilisation optimale</i>
DREES	French Directorate for Research, Studies, Evaluation and Statistics / <i>Direction de la recherche, des études de l'évaluation et des statistiques</i>
DTP	Diphtheria, Tetanus and Pertussis (vaccine) / <i>Diphtérie Tétanos Polyomyélite (vaccin)</i>
ECDC	European Centre for Disease Prevention and Control
ECR / <i>SSR</i>	Extended Care and Rehabilitation / <i>Soins de suite et de réadaptation</i>
ED / <i>DLC</i>	Expiry date / <i>Date limite de consommation</i>
EHPAD	Nursing Home for Dependent Elderly / <i>Établissement d'hébergement pour personnes âgées dépendantes</i>
ENT/ <i>ORL</i>	Otolaryngology / <i>Oto-rhino-laryngologie</i>
ES/ <i>HI</i>	Healthcare Institution (HI) / <i>Etablissement de santé</i>
ESBLE / <i>EBLSE</i>	Extended-Spectrum BetaLactamase-Producing Enterobacteria / <i>Entérobactéries productrices de bêtalactamase à spectre étendu</i>
FBIO / <i>TIAC</i>	Food-borne Illness Outbreak / <i>Toxi-infection alimentaire collective</i>
FBDO / <i>TIAC</i>	Food-borne Disease Outbreak / <i>Toxi-infection alimentaire collective</i>
FTE/ <i>ETP</i>	Full-Time Equivalent / <i>Equivalent Temps Plein</i>
GAS / <i>SGA</i>	Group A Streptococcus / <i>Streptocoque du groupe A</i>
GERES	French Working Group on the Risk of Blood Exposure / <i>Groupe d'étude sur le risque d'exposition des soignants (aux agents infectieux)</i>
GRE / <i>ERG</i>	Glycopeptide Resistant Enterococci / <i>Entérocoques résistants aux glycopeptides</i>
GREPHH	Hospital Hygiene Assessment Task Force / <i>Groupe d'évaluation des pratiques en hygiène hospitalière</i>

HACCP	Hazard Analysis Critical Control Point
HAI/ <i>IAS</i>	Healthcare-Associated Infection / <i>Infection associée aux soins</i>
HAS	French National Authority for Health / <i>Haute autorité de santé</i>
HBV / <i>VHB</i>	Hepatitis B Virus / <i>Virus de l'hépatite B</i>
HCRI/ <i>IAS</i>	Health Care-Related Infection / <i>Infection associée aux soins</i>
HCSP	Higher Council for Public Health / <i>Haut conseil de la santé publique</i>
HCV / <i>VHC</i>	Hepatitis C Virus / <i>Virus de l'hépatite C</i>
HIV / <i>VIH</i>	Human Immunodeficiency Virus / <i>Virus de l'immunodéficience humaine</i>
HSV	Herpes Simplex Virus (Herpes virus)
ICSHA	French indicator for the consumption of alcohol-based solutions / <i>Indice de consommation de solutions hydro-alcooliques</i>
ICT / <i>EOH</i>	Infection Control Team / <i>Équipe opérationnelle d'hygiène</i>
IDR	Intradermal reaction / <i>Intra-dermo réaction</i>
IGRA	Interferon gamma release assay / <i>Test de dosage de l'interféron gamma</i>
INVS	French Institute for Public Health / <i>Institut de veille sanitaire</i>
IUAIUC / <i>IUASAD</i>	Urinary Anfection Associated with Indwelling urinary catheter / <i>Infection urinaire associée au sondage urinaire à demeure</i>
IUC/ <i>SAD</i>	Indwelling Urethral Catherization / <i>Sondage vésical à demeure</i>
IVD / <i>DIV</i>	Intravascular device / <i>Dispositif intravasculaire</i>
IW/ <i>DASRI</i>	Infectious Waste / <i>Déchet d'activité de soin à risque infectieux</i>
KB/ <i>BK</i>	Koch's bacillus / <i>Bacille de Koch</i>
LTBI / <i>ITL</i>	Latent Tuberculosis Infection / <i>Infection tuberculeuse latente</i>
LTC / <i>SLD</i>	Long-Term Care / <i>Soins de longue durée</i>
MA / <i>DM</i>	Medical Apparatus / <i>Dispositif médical</i>
MDRO/ <i>BMR</i>	Multi-Drug Resistant Organisms / <i>Bactéries multirésistantes</i>
MID / <i>DIM</i>	Medical Information Department / <i>Département d'information médicale</i>
MPA / <i>EPP</i>	Medical Practice Assessment / <i>Évaluation des pratiques professionnelles</i>
MRSA / <i>SARM</i>	Methicillin Resistant <i>Staphylococcus Aureus</i> / <i>Staphylococcus aureus résistant à la méticilline</i>
MSO/ <i>MCO</i>	Medicine-Surgery-Obstetrics / <i>Médecine, chirurgie, obstétrique</i>
MVAP/ <i>PAVM</i>	Mechanical Ventilation Associated-Pneumonia / <i>Pneumopathie associée à la ventilation mécanique</i>
NF EN	French Standard Mandated by the European Union / <i>Norme française mandatée par l'Union Européenne</i>

NI / <i>IN</i>	Nosocomial Infection / <i>Affection nosocomiale</i>
NIC/ <i>LIN</i>	Nosocomial infection control / <i>Lutte contre les infections nosocomiales</i>
NIHW / <i>DAOM</i>	Non-Infectious Hospital Waste / <i>Déchets assimilables aux ordures ménagères</i>
NIV / <i>VNI</i>	Non-Invasive Ventilation / <i>Ventilation non invasive</i>
NUI/ <i>IUN</i>	Nosocomial urinary infection / <i>Infection urinaire nosocomiale</i>
OPCT	Needles and Sharp or Cutting Objects / <i>Objets piquants, coupants, tranchants</i>
PCR	Polymerase Chain Reaction (molecular biology method)
PEP / <i>PPE</i>	Post-Exposure Prophylaxis / <i>Prophylaxie post-exposition</i>
PFF / <i>FFP</i>	Particle Filtering Facepiece / <i>Pièce faciale filtrant les particules</i>
RPE/ <i>APR</i>	Respiratory Protective Equipment / <i>Appareil de protection respiratoire</i>
PVC / <i>CVP</i>	Peripheral Venous Catheter / <i>Cathéter Veineux Périphérique</i>
RABC	Risk Analysis and Biocontamination Control
RAISIN	National program for early warning, investigation and surveillance of healthcare-associated infections / <i>Réseau d'alerte, d'investigation et de surveillance des infections nosocomiales</i>
RSV / <i>VRS</i>	Respiratory Syncytial Virus / <i>Virus respiratoire syncytial</i>
SARS / <i>SRAS</i>	Severe Acute Respiratory Syndrome / <i>Syndrome respiratoire aigu sévère</i>
SDD / <i>DDS</i>	Selective Digestive Decontamination / <i>Décontamination digestive sélective</i>
SP/ <i>PS</i>	Standard Precautions / <i>Précautions standard</i>
SSI / <i>ISO</i>	Surgical Site Infection / <i>Infection du site opératoire</i>
TBI / <i>TM</i>	Tuberculosis Illness / <i>Tuberculose maladie</i>
TIVC/ <i>CCI</i>	Totally Implanted Venous Catheter / <i>Chambre à cathéter implantable</i>
UAW / <i>VAS</i>	Upper Airway / <i>Voies aériennes supérieures</i>
UI / <i>IU</i>	Urinary Infection / <i>Infection urinaire</i>
VZV	Varicella Zoster Virus / <i>Virus de la varicelle et du zona</i>
WHO/ <i>OMS</i>	World Health Organization / <i>Organisation mondiale de la santé</i>

# Context

The measures introduced to control nosocomial infections (NI) appeared in 1988, and by decree it was made compulsory, in public and private hospitals contributing to the public health service (PSPH), to implement nosocomial infection prevention committees (CLIN). This was complemented in 1992 by the creation of a national structure, the technical committee for nosocomial infections (CTIN), in charge of proposing orientations for national policies and for five inter-regional structures, with the coordination centers for the prevention of nosocomial infections (CCLIN) having the mission of providing scientific and technical support to the hospitals, in terms of investigations, epidemiological enquiries, information and training. At this time, the first version of the document entitled *100 Recommendations for the surveillance and prevention of nosocomial infections*, whose aim was to “serve as a guide for the acts decided by the presidents and members of the CLIN” and “to report on the priority actions to be implemented”. The periodic revision of these recommendations was mentioned.

Nosocomial infection control (NIC), which since this date was drafted into the public health law, and was then extended to all health establishments, public or private, by the decree of December 6, 1999. This decree stipulates that each hospital must elaborate a plan of action for PNI, and must establish an operational team for the promotion of hospital hygiene and the prevention of nosocomial infections (EOHH-PIN). The decree also requires that hospital hygiene correspondents be nominated (one medical correspondent and one paramedical correspondent from the personnel of each service or activity sector) in order to convey the implementation of preventative actions and the surveillance of nosocomial infections to the personnel. Finally, it is stipulated that the role of each hospital's occupational health service is to participate in the evaluation of biological risks for healthcare workers and become involved in the management of these risks, to monitor the screening and prevention of professional sicknesses, in particular of infectious origin, to ensure that all personnel have protective vaccinations, and to ensure that the staff are suitably trained and informed. During the course of this period of time, a second revision of the *100 Recommendations for the surveillance and prevention of nosocomial infections* appeared in 1999, “characterized by a similar philosophy” to that of the initial publication. A further decree<sup>1</sup> then imposed the declaration, by any hospital or non-hospital professional, of any undesirable event related to medical healthcare, in particular the occurrence of a NI. The implementation of the reporting of nosocomial infections in hospitals was accompanied by texts<sup>2</sup> dealing with the information of patients, and their participation, through users' representatives, in the NIC.

The organization of the NIC then underwent various modifications. In 2004, a permanent working group named the ‘Technical committee for nosocomial infections and healthcare-associated infections’ (CTINILS) was created under the auspices of the Higher council for public health of France (CSHPF). This replaced the CTIN created in 1992. The publication, in June 2007, of a broader definition for infections arising during healthcare was an important step: thereafter, one referred to healthcare-associated infections, independently of their place of origin<sup>3</sup>. A NI is thus a healthcare-associated infection occurring in the context of healthcare provided in a hospital. The short version of definitions for these healthcare-associated infections, according to anatomical location, is provided in the annexes to this document. The creation of the Higher Council for Public Health (HCSP), including the CSHPF and the Higher Committee for public health, led to the disappearance of the CTINILS in 2008, and to the creation in 2009 of the specialized commission: “Patient safety: nosocomial infections and other undesirable events related to healthcare and practice” (CsSP).

In an effort to ensure transparency to those benefiting from the health system, starting in 2004 the ministry of health expressed the wish for NI and healthcare-associated infections prevention indicators to be introduced. A “nosocomial infection scoreboard published every year allows the evolution of NI in hospitals to be monitored, using five indicators:

- The composite indicator of NI prevention activities, which measure the organization, means and actions used to prevent NI;
- The ICSHA (French indicator for the consumption of alcohol-based solutions), which measures the quantity of hydro-alcoholic solution used by the healthcare givers for hand hygiene, before and after healthcare, with a desired objective being defined for each hospital according to its type of activity;
- The “operating site infection surveillance” indicator, or SURVISO, which gives the number of surgical units taking part in this surveillance;
- The “antibiotic consumption” indicator, or ICATB, which indicates the organization, prescription modalities (protocols), dispensing (computer registration), and the quantity of antibiotics consumed by all of the hospital services;
- The “rate of methicillin resistant *Staphylococcus aureus*” or MRSA indicator, which represents the rate of occurrence, averaged over a period of three years, of methicillin resistant *staphylococcus aureus* for every 1000 hospital days; it takes isolated *staphylococci* found in diagnostic samples into account; methicillin is the resistance marking antibiotic for this bacterium; MRSA is one type of antibiotic multiresistant bacteria (MDRO).

These indicators are supplemented by an aggregate score, determined from the results of each of the first four of the aforementioned indicators. Hospitals are obliged to report these indicators to users, as was defined in the priorities of the 2005-2008 NIC program, and has recently been included in various regulatory texts <sup>4, 5, 6</sup>.

Since 1995, there have been two successive national programs, 1995-2004 and 2005-2008, aimed at promoting priority actions for PNI, by defining major orientations. Their preparation is based on a pilot group for the prevention of nosocomial infections program. These programs are assessed on the basis of the achievement of quantified national objectives. In parallel, in order to conserve the efficacy of antibiotics, a coordinated national policy was implemented through a multiannual program of actions. The published results <sup>7, 8</sup> were judged to be globally satisfactory, with the exception of the consumption of hydro-alcoholic solutions and the surveillance of operating site infections.

The new program of actions for the period 2009-2013 includes two components:

- The national strategic plan for the prevention of healthcare-associated infections (PNSP-HAI), with three sector-wide programs (hospitals, medico-social establishments, ambulatory care) and two plans:
  - The existing national plan for the conservation of antibiotic efficacy (<http://www.sante.gouv.fr/plan-antibiotiques/index.html> [last updated on May 13 2010]),
  - A future “national plan of actions for the control of MDRO”, coordinated with the national plan for the conservation of antibiotic efficacy,

■ The program for the prevention of hospital-specific nosocomial infections (PROPIN).

The general objectives of the PNSP-HAI) are to reinforce the organization of the prevention of healthcare-associated infections, provide a structure for the implementation of healthcare-associated infections preventative actions, and take actions with respect to the drivers affecting the risk of healthcare-associated infections.

The objectives of PROPIN<sup>10</sup> are to promote a shared culture of healthcare quality and safety, to optimize the collection and utilization of surveillance data, to anticipate and detect the emergence of pathogenic organisms capable of leading to an epidemic, to ensure that the user remains central to the program, to improve the program's organization for the prevention of NI and to promote research on NI. The PROPIN foresees the establishment of a second generation of indicators, and quantified objectives in 2012 (nationwide results and means for the hospitals). The application of this program will be the responsibility of the organizations defined in the hospital, in accordance with the relevant regulations.

It is thus in this context that the third version of *Surveillance and prevention of healthcare-associated infections* has been edited.

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1- Decree n° 2001-671 du 26 juillet 2001 (J.O. 28 juillet 2001).

2- Circular DHOS \E2 - DGS\SD5C N° 21 du 22 janvier 2004.

3- [http://nosobase.chu-lyon.fr/recommandations/defIN\\_complet.pdf](http://nosobase.chu-lyon.fr/recommandations/defIN_complet.pdf) (consulté le 13 mai).

<sup>4</sup> Decree dated December 30, 2009, fixing the conditions under which hospitals make the results of quality and care safety indicators, published every year, available to the public.

<sup>5</sup> Decree n° 2009-1763 of December 30, 2009 relating to the dispositions applicable in cases where hospitals do not respect the requirement of making the results of quality and care safety indicators available to the public.

<sup>6</sup> Instruction DGos/pf n° 2010-192 of June 9, 2010 relating to the practical measures to be used by hospitals to make the results of quality and care safety indicators available to the public.

<sup>7</sup> Hajjar J. Healthcare associated infection control in France: 2005-2008 national program. J Hosp infect 2008; 70 suppl 1: 17-21.

<sup>8</sup> Carlet J, astagneau P, Brun-Buisson C, Coignard B, Salomon V, Tran B, *et al.* French national program for the prevention of Healthcare-associated infections and antimicrobial resistance, 1992-2008: positive trends, but perseverance needed. Infect. control Hosp. epidemiol. 2009; 30: 737-745.

<sup>9</sup> Interministerial circular DGs/DHos/DGas/2009/254, of August 19, 2009

<sup>10</sup> Circular ref. DHos/DGs/2009/272 of August 26, 2009



# Target-Objective-Methodology

## Targeted readers and the aim of this document

Non-hygienists, in particular hygiene medical and paramedical correspondents for hygiene, independently of the place of their practice, are the main target of this document. However, the structure of the document will help hygienists, in particular at the beginning of their practice, to find detailed information.

The aim is to provide healthcare professionals with a basic and reference document containing some of the fundamentals of minimal measures to be applied.

## Methodology

The recommendations of the National Health Service (UK) were used as a model for constructing the suggested methodology<sup>8</sup>.

It relies on the following principles:

- No contradiction with prevailing regulatory requirements and recommendations;
- Specialty- or setting-related specificities are mentioned for each of the addressed topics;
- Medical devices are excluded from the treatments (disinfection, sterilization).

As to the literature review, the main and most recent publications (in particular, national and foreign recommendations, in French and English), pertaining to each one of the topics to be addressed, were made available to the drafters<sup>9</sup>. They added, when appropriate, references which they deemed absolutely essential for the addressed subject.

Recommendations have not been subjected to any grading system in terms of recommendation strength and evidence level. When further evidence levels were not available, expert consensus recommendations were retained.

One chapter covers the following aspects:

- a brief rationale;
- the recommendations themselves;
- criteria for assessing medical practices, namely simple and operational good practice for "appraising through measurements, quality and safety of a patient's care, and improving practice, in particular by implementing and monitoring actions leading to the convergence, when appropriate, of real practice and reference practice" (as defined by the French Authority for Health); these criteria may be used prospectively or retrospectively according to the type of action or program selected; the retained criteria should illustrate a significant part of the professional's or teams' activities and there should be a potential for improving quality and security;

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<sup>8</sup> - PRATT RJ , PELLOWE CM, WILSON JA , LOVEDAY HP, HARPER PJ, JONES SRLJ, *et al.* epic2: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England. J Hosp Infect 2007; 65S: S1-S64.

<sup>9</sup> - This research was carried out using the NOSOBASE documentation center by NATHALIE SANLAVILLE, documentalist Webmaster at CCLIN sud-est.

- specificities related to particular settings or environments: intensive care, pediatrics, geriatrics, extended care and rehabilitation, dialysis, psychiatry, homecare, private practice, prisons;
- research topics, by identifying measures that are still not based on clearly defined scientific evidence levels, and require further research for elucidating uncertainty issues;
- a "further reading" section referring to specialized articles or books or targeted recommendations and Web links, etc.;
- bibliographic references.

## Drafting-Distribution

In April 2008, CTINILS appointed a steering committee to draft revision proposals, which have later been confirmed on May 14th 2008 during a plenary meeting. Preliminary work carried out during the previous CTINILS term was taken into account.

The members of the CTINILS committee as well as outside experts were called upon for elaborating these guidelines.

The guidelines have been proofread by field practitioners appointed by each of the five CCLIN committees (nearly 60 proofreaders).

Before its distribution, the document was submitted to the CsSP department of HCSP which unanimously approved it on May 18th 2010.

This document has been designed to be distributed entirely or partly in electronic and printable form; regular follow-up and updating is planned.



# Summary of Recommendations

## Surveillance of healthcare-associated infections

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### SURVEILLANCE IMPLEMENTATION

**R1** Each health or medico-social establishment should define its healthcare-associated infection surveillance policies, taking the specificities of its clinical activities, any regulatory restrictions and the means it can deploy for this activity, into account.

**R2** In each hospital, the healthcare professionals, hygienists and epidemiologists should contribute towards the definition of the detailed surveillance protocol(s), with particular attention being paid to the following points: relevance of the selected indicators, periodicity, modalities for the determination and use of indicators, workload and sharing of responsibilities, use of data recorded in the hospital's information system, confidentiality and access to information.

**R3** The persons in charge of the surveillance program should be clearly identified and mandated. They should take the references and protocols already established and tested into account, and should consult, whenever necessary, the reference authorities responsible for the surveillance of healthcare-associated infections (InVS, CCLIN).

### SURVEILLANCE UNDER OPTIMAL CONDITIONS

**R4** The persons in charge of the surveillance program, and the users of its results, should encourage their hospitals to include the surveillance of healthcare-associated infections in the development objectives of their information system. They should actively participate in the collaborative steps taken to develop a computerized surveillance system.

**R5** Whenever a computerized surveillance system is installed, each of the hospital professionals should contribute to the system by identifying those relevant items from medical, paramedical, biological, pharmaceutical, x-ray imaging and administrative files. The hygiene specialists should ensure that the collected information, as well as the automatically produced extractions and analyses, and their restitution and practical use by the healthcare teams, is of a suitable quality.

### NETWORK SURVEILLANCE IN SECTORS AT RISK

**R6** If they have the means to contribute efficiently, and in particular if they have a suitably adapted information system, dedicated personnel, and the methodological support of the infection control team, the healthcare units in specialized areas at risk are strongly encouraged to implement an “advanced” surveillance system linked to the national and inter-regional surveillance networks. They have the advantage of being able to be placed within a group of hospitals, and of taking part in collaborative research by contributing data to the national RAISIN databases, coordinated by the five CCLIN and InVS.

## SURVEILLANCE IN OTHER CASES

**R7** In the context of the national inquiry into the prevalence of healthcare-associated infections, each hospital should, on a five-year basis, organize a prevalence survey involving all of its departments. The professionals in the clinical and biological teams and the hygiene specialists should contribute their knowledge and experience to this survey. These prevalence surveys may be organized with a shorter periodicity.

**R8** In the absence of computerized surveillance or participation in a surveillance network, each healthcare unit in a specialty at risk (surgery, obstetrics and critical care in particular) should implement a minimum active identification and computerized recording process for significant healthcare-associated infections, including the following information: type of infection, date of appearance, responsible microorganism(s), code of any eventual surgical procedure. In collaboration with the MID, the infection control team is responsible for the analysis and generation of “simple” occurrence indicators and their temporal tendencies: SSI incidence rates, at least those which occurred during hospitalization (% according to each type of operation targeted by the surveillance), incidence rate of other healthcare related infections according to type, and for 1000 hospital days. The healthcare units should propose the most appropriate indicators for their activity, for example: rate of meningitis following an external ventricular derivation, rate of endometritis following Caesarean sections, infection rate on totally implanted venous catheters, etc.

**R9** The laboratory in charge of microbiology should warn both the healthcare and infection control teams in the following situations: results leading to the suspicion of a serious case of healthcare-associated infections, grouped healthcare-associated infection occurrences, unusual or dangerous germs (severe infections, risk of the spread of infection, for example ...) or any other situation corresponding to the criteria of the healthcare-associated infection reporting mechanism.

**R10** All laboratories in charge of microbiology, pharmacies and occupational medicine teams in hospitals contribute to the transverse surveillance systems organized to monitor the evolution (local or general) of antibiotic multi-drug resistant bacteria, of the consumption of antibiotics, and of blood and body fluid exposure accidents. The data from these surveillance systems are returned to the healthcare teams.

**R11** Whenever it is suspected that a healthcare-associated infection has a localized origin (environmental contamination, errors at the “sharp end”, mistakes, etc.), this infection must be submitted to multidisciplinary analysis and, when applicable, presented to the unit for a mortality-morbidity review. Grouped cases must be submitted to an epidemiological investigation.

## Reporting of nosocomial infections

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### ORGANIZATION, TRAINING, ASSESSMENT

**R12** The reporting mechanism for NI is based on the organization of internal reporting, and the training of the various actors within the hospitals concerning the operation and purpose of reporting. It would be advantageous for this internal reporting mechanism to be computerized. Finally, it should be assessed on a regular basis.

## ROLE OF THE PERSON IN CHARGE OF REPORTING

**R13** The management of each hospital should nominate a person in charge of reporting, who is responsible for: (1) establishing this internal organization through the use of local sources of information related to the NI (laboratory, patient files [DIM encoding] ...), whilst ensuring relevant internal communication and informing the caregivers, persons in charge, and clinical department executives; (2) supplying external reports to the CCLIN and to the health authority (ARS).

## ROLE OF THE INFECTION CONTROL TEAM PRACTITIONER

**R14** The practitioner analyses all internal reports in order to evaluate, together with the Reporting officer, the NI corresponding to the criteria for external reporting. For any NI requiring an external report, he/she makes an investigation with the help, if necessary, of the available procedures (for example via the CCLIN or the InVS) or by taking direct advantage of the ARLIN or CCLIN team. He/she must also organize the feedback and return of experience within the hospital (clinical departments, CCLIN, head office ...) following any external report, and ensure that the patient or his/her close family are informed.

It is essential that all information relative to the investigation be archived in paper or digital form in order for it to remain reusable (new reports, similar cases, scientific publications, etc.).

## Managing and controlling a healthcare related epidemic

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### CRISIS CELL

**R15** It is recommended, in the case of an epidemic situation, which is recognized and confirmed by the infection control team, to: 1) implement a crisis team within the hospital; 2) include at a minimum the hospital director or his representative, the person in charge of the coordination of risk management, the head and the health care executive of the affected department; 3) define the crisis cell's mission: identification of the means of prevention and control of the epidemic, define communication policies inside and outside the hospital, nominate a multidisciplinary investigation coordinator.

### INVESTIGATION

**R16** It is recommended that the investigation be carried out by a pluridisciplinary team. The infection control team must be able to coordinate the investigation, in collaboration with the ARLIN and the CCLIN, or the health authority in the case of specific difficulties, or national reference centers or expert laboratories in the case of microbiological investigations.

**R17** It is recommended:

- to confirm the epidemic, and clearly define and identify each case;
- to describe the epidemic in time, place and as a function of the individual characteristics of each case.

**R18** Once the initial measures have been established, it is recommended:

- to develop a hypothesis concerning the relationship between “source, infectious organisms, means of transmission, and favorable factors”, and if possible to test this using analytical methods (witness cases or a cohort), if there is a sufficient number of cases;
- to assess the applicability of an environmental or microbiological investigation (comparison of isolated strains).

## MEASURES TO BE IMPLEMENTED

**R19** Whatever the type of epidemic, it is recommended to reinforce the application of standard precautions and to propose possible additional preventative precautions, to be adapted to the situation as early as possible. It is very important not to defer the implementation of preventative precautions, and to wait neither for the outcome of microbiological and epidemiological investigations, nor for the verification of hypotheses under test.

**R20** It is recommended to assess the applicability of implementing cohorting of patients and healthcare personnel, in order to ensure that the preventative measures are efficient.

**R21** It is recommended to assess the applicability of implementing systematic screening of patients, persons in contact with “cases”, and possibly the healthcare personnel, depending on the pathogenic organism responsible for the epidemic, in collaboration with the microbiology laboratory and the occupational health service. In some circumstances, screening of the healthcare workers is not recommended, in the absence of convincing evidence of their role in the pathogen’s transmission. The decision to implement screening implies prior definition of the proposed collective or individual precautions.

**R22** It is recommended to inform the health professionals and visitors of the precautions to be taken. This information must be in written form. Whenever patients are transferred, the receiving hospitals must be informed of the situation.

**R23** It is recommended to assess the applicability of informing patients who have already left the hospital, and who were exposed to the risk of infection.

**R24** It is recommended to organize internal communications with patients, visitors, hospital staff and, if necessary, external communications (authorities, CCLIN, InVS, media, etc.).

**R25** It is recommended to implement monitoring of each new case and thus to evaluate the efficacy of the precautions taken.

**R26** It is recommended to organize an audit of care practices.

**R27** In the case of an epidemic corresponding to the criteria requiring a report, it is recommended to proceed, as quickly as possible, with external reporting to the health authorities and to the CCLIN of any confirmed epidemic situation. The reporting is carried out by the hospital’s officer in charge of the external reporting of HAIs.

**R28** It is recommended to draft an epidemic investigation report in order to encourage the lessons-learned process.

## Standard precautions

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### HAND HYGIENE

**R29** Prior to hand hygiene procedures, the healthcare giver must wear short-sleeved professional clothing, have short fingernails (1 mm or less), with no false fingernails or nail polish, and wear no jewelry (including watches and wedding ring).

**R30** It is recommended to carry out hand hygiene procedures:

- immediately before any direct contact with a patient,
- before any clean care or any invasive procedure,
- between contaminating care and clean care or an invasive procedure with the same patient,
- following the last direct contact with, or care given to a patient,
- after any contact with body fluids,
- before pulling gloves on for care,
- immediately after removing gloves.

**R31** It is recommended, for hand hygiene, to use an alcohol-based handrub instead of simple washing, hygienic washing or surgical washing. If the hands are visibly soiled, it is imperative to perform first simple hand washing.

### WEARING OF GLOVES

**R32** Gloves are always to be worn when there is a risk of contact with blood or any other product of human origin, the mucosa or non-intact skin of a patient, in particular during care with splatter or splashing risks (hemoculture, blood sampling, insertion and removal of venous catheters, totally implantable venous catheter, ...). They must also be worn during the manipulation of biological sampling tubes, and soiled linen and equipment. They are systematically worn during any care for which the caregiver's hands have any lesions (cuts, wounds, abrasions or dermatosis).

**R33** It is not recommended to wear gloves during contact with intact skin. This recommendation is not relevant to the approach used to deal with certain microorganisms (toxigenic *Clostridium difficile*, glycopeptide-resistant enterococcus) for which there are specific recommendations.

**R34** Gloves are to be changed between any two patients or activities (including those involving the same patient). They should be worn just before the contact, care or treatment. They should be removed as soon as the care has been completed, and be disposed of before the wearer touches the surrounding environment.

### MASKS

**R35** Healthcare givers must systematically wear a surgical splash-resistant mask (norm EN 14683) with safety goggles or a full-face visor when giving care with a risk of blood or biological fluid splattering. These instructions are also applicable to visitors when they are involved in healthcare. The patient must wear a surgical mask (norm 14683) whenever he/she has a cough thought be of infectious origin, and leaves his/her room.

**R36** Healthcare givers and visitors must wear a disposable PFF (PFF1 or PFF2) type of BPA, compliant with the criteria of the EN 149 norm, in the case of the risk of exposure to microorganisms which can be communicated by aerosols. In the case of invasive acts, whenever there is a risk of exposure to certain types of microorganisms, which can be communicated by droplets or the air, the healthcare givers are to wear a disposable PFF (PFF1 or PFF2) type of BPA, compliant with the criteria of the EN 149 norm.

**R37** The mask must always be worn in such a manner as to cover the nose, chin and mouth, and must be hermetically applied to the face. It must not be repositioned or worn around the neck.

## PROFESSIONAL GARMENTS

**R38** The professional garments should be adapted to the use for which they are intended. They are to be changed daily and whenever they are soiled. They should be composed of a polyester / cotton mix (most often 65%/35%), allowing them to be washed at temperatures > 60°C. The garments' sleeves should be short, so as to permit efficient hand hygiene procedures. The hair should be clean and tied back.

**R39** A gown or a disposable plastic apron is systematically used to protect the garments, whenever there is a risk of splashing or aerosolization of blood or biological fluids. This protection is also to be worn during the direct care of a patient requiring additional contact precautions.

## Cross-contamination

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### CROSS-CONTAMINATION THROUGH CONTACT

**R40** The Standard Precautions (SP) are applicable to all patients; additional precautions are used to complement these.

**R41** Additional Contact Precautions (ACP) are associated with SP for patients carrying emerging, potentially highly cross-contaminating microorganisms, models of which are given by MRSA, GRE (glycopeptide-resistant enterococcus), *Clostridium difficile*, ESBLE (Extended-Spectrum BetaLactamase-Producing Enterobacteria), etc.

**R42** The precautions to be implemented are complementary to the SP (with a privileged role reserved for hand hygiene using alcohol-based hand-rubs). The indications for the wearing of disposable gloves do not differ in such ACP situations (they remain restricted to cases of exposure to biological fluids or blood). The wearing of a disposable gown or plastic apron over the professional garments is broadened to all cases of direct contact with the patient.

**R43** If the use of ACP has been decided for a given patient, these must be maintained throughout his/her stay in medicine-surgery-obstetrics. In the case of a patient carrying MRSA, provided a decontamination strategy is applied and its efficacy has been verified, the precautions may be lifted following two negative screenings.

**R44** Following the well-informed choice made by the CLIN (or equivalent consultative and monitoring authority), ACP may be associated with SP for:

- Methicillin resistant *Staphylococcus aureus*;
- Imipenem-resistant *Acinetobacter baumannii*;
- *Acinetobacter baumannii* sensitive only to imipenem;
- Extended-spectrum betalactamase-producing enterobacteria
- Cephalosporinase Hyper Producing Enterobacteria in neonatology;
- *Pseudomonas aeruginosa* with resistance to imipenem associated with other resistances.;

**R45** The CLIN (or equivalent consultative and monitoring authority) may define a cross-contamination prevention strategy, in between purely “SP ” and “SP + ACP ” if all of the following conditions are met:

- Availability of alcohol-based products close to the locations used for healthcare;
- High level of hand hygiene observance, measured on the basis of a large number of observations;
- High level of alcohol-based product consumption, with data available for each department;
- High level of use of ABHR (Alcohol-Based Hand Rub) for hand hygiene;
- Good practice in the wearing of gloves;
- Expertise / solid experience of the infection control team and the CLIN;
- Solid knowledge of microbial epidemiology, based on screening samples (notion of prevalence).

**R46** The CLIN (or equivalent consultative and monitoring authority), in the context of the general hospital policies:

- Defines a screening policy for these microorganisms, including MDRO, in agreement with the national recommendations (which microorganisms, for which patients, in which epidemiological context, according to which technique – concerning the sampling site and the microbiological technique);
- Keeps this policy regularly up to date;
- Adapts it to the needs of each different hospital department (critical care, general medicine, surgery, ...) and of the local epidemiological history, whether or not this relates to multiresistant bacteria.

**R47** The dissemination of information is organized as follows:

- The laboratory explicitly mentions (or notifies) the identification of one prioritized organism per hospital, and whether the samples indicate an obvious infection or colonization;
- A reporting policy for patients carrying a bacterium justifying ACP is defined by the CLIN or the hospital (distribution of logos, computer-based material, ...);
- The eventual screening of these microorganisms is coupled with the return of results to the teams and the implementation of ACP.



**R48** The organization of healthcare for patients under ACP should take the infectious risk into account:

- Use of individual rooms, grouping of patients in the same area of a unit, sectorized organization of healthcare (as opposed to sequential care), with all of the actors being informed (technical platforms, part-time caregivers, ...);
- The status of a patient “having to be put under ACP” should not preclude his/her permission to visit the technical platform for physiotherapy, the shared living spaces ... in the case of patients justifying ACP for an open infectious site, but should lead them to be accompanied by specific hygiene precautions.

**R49** The individualization of reusable equipment should be preferred in the room of a patient for whom ACP is applicable. Only limited quantities of materials should be stocked in the patient’s room. It is not necessary to systematically dispose of unused disposable material in the room of a patient for whom ACP is applied, including patients who are MDRO carriers. Similarly, no specific treatment is required for dishes, utensils and dirty washing in the case of a patient for whom additional contact precautions are applicable.

## CROSS-CONTAMINATION BY DROPLETS

**R50** Precautions to be applied to source patients:

- Patient to be placed in an individual room, or grouping of patients affected by the same pathology in a shared room or in the same unit;
- Wearing of a surgical (so-called healthcare) mask in the presence of other persons, use of disposable handkerchiefs and frequent hand hygiene;
- Restriction of the patient’s movements beyond his/her room, and the wearing of a surgical mask when appropriate.

**R51** Precautions to be applied to healthcare workers:

- Wearing of a surgical (so-called healthcare) mask and safety goggles for any near contact at a distance closer than one meter from the patient;
- Hand hygiene for any contact with source patients or their immediate surroundings: the alcohol-based products must be effective on infectious agents which can be transmitted by droplets.

## Environment and microorganism pathways

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### AIR

**R52** The hospitals are to establish a pluridisciplinary team in charge of the global air quality strategy. This team includes representatives from the infection control team, the technical and/or biomedical services management, the head of the laboratory responsible for analysis of the air quality, at least one biomedical technician, and representatives of the healthcare personnel (executives and/or doctors), the occupational health doctor, and a specialist in risk management if the hospital has such an employee (“environmental group”: which may be common to air, water and construction work).



**R53** Those units which have *aspergillus* risk patients (neutropenics with an aplasia of less than 500 granulocytes for more than two weeks, or less than 100/mm<sup>3</sup> for any duration, immuno-suppressed patients, whose airways are colonized by *aspergillus* or who have a history of *aspergillus*, allografted patients) are to implement an organization to deal with:

- Identifying aspergillus risk patients;
- Verifying that the accommodation conditions correspond to the patient's level of risk (protective isolation for very high risk patients);
- Limiting the patient's movements and, in the case of absolutely necessary movements, providing adapted protection (e.g. PFF1 type protective breathing apparatus and protective garments for a patient under laminar flow);
- Planning of microbiological air and surface surveillance (to test for Aspergillus).

**R54** The operating room organization allows:

- It to be ensured that the rooms are qualified on a regular basis (at least once per annum);
- It to be ensured that training in biocleaning and surface and equipment cleaning procedures is given to all new personnel who are assigned to such tasks;
- It to be ensured that the cleaning and maintenance of the rooms is traceable;
- Periodic microbiological tests to be defined and organized with the infection control team, in order to verify the efficiency and correct application of the cleaning procedures;
- Process verifications (filtering, overpressure, flow rate, air renewal rate) to be planned;
- The level of overpressure to be verified and recorded daily, before the rooms are opened;
- A procedure to defined for restarting the rooms, following an interruption of the ventilation system.

## WATER

**R55** The hospital is to organize the global strategy for appropriate control of the water quality, by establishing a pluridisciplinary team associating the infection control team, the pharmacist (in charge of dialysis water), the person in charge of the technical department, the person in charge of the laboratory which undertakes the water analysis, at least one technician in charge of the water system, and representatives of the healthcare workers (executive staff or doctors), and a specialist in the management of risks, if the hospital has such an employee ("environment group": which may be common to air, water and construction).

**R56** The organization of water risk management foresees, within each department, that:

- professionals receive training on the risks associated with water, in particular those related to legionella, and to the cleaning procedures for drinking fountains, refrigerated drinking fountains and icemakers, for all new personnel assigned to such tasks;
- the traceability of the application of the cleaning procedures for drinking fountains (descaling and disinfection) as well as the traceability of filter changes (for filtered water supply taps) is ensured;
- rarely used water supply taps are either regularly purged, or suppressed.

## CONSTRUCTION

**R57** Major construction work may justify the removal of the affected hospital department or unit to a different area, which is suitable for the correct functioning of healthcare activities. The zone under construction must be isolated by means of sealed partitioning, and a protocol defining the movement of persons, construction materials and debris in space and time must be drafted, validated and posted in the construction zone. The adjacent departments are informed, must keep their doors and entry locks closed, and increase the frequency of cleaning in the areas adjacent to the construction zone. The movement of patients at risk within these areas is to be forbidden.

**R58** Minor construction work may be carried out in a functioning unit, provided that:

- the risk is evaluated (taking into account the patients at risk, in particular those who are immuno-depressed, and using a risk evaluation grid ...);
- the persons in charge are identified;
- the intervention methods are formally planned (who, what, where, when, how) and the protocols are validated;
- dust accumulation is limited (tools with integrated dust receptacles, dust vacuum cleaner with HEPA filters, humidification by means of water pulverization during all construction work which could produce dust: drilling of holes, removal of false ceilings, ...), sealing of air vents in premises isolated for construction work and testing of the air quality is carried out if necessary (close to the units at risk);
- the doors are kept closed (those of the patients' rooms, as well as those of other areas in the department);
- cleaning is enhanced to several times daily, and is recorded;
- the reporting of any dysfunction (insufficient or unapplied precautions) is clearly organized, and corrective measures are promptly implemented.

**R59** A department may be reopened, following construction work, only if:

- the air-conditioning system has been verified (extraction gratings cleaned, air quality compliant with the expected values);
- the microbiological quality of the water corresponds to the expected values (revivable aerobic flora, absence of *Pseudomonas aeruginosa*, *legionella* ...);
- very careful cleaning of the rooms has been carried out;
- in the case of a unit at risk, the tests for the presence of *Aspergillus* have been carried out and the results correspond to the expected values;
- a visual evaluation of the rooms has been carried out by the person in charge of cleaning operations, or by a health service executive.

## ROOM HYGIENE

**R60** Each hospital must:

- classify the premises according to the risk of infection;
- define a hygiene policy for the premises (equipment, methods, cleaning products, cleaning frequency) in accordance with the predetermined level of infectious risk;
- appoint a person in charge of hygiene of the premises, whose main assignments, in collaboration with the infection control team (ICT), are to supervise the drafting of data sheets and procedures, coordinate the hygiene policies for the premises throughout the hospital (selection of equipment and cleaning products, organization ...), introduce cleaning service evaluations and take part in the organization and training of the personnel responsible for cleaning the premises;

- prefer ergonomic and hygienic cleaning methods which avoid any redistribution of microorganisms (sweeping, wiping with a damp cloth, washing flat surfaces);
- if the hospital appoints an external service provider, implement contract specifications which include technical provisions (descriptions of the relevant zones, frequencies, cleaning products, equipment, clothing, training of the personnel, service evaluation, etc.);
- implement a training course for the cleaning personnel (recruitment training and continuous professional training) which is regularly renewed and assessed, taking the specificities of the infectious risk areas into account.

**R61** The management and usage procedures for cleaning products provide for:

- limiting the number of products available for the cleaning of the premises, in order to avoid confusion, misuse and inappropriate mixtures;
- cleaning the floors with a detergent or detergent-disinfectant, except for floors soiled by biological liquids, in which case a disinfecting detergent must be used (operating rooms, laboratories ...);
- verifying adherence to instructions for the use of cleaning products (dilution, expiry date, contact duration);
- labeling and dating of bottles, and avoidance of the mixing of products, in order to prevent any professional chemical risk ("cleaning product" technical datasheets prepared for this purpose);
- selection of cleaning products taking into account efficiency standards related to the expected objectives

**R62** The cleaning methods are subject to validated policies, staff training and planned assessments. These shall ensure that the following principles are taken into account:

- the cleaning equipment is to be in good condition, clean and specifically assigned to high infectious risk areas;
- the floor cleaning methods should make use of damp wiping, "flat cleaning" (using flat mop systems) and mechanization using autoscrubbers whenever possible (dry sweeping is prohibited, with the exception of outside areas);
- if used, vacuum cleaners must be fitted with filters which prevent the discharge of dust;
- steam cleaners are an efficient, ecological approach which is economical in terms of water and cleaning product consumption: in particular, they are recommended for extensive cleaning and for areas which are difficult to access;
- surfaces are cleaned using wipes (mops) which are disposable or re-usable (in the latter case, there shall be a sufficient quantity of wipes, and a used wipe shall not be dipped again into the detergent-disinfectant bucket); sponges are prohibited;
- cleaning must be carried out from top to bottom, and from the cleanest towards the dirtiest area; the chosen method must avoid re-soiling of an already cleaned surface;
- dirty linen, waste material and equipment must be removed before cleaning;
- complementary disinfection (sprays, aerosols) is reserved for a limited number of exceptional situations, such as an uncontrolled epidemic from a microorganism with a high potential for survival in the local environment;

**R63** Room cleaning is organized in such a way as to:

- ensure daily cleaning of the rooms, after washing and dressing, in the patient's presence. It is not indispensable, in the case of a patient requiring complementary hygiene precautions, for his/her room to be cleaned last, if the cleaning operations are under good overall control: the mops and wipes are to be changed for each room;
- clean, every day, all surfaces which are frequently touched by patients and care givers

during healthcare operations;

- meticulously clean a patient's room (bed, toilets, cupboard, upper surfaces) following his/her discharge;
- in order to mitigate fouling and dust accumulation in certain areas, plan and ensure the traceability of comprehensive cleaning: air-conditioning vents, light fittings, radiators ... The frequency of comprehensive cleaning shall be adapted in accordance with the type of premises and the specific nature of the hospital (long-term care, nursing homes for the dependent elderly ... ).

## LINEN

**R64** Clean linen must be stored in a special-purpose room, which does not communicate with areas allocated to other functions. The size of this room must be adapted to the volume of linen, and rotation of the stock must be ensured. Its design must make it easy to clean: absence of humidity, smooth, rot-proof surfaces, no zones prone to the accumulation of dust, coved skirting. The room must be cleaned regularly. All professionals who access this room must be wearing clean clothes and have disinfected their hands. If the linen supplied by the dry-cleaning service has a plastic protection, this must be kept during storage of the linen, and removed only when it is used. The usefulness of sterilizing linen has never been demonstrated, including its use for fragile patients (hematology, neonatology ..).

**R65** The supply trolley used by care givers during clothing changes and serial toilet care must be stocked daily with a carefully adjusted quantity of linen. The supply trolley must be emptied every day and cleaned by humid wiping with a detergent-disinfectant. A supply trolley used for clean linen only should be preferred, with dirty linen being placed into a separate collection bin.

**R66** The professional garments must be changed every day, and whenever they are soiled. Their cleaning must be organized internally or through a sub-contractor, by the hospital. The frequency with which bed linen is changed depends on the patient and the care he/she receives: daily changing of linen is not necessary for able-bodied patients. Only the quantity of linen needed for a patient's care and the making of his/her bed should enter the room. Special mattress covers intended for the prevention of bedsores must be cleaned between patients, and destroyed as soon as they appear to no longer be impermeable.

**R67** The management of dirty linen within healthcare units must observe the following hygiene rules:

- systematically carry out hand hygiene before handling clean linen, and following the handling of dirty linen;
- avoid any contact between dirty linen and one's professional garments;
- handle dirty linen with care, in order to avoid the dissemination of microorganisms into the environment;
- wear disposable gloves when handling linen soiled by biological liquids, and do not touch the face with one's hands during work;
- verify there are no foreign objects in the pile before eliminating dirty linen;
- observe prior sorting, to simplify the work of the dry-cleaning personnel;
- prohibit the depositing of dirty linen on the floor or the furniture of a room, or at any intermediate location between the room and the collector;
- when removing the linen to the collector, use the non manual opening system, do not fill the bags by more than two thirds of their capacity, and do not transfer dirty linen from one bag to another;
- do not bring the collector trolley into the rooms;

- prohibit the storage of linen bags in the patient's room, even if he/she requires additional precautions;
- following their closure, take the linen bags directly to the dedicated storage room (ventilated, and well cleaned) at least once a day, without dragging them on the floor;
- clean and disinfect the linen bag holders every day;
- if the domestic types of washing machine are used in some units, monitor their usage and cleaning by means of precise and validated cleaning protocols.

## FOOD

**R68** Food safety is governed by rules and the resulting measures are applied throughout the food chain, as well as inside the healthcare units. The main points are related to:

- temperature control of food until the time when it is eaten (absolute observance of the cold and hot chains up until the last meal is served);
- traceability of all products and all production steps;
- observance of hygienic conditions and cleanliness of the storage areas;
- observance of hygienic conditions when the meals are served;
- training of the personnel, in particular of the person in each healthcare unit, who is responsible for distributing the meals.

## WASTE MATERIAL

**R69** The hygiene rules to be observed in healthcare units are as follows:

- during care, place the individualized waste collection bag and the Needles and Sharp or Cutting Objects (NSCO) container near to the patient;
- prohibit the introduction of the waste collector trolley into rooms;
- prohibit the storage of IHW in a patient's room, except in cases where there is a considerable and continuous production of waste during the course of the day (critical care for example);
- when waste is removed in the collector, use the non manual opening system;
- never fill the bags up to more than two thirds of their capacity, and do not transfer waste from one bag to another;
- during transportation to the storage room, at least once a day, ensure that the waste containers are perfectly closed and are clean on the outside; do not place the bags on the floor, do not leave waste in clean areas;
- wear gloves during the transportation of the bags to the storage room, and observe hand hygiene procedures after removal of gloves;
- keep the bag holders clean by means of humid wiping with a detergent-disinfectant once a day, and whenever they are soiled.

# Urinary infections

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## GENERAL PRECAUTIONS

**R70** Isolated cases of incontinence are not an indication for the use of an indwelling urinary catheter. It is recommended to use alternative methods (absorbent protections, penile sheath, iterative bladder catheterization), exposing the patient to a lower risk of infection, rather than permanent catheterization.

**R71** The best adapted method for the situation of each patient should be evaluated and recorded in the patient's file. Periodic re-evaluation is necessary and must also be traceable. Any indwelling or sub-pubic catheter should be removed as soon as possible.

**R72** The use of ultrasound imaging of bladder volume to define the best suited drainage method and the most suitable periodicity, in the case of drainage catheters, must be developed in all specialist services.

**R73** The systematic search for bacterial infections (bacteriuria) is not recommended. The treatment of asymptomatic bacterial infections (bacteriuria) is not recommended. This must be limited to specific indications, such as the treatment of a patient in the case of a surgical operation with an infectious risk.

**R74** Health professionals must be trained and have practice in the various catheterization techniques and in the care of catheterized patients. The patients and their families must be educated in their role in the prevention of UI (Urinary Infections) (and be trained and have experience if they are to carry out catheter insertions themselves).

## INDWELLING BLADDER CATHETERIZATION

**R75** Choose material with which one is familiar, which is adapted to the clinical needs, and which takes the expected duration of the catheterization into account. Choose a catheter with as small a diameter as possible; a 10 ml balloon is normally sufficient for an adult; in urology a larger diameter and a balloon with a greater capacity are recommended. Use a sterile single dose of lubricant or anesthetic.

**R76** When the catheter is inserted, the IUC must be connected to a sterile collection bag allowing closed-circuit drainage. Verify that the system cannot become disconnected, apart from the case of essential clinical needs such as the changing of the bag in accordance with the manufacturer's instructions.

**R77** Other precautions:

- disinfect the hands and pull the gloves on, before any manipulation of the IUC (including emptying); disinfect the hands following removal of the gloves;
- make aseptic use of the sampling site whenever urine samples are taken;
- place the bag so as to avoid any reflux and prevent it from coming into contact with the ground;
- empty the collector bags regularly to avoid any reflux; use a clean recipient for each patient in order to limit contamination of the drainage cocks;
- do not put any antiseptic product in the bag, do not implement any antibioprophylaxis;
- do not systematically change the catheters, except in the case of specific indications



given by the manufacturer;

- routine personal hygiene is sufficient in the case of an IUC;
- irrigations or instillations of the bladder must not be used for the systematic prevention of urinary infections;
- It may be useful to change an IUC in the case of a urinary infection, but this change must not be made before at least 24 hours of correctly adapted antibiotic treatment;

## PENILE SHEATH

**R78** Routine patient hygiene must be carried out; special attention must be paid to the patient's cutaneous condition, and to drying after washing. The use of antiseptics is not recommended. Daily changing may be proposed, to be adapted according to the devices used.

## SUPRAPUBIC CATHETER

**R79** Catheter insertion should be performed by a trained surgeon: follow aseptic technique at a surgical level (pre-operating shower, antisepsis combining cleansing, rinsing, drying, and application of an alcohol-based antiseptic, operator's clothing, protective sterile drape, and aseptic insertion). The catheter should be connected to a sterile collector bag for closed drainage. Ensure that the system cannot be disconnected except for good clinical reasons, e.g., changing the drainage bag in line with the manufacturer's recommendations.

**R80** Other measures:

- decontaminate the hands and put gloves on before manipulating the system (including when emptying the drainage bag);
- decontaminate the hands after removing the gloves;
- obtain urine samples from a sampling port using an aseptic technique;
- place the drainage bag so as to prevent reflux, and avoid contact with the floor;
- empty the urinary drainage bags frequently enough to prevent reflux; use a clean container for each patient so as to avoid contamination of the urinary drainage cocks;
- do not add antiseptic solutions into urinary drainage bags;
- do not change the catheter unnecessarily, except when specified by the manufacturer;
- bladder irrigation or instillations should not be used for the routine prevention of urinary infection;
- any clinical sign of an infection along the path of a catheter through the abdominal wall should be investigated promptly.

## EVACUATIVE OR ITERATIVE BLADDER CATHETERIZATION

**R81** Isolated evacuative catheterization is carried out with the same level of asepsis as urethral catheterization using a closed urinary drainage system. Specific pre-connected equipment is preferred, to prevent contamination of the environment.

**R82** Iterative catheterization, in contrast, is a "clean" procedure only intended for the prevention of cross-contamination.

**R83** Other measures:

- select familiar equipment and prefer self- or pre-lubricated, disposable equipment; if this kind of equipment is not available, the same catheter can be re-used several times in

outpatients, provided it is washed and dried;

- select a urethral catheter with the smallest diameter possible, except in surgery or maternity departments, where an adequate diameter will be chosen to ensure fast and complete evacuation of the bladder;
- clean the urinary meatus with soap and water, rinse; before each catheterization, apply antisepsis for a single evacuation catheterization;
- decontaminate or wash the hands before catheter insertion;
- ensure personal hygiene is observed routinely.

## Respiratory infections

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### NON-SPECIFIC MEANS

**R84** Use an alcohol-based handrub before and after contacting an intubated, ventilated or tracheotomized patient, before and after manipulating an artificial ventilation device used in a patient, with or without gloves. Gloves are used for manipulating respiratory secretions or equipment contaminated with such secretions. These gloves should be removed immediately after the manipulations, in combination with an alcohol-based handrub. A disposable sterile suction catheter should be used when open tracheal suction systems are employed.

### SPECIFIC NON-MEDICINAL MEANS

#### REDUCE INTUBATION TIME

**R85** Prefer the use of NIV and adhere to known indications. A weaning algorithm and analgesic sedation (avoiding unnecessary ventilation extension tubes) should be used to reduce intubation time.

#### INTUBATION, RESPIRATOR CIRCUITS AND STOMACH TUBE

**R86** The use of an oral tracheal tube is preferred in adults. The pressure in the intubation catheter balloon should be maintained between 25 and 30 cm H<sub>2</sub>O (between 20 and 25 cm H<sub>2</sub>O in children). It is not necessary to replace respirator circuits, except when they are visibly soiled. If filters are used, they should be replaced every 48 hours. The stomach tube should be removed as soon as possible, however its removal should be weighed up against the potential benefits of enteral feeding.

#### KINESITHERAPY AND PATIENT'S POSITION

**R87** The patient should be placed in a semi-seated position, as close as possible to an angle of 45°. A respiratory physiotherapeutic treatment should be carried out, even in ventilated and sedated patients.

### SELECTIVE ORAL-PHARYNGEAL AND DIGESTIVE DECONTAMINATION

**R88** A nasal and oral-pharyngeal routine decontamination by means of an antiseptic solution should be carried out.

**R89** In adults, SDD combined with a systemic antibiotic treatment has proven efficient in certain groups of patients. However, uncertainties still remain as to the choice and dosage of



molecules, and the duration of SDD and antibiotic treatment. Resorting to this strategy implies improved monitoring of the bacterial ecology in the department. Its use should preferably not be recommended in units with a high prevalence of methicillin-resistant staphylococci or vancomycin-resistant enterococci. The long-term impact of this strategy on bacterial ecology still remains to be assessed.

## OVERALL CARE

**R90** In spite of the sometimes low level of evidence of each of the individual recommendations, they should all be applied.

## SURGICAL SITE INFECTION

**R91** SSI surveillance should be implemented in the framework of the control panel for nosocomial infections, and according to one of the nationally recommended methodologies.

**R92** Report SSIs according to the criteria defined in the July 2001 decree defining the manner in which NIs should be reported.

**R93** Before any surgical procedure, a pre-operative shower (or toilet) should be requested, by observing the procedures decided by the relevant institution, in agreement with the surgical teams and the ICT.

**R94** To prepare the skin of the patient to be operated, if hair removal proves necessary, it should preferably be performed with clippers; except for contraindications, antisepsis should be applied in the form of an antiseptic alcoholic solution; the size of the disinfected area and of the draped operating field should be much larger than that of the incision area.

**R95** Provide the patient with antibioprophylaxis whenever this is found to be necessary, by observing the recommended procedures for administering antibiotics (product, dose, administration time, possible reinjection, duration).

**R96** Adhere to surgical hand disinfection procedures using an alcohol-based product, after washing the hands if they are visibly soiled.

**R97** Adhere to the wearing of specific clothing adapted to surgical procedures, to safety-based behavior (to be implemented according to the "patient safety in the operating room" check-list) and to the necessary discipline in the operating room.

**R98** Ensure appropriate air conditioning in the operating room, which should include filtration, overpressure, a renewal rate and flow control, which are adapted to the surgery to be carried out.

# Infections associated with intravascular devices

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## GENERAL MEASURES

**R99** The indications for the insertion and maintenance of an intravascular device (IVD) are restricted whenever this is possible, by systematically preferring the oral or enteral route to the venous route, for the administration of medication or nutrients. The IVD should be removed once it is no longer indispensable.

**R100** The techniques for placing, managing and monitoring IVDs are disclosed in technical specifications or protocols, and are updated once new recommendations have been published. IVD placement and surveillance are carried out by authorized personnel. Ensure traceability of IVD placement in the patient's file: placement date, removal date, catheter type, insertion site, operator. Clinical surveillance of the IVD insertion site should be done on an at least daily basis (search for local symptoms).

## TRAINING, AUDIT, SURVEILLANCE

**R101** Healthcare workers should be trained for IVD indications, placement procedures and IVD maintenance as well as for the prevention of IVD-associated infections. The patient shall be informed about the IVD-related infectious risk and should take part, in association with his/her relatives, in the prevention and detection of IVD-associated infections through adapted educational methods.

**R102** The practice of professionals in charge of IVD placement and maintenance is reviewed on a regular basis. Practice auditing is carried out using adapted tools, including a checklist both serving as a reminder and as an appraisal tool for the adherence to recommendations. The identification of practice errors, as well as information feedback to the healthcare team, are indispensable.

**R103** Continuous surveillance of IVD associated infections (bacteremias) is established in high-risk units (critical care and intensive care units). The results are expressed as the number of IVD associated bacteremias per 1000 catheter-days.

## INTRAVASCULAR DEVICES

**R104** Catheters made of polyurethane or fluoropolymers and stainless steel cannula devices are preferred. It should be noted that stainless steel cannula devices should not be used when administering a substance which may induce cutaneous necrosis (extravasation risk). Prefer safety devices when available and train carers in the use of such equipment. Antiseptic or antibiotic-impregnated catheters should not be used on a routine basis. Avoid antibacterial filters.

## INSERTION SITE

**R105** In adults, for PVCs, favor an insertion site which is located on the upper, rather than the lower limbs. For CVCs, favor an insertion site which is located in the superior vena cava area (especially the subclavian route), whenever the expected catheterization duration exceeds 5-7 days; the femoral route, in spite of its greater infectious risk, may be used in cases of emergency. Ultrasound guidance, under the same asepsis conditions as conventional placement, by ensuring safe placement conditions, is believed to produce fewer infections.

**R106** Replace any catheter that has been inserted in a lower extremity as soon as possible. Do not insert a catheter in the vicinity of weeping infectious skin lesions, or into a limb on which lymph node dissection or radiotherapy has been carried out, or on which a malignant tumor has been diagnosed, or with an arterial venous fistula, or next to a joint, or with an orthopedic prosthesis or into a paralyzed limb.

**R107** "Degreasing" agents, such as acetone or ether, should not be applied before IVD placement. If necessary, remove hair with clippers, scissors, or depilatory cream (no shaving). If a topical anesthetic is required, favor single-dose presentations and apply the topical anesthetic before beginning skin preparation of the insertion site.

## **PLACEMENT OF A CENTRAL VENOUS CATHETER OR A TOTALLY IMPLANTED VENOUS DEVICE**

**R108** Do not administer antibioprophylaxis treatments or antibiotic ointments or creams during catheter placement or during catheter use. The placement of antiseptic-impregnated sponge is to be envisaged.

**R109** The placement of a CVC requires an environment, which should be adapted to the required asepsis level, and at best, to that of the operating room or intensive care unit. The placement of a totally implanted venous catheter (TIVC) is to be carried out surgically. Restrict the attendance of staff in the patient's vicinity to the strict minimum, when catheter insertion is carried out. Use a checklist.

**R110** Insertion is to be carried out by a trained operator wearing surgical garments (cap, surgical mask, sterile gown), with the help, in the case of TIVC, of an assistant wearing a clean gown, a head cap and a surgical facemask. Before placement, the operator carries out a surgical handrub and then puts on a pair of sterile gloves.

**R111** Skin preparation of the insertion site is performed in four steps: cleaning (antiseptic soap), rinsing (with sterile water), drying (with sterile pads) and antisepsis (with an alcohol-based antiseptic). Sterile drapes that are much larger than the catheterization area, are placed after the antiseptic has naturally dried. Tunneling is seldom used and cannot be subject to a formal guideline recommendation, although it offers advantages for the jugular and femoral sites. The IVD is firmly secured to the skin with a non-resorbable suture. Replacement by guide wire exchange should be carried out under the same aseptic conditions as insertion.

## **PLACEMENT OF A PERIPHERAL VENOUS CATHETER**

**R112** No specific measure is required concerning the operator's garments. Before insertion, the operator is to carry out a hand hygiene procedure, and then put on a pair of gloves (as per standard precautions), which may be non-sterile if the insertion site is not touched after the antisepsis phase. The preparation of the skin at the insertion site is carried out in four steps: cleaning (mild soap or antiseptic soap), rinsing (sterile water), drying (sterile pads), and antisepsis (alcohol-based antiseptic). For PVCs with a short catheterization period, when the skin is visibly clean, skin preparation may be carried out through two consecutive applications of an alcohol-based antiseptic. Wait until the antiseptic has dried out naturally.

## DRESSING

**R113** Cover the IVD insertion site by using a transparent, semipermeable, sterile dressing made of polyurethane, to allow visual inspection of the IVD. Use sterile gauze with the sterile adhesive dressing in case of bleeding or exudation. Before exposure to water, temporarily protect the dressing with an impermeable material. Before manipulating the dressing, disinfect the hands (handrub). Proceed with dressing replacement only when it becomes loosened or soiled, or when inspection of the site is necessary, under the same conditions as during dressing application. Indicate the date of dressing replacement in the patient's file.

## MANIPULATION OF THE INTRAVASCULAR DEVICE, TUBING AND STOPCOCKS

**R114** Reduce the number of manipulations as far as possible. Decontaminate the hands using an alcohol-based handrub before manipulating the IVD or components of the infusion device. Perform manipulations in an aseptic manner, with observance of the closed system concept. Disinfect the tips and stopcocks before they are manipulated, using a sterile gauze pad dipped in an alcoholic antiseptic. The use of needleless connectors is possible as long as they are disinfected before use. Install a new sterile stopper whenever the access site or the stopcock is opened. Place a sterile stopper on any unused stopcock.

**R115** Abide by the asepsis rules when preparing the liquids to be infused. Never use solutes with visible turbidity, leaks, cracks or particles of material, or with an overdue expiry date. Favor the use of disposable ampoules. Discard the unused contents of disposable ampoules. Manipulate the multi-dose vials under strict aseptic precautions, whilst adhering to the preservation conditions and durations. Clean the multi-dose vial stoppers with 70% alcohol before adding any material into the vial. Use sterile equipment for sampling the contents of the multi-dose vials. Discard any multi-dose vial with a compromised sterility.

**R116** Terminate the infusion of labile blood products within four hours after the beginning of administration. Terminate the infusion of lipid emulsions within 24 hours of the start of the infusion. Replace the tubing used after each administration of labile blood products and within 24 hours after administration of lipid emulsions. Abide by the antisepsis rules when using a heparin lock, continuous heparinization, a saline lock or a stopper.

## REMOVAL AND REPLACEMENT OF THE INTRAVASCULAR DEVICE

**R117** Do not systematically change a CVC at regular intervals. Change a CVC by changing the site when purulence is observed on the insertion site or in case of suspected bacteremia on the catheter. The replacement by guide wire exchange of a CVC may be considered when an infection is weakly or moderately suspected, in the absence of any clear local signs.

Replace a PVC as soon as possible, if non-aseptic insertion is suspected. Change the PVC insertion site every 96 hours and imperatively, in the case of signs of venous intolerance, local complications, or a suspected catheter-related systemic infection.

When an infection is suspected, carry out aseptic removal of the distal end of the catheter and send it to the laboratory for microbiological examination.

Change the infusion device (tubing and auxiliary items) whenever a catheter is replaced.

## FOOD-BORNE ILLNESS OUTBREAK

**R118** The investigation of food-borne illness outbreak requires:

- checking the infection diagnosis and whether an epidemic has occurred;
- setting up ACPs in support of SPs, until the responsible pathogen has been identified and/or termination of the epidemic;
- considering temporary removal of the affected staff;
- defining the case, period, and concerned population;
- interviewing the affected persons in order to identify common food intake and formulate a possible hypothesis as to the responsible pathogen. The onset of signs within several hours after ingestion would suggest a toxin-based origin (staphylococci), whereas an onset 24 hours after ingestion, or fever, or bloody diarrhea, would rather suggest enteral invasive bacteria;
- if needed, conduct a food-related interview by performing a case-control study (e.g. using the WINTIAC software developed by the InVS);
- computing the attack rate;
- constructing an epidemic curve;
- considering a microbiological analysis of the food ingested over the preceding days, samples of which must be preserved for five days in the institution's central kitchen (French Order of September 29<sup>th</sup>, 1997);
- sampling stools (or vomit) from a group of three to five patients having symptoms as well as from potentially infected staff.

## NOSOCOMIAL GASTROENTERITIS OUTBREAKS

### GENERAL MEASURES

**R119** Any patient hospitalized for infectious gastroenteritis should be maintained in an individual room until the infectious source of the diarrhea has been eliminated. SPs and ACPs should be applied. "Contact" precautions only apply to symptomatic patients and comprise:

- the geographical isolation of symptomatic patients in individual rooms with private bathrooms. If not possible, patients infected (by the same enteral pathogen) should be grouped together. During the time period of an epidemic, it is acceptable to group infected persons together in the same area of a healthcare unit and for the appropriate care to be provided by specifically assigned medical and paramedical staff ("cohorting");
- informing persons entering the room of an infected patient (healthcare workers, outside professionals or visitors) about the precautions to be observed and the control measures to be taken. Signs displaying the precautions to be observed must be posted on the room's door and in the medical and nursing files. Visitors are warned not to use the patient's bathroom and must perform an appropriate hand hygiene procedure when leaving the room;
- the movement of infected patient outside their rooms (including transfers) should only be allowed when strictly necessary. The destination unit should imperatively be forewarned,

so as to maintain the continuity of "contact" precautions;

- enhanced hand hygiene before and after any provided care, using, in order of priority, alcohol-based handrubs, except if alcohol appears to be ineffective with the responsible microorganisms (see specific measures: *C. difficile*);
- the use of disposable gloves preceded by an alcohol-based handrub before entering the room of patients suffering from nosocomial gastroenteritis (because the environment is often contaminated). Before leaving the room, the gloves should be discarded and the hands cleaned according to a procedure which is adapted to the relevant germ (see specific measures);
- the wearing of a gown:
  - of the long-sleeve, disposable type, when directly handling the patient, his/her excreta and environment,
  - which is put on when entering the room, replaced after a sequence of care, and removed before leaving the room,
  - to be supplemented with a disposable, impermeable plastic apron for care involving "splashing" or splattering;
- the use of disposable medical supplies, to be discarded with other infectious hospital waste. Potentially non-disposable supplies in direct contact with a patient (stethoscope, sphygmomanometer, thermometer, antiseptic vials, ...) should be dedicated to the concerned patient, maintained in his/her room until the measures are terminated and be disinfected at least once a day using a virucidal or sporicidal disinfectant according to the nature of the responsible germ;
- fast removal of stools, for incontinent persons, by removing the protections prevailing for infectious hospital waste, and for continent persons, using bed-pan washers, or if not possible, through disposal in the sewer system followed by disinfection of the bed-pan washer with a sporicidal or virucidal disinfectant, as appropriate. The use of hand showers to wash the bed-pans is not recommended, as it may promote spreading of the pathogen into the environment, onto the garments and onto the carer, through splattering;
- daily biocleaning of the environment using a disinfecting detergent which is efficient on the infectious agent (whether of the virucidal or sporicidal type). This is all the more crucial when the environment of a patient suffering from infectious gastroenteritis is frequently contaminated. Isolation measures and the observance of "contact" precautions should be maintained until the end of the diarrhea episode.

## SPECIFIC MEASURES

### *C. difficile* Infections

**R120** Washing the hands with water and soap is recommended, to mechanically eliminate *C. difficile* spores. Such washing should be followed by thorough drying, and then by an alcohol-based handrub in order to eliminate other bacteria which might have escaped the action of the soap, and to maintain the awareness of healthcare workers concerning the use of alcohol-based products.



**R121** After having been used on an infected patient, the medical equipment should be cleaned and disinfected with a sporicidal product. Alcohol should be avoided for the disinfection of stethoscopes between two patients. The sharing of thermometers is to be avoided. Biocleaning on at least a daily basis of floors and surfaces of the infected or colonized patient's room should be performed. This includes:

- thorough cleaning (detergent cleaning, rinsing) with disposable items, ending with passive drying;
- followed by disinfection using a 0.5% active chlorine sodium hypochlorite solution, that is, bleach diluted to 1/5 (1 liter of 2.6% bleach and 4 liters of water for a final volume of 5 liters, or 250 ml of the 9.6% solution in a serving carton and 4.5 liters of water), by observing a minimum contact time of 10 minutes.

**R122** In case of an epidemic or high incidence of CDI, it is recommended to update or implement a purposeful antibiotics prescription policy, specifically designed to avoid the prescription of risk-prone antibiotics (second- and third-generation cephalosporins, fluoroquinolones, clindamycin, amoxicillin/clavulanic acid), and which should include, *inter alia*, the measurement and monitoring of the intake of such antibiotics, expressed in DDD for 1000 hospital days.

**R123** In adults, the search for *C. difficile* should be performed on a routine basis for any stool culture that would have been prescribed after the third hospital day (the so-called 3-days rule). This increases the number of identified CDIs by 24%. A CDI diagnosis should also be considered when a post-antibiotic diarrhea occurs (simple diarrhea), but also in cases where an ileus is diagnosed along with fever, abdominal pain and leukocytosis (pseudomembranous colitis), in particular in elderly patients with prior antibiotic treatment in the preceding months. The search for *C. difficile* or its toxins after treatment is to be forbidden. Routine screening of asymptomatic patients for *C. difficile* has never been proven to efficiently reduce cross-contamination.

**R124** Surveillance is an integral part of the CDI prevention program. It allows the health institution concerned to identify risk-prone units, monitor incidence rates, obtain an early warning of an epidemic, and assess the efficacy of the prevention measures. It should make use of the standardized definitions of infections described in recent European or French guidelines. Surveillance relies on microbiological laboratory data. The ratio of the number of infections to the number of hospitalizations or hospital days is computed. Attention should be focused on the difference between the community acquired and healthcare-associated case percentages, as well as on the proportion of severe cases (according to the accepted definitions), for which an increase may reveal the appearance of a new hypervirulent clone. The Infection Control Teams and Nosocomial Infection Control Committee should be notified by the microbiology laboratory or by the relevant clinical department, of an increase in the number of nosocomial diarrheas considered to be abnormal, and of each situation where the search for an A/B toxin has turned out to be positive, or when a toxinogenic strain of *C. difficile* has been isolated. It is imperative that the following information be reported to CCLIN and ARS as soon as possible, in compliance with the order of July 26<sup>th</sup>, 2001, and circular of January 22<sup>nd</sup>, 2004, by additionally specifying the potential need for external expertise:

- any severe case of nosocomial CDI,
- any clustered or epidemic CDI.

Any reported *C. difficile* infection should be accompanied with the shipping of the strain to one of the expert laboratories of the network built around the National Reference Centre for anaerobic

bacteria and botulism screening, for expert analysis the aim of which is to determine whether the strain belongs to the epidemic clone 027. In the case of an epidemic, the ICT should implement a practical review of the care and hygiene procedures provided in the affected department(s), with support from the CCLIN and their regional branches, with, if necessary, specific focus being placed on the implementation of "contact" precautions, hand hygiene and biocleaning of the premises. Furthermore, a review of the antibiotic therapy practices should be carried out in collaboration with the Antibiotics Committee of the concerned institution, and with the antibiotics senior adviser(s).

#### Gastroenteritis of viral origin

**R125** The measures to be imperatively implemented are as follows:

- do not use hand showers to clean bed-pans, because of the risk of producing contaminated aerosols;
- for enteric virus inactivation, use solutions that are active against naked viruses: bleach or phenol derivatives such as triclosan. Seventy percent alcohol is effective against rotaviruses. Alcohol-based products are thus especially recommended for the control of rotavirus hand contamination;
- without delay, report the following information to the CCLIN and ARS, in accordance with the order of July 26th, 2001, and the circular of January 22nd, 2004, by additionally specifying the potential need for external expertise:
  - any clustered cases of a viral gastroenteritis epidemic,
  - any death related to acute gastroenteritis;
- send stool samples to the enteric virus National Reference Centre at the Dijon university hospital;
- in case of a norovirus gastroenteritis, the staff in charge of biocleaning should wear a mask;
- group activities should be suspended (in the pediatric or geriatric departments);
- parents must be educated in diaper handling in pediatric departments.

## Infections in maternity units

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### EPIDEMIOLOGIC SURVEILLANCE

**R126** Organize surveillance:

- of SSIs and endometritis in women undergoing caesarean section, preferably with a post-hospital follow-up, by at least integrating the data from patients returning to the maternity units for infectious reasons;
- of UIs and endometritis for vaginal deliveries;
- of infections in neonates.

**R127** Implement a warning and reporting system to detect unusual and/or severe infectious events in parturients and newborns (e.g.: *Streptococcus pyogenes* infections).



## ANTIBIOTIC PROPHYLAXIS

**R128** Perform antibiotic prophylaxis for any caesarean section, using an intravenous route and after cord clamping. In the presence of a B streptococcus infection risk, perform antibiotic prophylaxis as soon as possible during delivery. When no search for the B streptococcus has been performed, per-partum antibiotic prophylaxis should be carried out in case of pre-term birth, rupture of membranes after 12 hours, and for mothers with fever above 38°C (100°F).

## GOOD PRACTICE FOR HYGIENE AND THE PREVENTION OF INFECTIOUS RISKS

### GENERAL HYGIENE MEASURES

#### Hand hygiene

**R129** Carry out hand hygiene procedures inbetween any two patients, be it mothers or infants, between two different care acts on the same patient, before putting gloves on, and immediately after removing them. Use an alcohol-based handrub for dry, powder-free and non-soiled hands.

#### Individual protection garments and equipment

**R130** Midwives or obstetricians should wear a surgical mask when membrane rupture occurs during any genital procedure carried out in front of the parturient (vaginal inspection, vaginal sampling, delivery...), wherever the delivery takes place, including at home. Midwives or obstetricians should wear surgical garments (surgical masks and eye protections, sterile gowns, caps, dedicated shoes) for any invasive procedure during pregnancy, in the delivery room and in the operating room.

### MEASURES DURING PREGNANCY

#### Ultrasound inspection (intravaginal, abdominal)

**R131** Use an appropriate protective disposable sheath for any intravaginal ultrasound examination. Treat ultrasound probes between two patients, whether abdominal or vaginal, even if protected. Use sterile ultrasound gel in unidose packaging for intravaginal ultrasound examinations, and ultrasound gel in daily renewed 250 ml cans, for abdominal ultrasound examinations.

#### High-risk intrauterine interventions through the abdominal route (amniocentesis, trophocentesis)

**R132** Ask the patient to take a shower before the procedure. Perform a pre-operative skin preparation (detergent cleaning, rinsing, drying, antiseptics allowing the antiseptic to dry spontaneously). Perform the procedures under aseptic surgical conditions (premises, surgical disinfection of hands, surgical garments for the operators, sterile material and drapes, disposable sterile protective sheath for the ultrasound probe, sterile unidose gel).

#### High risk intra-uterine interventions through the vaginal route (trophoblast biopsy)

**R133** Perform vulvoperineal and then vulvovaginal antiseptics before any procedure on the foetus during pregnancy, during labor and before expulsion. Perform these procedures under surgical asepsis conditions.

## MEASURES TO BE TAKEN DURING DELIVERY

### For all parturients

**R134** Restrict the number of vaginal manipulations, in particular after membrane rupture. Perform antiseptic vulvoperineal cleansing before the first vaginal examination. Perform vaginal examinations with a sterile, disposable finger stall after membrane rupture. When a urinary catheter is required, prefer evacuation tubing.

### Vaginal birth

- Preparation and placement of an epidural catheter

**R135** Before placing an epidural catheter, prepare the skin (detergent cleansing, rinsing, drying, antiseptic treatment, waiting until the antiseptic has spontaneously dried). Perform the epidural or spinal anesthesia under surgical aseptic conditions (surgical disinfection of hands, surgical garments, sterile gloves, wearing of a surgical mask).

- Eutocic delivery

**R136** Perform an antisepsis procedure on the perineal region, followed by the anal regions; if hair removal is necessary, use clippers or scissors (trimming). Wear surgical garments (with a mask and eye protection), surgically disinfect the hands by rubbing, use double sterile gloves for delivery, and long-sleeved sterile gloves in case of removal of retained placental tissue. Use a sterile delivery kit and sterile drapes. When episiotomy is required, use sterile scissors which should be discarded immediately after use. Unless a particular examination is required, discard the placenta through the IW circuit using an appropriate container.

- Particular situations

These include: the placement of intra-uterine pressure devices, fetal oximetry, artificial delivery, removal of retained placental tissue, artificial rupture of membranes, placement of scalp electrodes, intra-uterine per-partum manipulations, assisted extraction (forceps, spatula, vacuum extractors), perineal repair.

**R137** Perform vulval, perineal, vaginal antisepsis, depending on the type of act. Carry out the procedure under surgically aseptic conditions. Use sterile medical devices (amniotome, electrodes, forceps, scissors, clamps) and sterile consumables (delivery sets, drapes, gauze, pads). Do not wet the forceps cups with an antiseptic solution. Refrain from using equipment that has been previously employed for episiotomy when performing perineal repair.

### Cesarean delivery

**R138** Have the parturient take at least one pre-operating shower for planned caesareans. Do not shave pubic hair (if hair removal is required, use clippers or trimming). Prepare, including the case of urgent caesarean sections, the skin of the lining (cleansing, rinsing, drying, antisepsis), preferably with alcohol-based antiseptics. Observe surgical antisepsis (premises, operators' garments, surgical disinfection of hands, double sterile gloves); protect the uterus with sterile drapes when it is exteriorized. Replace gloves after fetal extraction and/or removal of retained placental tissue.

## NEONATES IN THE DELIVERY ROOM

**R139** Use an alcohol-based handrub before touching the neonate. Treat the cord with an antiseptic before cutting, and use new sterile scissors to cut the cord. If a maternal-fetal infection is suspected, take several microbiological samples (gastric fluid and one or more peripheral sites, preferably the ears and the anus) to make sure that any later infection is not nosocomial.

## POSTPARTUM MEASURES

### Mother

- [Vulvoperineal cleansing and perineal care](#)

**R140** Perform a daily check of the condition of the perineum, the quantity, nature and odour of lochia. Ask the parturient to carry out the vulvoperineal cleansing herself, as soon as possible.

- [Breastfeeding hygiene and breast care](#)

**R141** Assess the breastfeeding-associated infectious risk. Encourage breastfeeding, since only an unexplained maternal fever would be a temporary contra-indication. In case of unexplained coughing or herpes affecting the mother, ask her to wear a surgical mask when she breastfeeds and provides care to the infant. Explain why appropriate body hygiene, and especially hand and breast hygiene, are important for the parturient.

### Neonate

- [Cord care](#)

**R142** Create, validate and publicize a protocol pertaining to cord care, specifying hand hygiene, substances and materials to be used, and the corresponding techniques.

- [Hygiene of infant formula rooms in maternities](#)

**R143** Implement an organization and define relevant procedures.

- [Use of antiseptics in the premature and neonate](#)

**R144** Do not use povidone iodine, 70% alcohol, 0.5% alcoholic chlorhexidine, substances containing camphor, in the premature and infants below the age of one month. Use low alcohol chlorhexidine as well as chlorine-based antiseptics. Prefer products in single-use sachets.

## PREVENTING BLOOD EXPOSURE ACCIDENTS

**R145** Use double pairs of gloves for delivery, long-sleeved gloves for uterine scar revision, and gloves to manipulate the infant. Protect professional clothing and the face of healthcare workers from splashing (disposable aprons, facemasks or surgical masks with protective goggles). When compatible with the chosen episiotomy technique, for suturing an episiotomy, use blunt curved needles which mounted on a needle carrier. Dispose of sharp objects in specific containers specifically designed for hazardous objects, as close as possible to the point of use.

### PARASITIC CUTANEOUS INFECTIONS – THE EXAMPLE OF SCABIES

#### **R146** Managing an isolated case:

- the application of SPs is an efficient barrier against parasitic transmission;
- observe CCPs before any confirmed or probable case of scabies, to prevent spreading of the parasitosis;
- imperatively wear non-sterile disposable gloves and a short-sleeved gown for any long-lasting continuous contact with the patient or contaminated object;
- perform simple hand washing so that, on rinsing, parasites on the surface of the skin are physically removed (non-acaricidal alcohol-based products do not kill mites at certain stages of their growth cycle on the surface of the skin);
- handle potentially parasite-infested laundry with care, without placing it on the floor; treat it with antiparasitic products and transfer it to the treatment service without intermediate storage;
- in the case of a profuse form of scabies, apply supplementary disinfection measures with an acaricidal of the APAR® type, following cleaning on D1 at the beginning of treatment; treatment of the surrounding environment is not indicated for common scabies.

#### **R147** Management of an epidemic (two or more cases of scabies, diagnosed by a physician):

- set up a crisis team aimed at assessing the seriousness of the epidemic, choosing a therapeutic strategy whilst taking organizational constraints into account, organizing the information of patients, relatives, staff and outside workers, setting the missions and responsibilities of all concerned, and establishing recommendations;
- select the date at which handling of the epidemic should begin (treatment of patients and surrounding environment), only when all of the required logistic resources are available;
- implement surveillance aimed at screening other cases (patients whose clinical signs would not have been noticed or would have been wrongly interpreted);
- report the epidemic.

### BACTERIAL SKIN INFECTIONS – EXAMPLES OF PYOGENIC INFECTIONS:

#### STAPHYLOCOCCUS AUREUS AND STREPTOCOCCUS PYOGENES

**R148** Bacterial skin infections are mainly transmitted through cross-transmission; as a result, it is appropriate to:

- apply SPs;
- organize a warning system for MDROs (e.g.: MRSA) or epidemic bacteria which may lead to severe infections (e.g. Streptococcus A.) using, when available, tools enabling rapid diagnoses, which optimize screening and early treatment;
- apply CCPs when required (see the cross-transmission section);

- define the conduct to be followed in case of an epidemic (see the section about treatment and controlling healthcare-associated infections);
- report clustered cases (see the chapter on reporting).

## VIRAL SKIN INFECTIONS – HERPES VIRIDAE EXAMPLES (VARICELLA, HERPES ZOSTER, HERPES SIMPLEX)

**R149** Since varicella is no longer only an infant illness, a preventative strategy must be established in the relevant institutions, by associating occupational healthcare in order to:

- screen seronegative staff upon hiring and propose their vaccination;
- apply SPs;
- apply ACPs (single room, closed door, or even negative pressure room if possible) and CCPs for the varicella or zoster herpes cases;
- maintain isolation until the lesions become crusty;
- limit displacements of the index case (or cases);
- identify the exposed individuals, check their immunity, isolate receptive persons and set up the therapeutic management (by resorting to an infectious diseases specialist or a physician in an occupational health service).

**R150** The herpes simplex virus is mainly transmitted by contact, and it is therefore appropriate to:

- apply SPs;
- avoid, in the neonate or pediatrics unit (hematology, oncology), any direct contact between healthcare workers having recurrent herpes and the patients;
- set up a protocol for treating mothers who deliver, with ongoing or previous herpes conditions;
- establish a close clinical surveillance in the first month of life in neonates exposed to an herpetic infectious risk;
- apply the appropriate procedures to disinfect equipment, or use disposable equipment.

## SPECIFICITIES – THE EXAMPLE OF BEDSORES

**R151** The main actions to be performed are to:

- identify patients at risk;
- identify risk factors (using clinical assessment and a validated scale);
- carry out a re-assessment whenever the patient's condition changes;
- observe the skin's condition on a regular basis;
- involve the patient, relatives and friends;
- set up preventative measures:
  - reduce pressure (mobilization)

- use supports,
- maintain skin hygiene,
- prevent maceration,
- adapt the nutritional balance;
- provide initial training to all physicians and healthcare workers in the prevention and treatment of bedsores.

## Occupational risks (BBFE, tuberculosis) and vaccination

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### BLOOD EXPOSURE ACCIDENTS

**R152** Any BBFE (Blood and Body Fluid Exposure) must be taken care of:

- IMMEDIATELY: wash and disinfect the wound (in case of pricking) or the contaminated area (in case of splattering);
- IMMEDIATELY: contact the source patient's physician to know whether he/she is infected by, or is at risk of being infected by HIV;
- WITHIN AN HOUR: contact a referring physician (or, if not available, the emergency physician) to assess the risk of transmission; if the source patient's HIV serology is unknown, propose serology screening (with the patient's agreement), in particular, by means of a quick test;
- WITHIN AN HOUR: if the source patient is known to be infected by HIV and is treated, ask his/her physician to indicate the source patient's treatment, and his/her previous medical conditions, so as to be able to adapt the PEP, if required,
- WITHIN AN HOUR: decide whether to start a PEP:
  - inform the professional about the administered medications (intake modalities, duration, side effects...) and ensure that this information is well understood,
  - inquire about the exposed professional's immune status with respect to HBV,
  - if the source patient has been identified, document his/her CHV serology at the same time as HIV, as well as his/her HBV serology, if the exposed professional has not been vaccinated or is not immunized,
  - recommend protection (protected intercourse) and prohibit blood donation until the three-month serology check-up (or four months in case a PEP has been prescribed);
- WITHIN 24 HOURS:
  - report the occupational accident,
  - suggest contacting the occupational physician for the follow-up,
- ALSO: report to the InVS (the French Institute for Public Health Surveillance) any HIV, HCV and HBV contaminations that have occurred after a viral exposure accident in a healthcare institution.

**R153** The staff must be aware of the procedures to be avoided, the hygiene rules to be observed (SPs), the practical details applicable in the concerned institution for reporting and treating BBFEs. Educational actions are organized for the entire staff (medical, paramedical, medical-technical), with particular being paid to newly hired staff and students.

**R154** The use of safety equipment should be preferred:

- equipment with built-in rather than added security;
- equipment provided with the earliest possible automatic safety action (with respect to the intended act);
- among those systems which require operator-triggered safety, those with an irreversible single-handed actuation, and with a safety action indicator will be retained;
- the selection of this equipment should be performed in collaboration with the pharmacist, the occupational physician, the ICT, the nursing care unit, the administrative department, and after it has been evaluated by the users;
- containers for needles and sharps should be in accordance with the prevailing standards and the staff should know how to safely assemble, use and discard such containers;
- users should be trained for the appropriate use of the safety equipment and collector containers.

**R155** Any person who may be exposed to a BBFE risk should be immunized against hepatitis B. Proof of such immunity should be available for any exposed healthcare worker.

**R156** A BBFE surveillance system should be established by the occupational healthcare unit. Resorting to the tools proposed within the frame of the RAISIN BBFE national surveillance system should be encouraged. The circumstances under which BBFEs occur should be analyzed in collaboration with the CLIN and the Health and Safety at Work Committee, to determine the priority actions to be implemented in terms of staff training and the selection of equipment. The results of such analyses should be communicated to the relevant departments (feedback).

## TUBERCULOSIS

**R157** The HCSP recommends that the BCG vaccination of professionals and students in the mentioned healthcare and social sectors (listed in the appendix of the notice) should no longer be compulsory, but that the tuberculosis test should be maintained as the reference test on hiring. The HCSP recommends, although it is not compulsory:

- BCG vaccination on a case by case basis, after the risk has been evaluated by an occupational physician, only for tuberculin-negative, highly exposed healthcare workers (healthcare staff with repeated contact with contagious tuberculosis patients, in particular those with a high risk of multiresistant tuberculosis; laboratory staff working on microbacteria cultures),
- the above should be implemented, whilst reminding those concerned that barrier measures should be strictly observed, and that adherence to medical screening and follow-ups is of the utmost importance.



**R158** Any case of potentially contagious tuberculosis (pulmonary and otorhinolaryngology tuberculosis with a positive culture) should be reported by the clinical department and/or laboratory, to the staff's occupational healthcare department and to the ICT, in order to check whether the isolation measures have been applied and, if necessary, to carry out a survey.

**R159** Routine surveillance of the healthcare practitioners working in high-risk departments (which receive at least five tuberculosis cases per year) and of the laboratory staff manipulating samples with a high risk of aerosolization (bacteriology, anatomopathology) should be implemented: periodic IDR every two years for staff with prior IDR < 10 mm, and every 5 years for others (IDR > 10 mm). The practice of interferon testing during the follow-up period is recommended by the HAS (2006), whether alone or combined with the IDR. This aspect is expected to be specified in the recommendations of the national tuberculosis program at the end of 2010.

**R160** Indication and duration of the geographical isolation and setting up of ACPs:

- any patient with suspected tuberculosis of the respiratory system should be geographically isolated (in a single room) and his/her treatment should be carried out with adherence to the ACPs (FFP1 mask or FFP2 mask if multiresistant tuberculosis is suspected) until this diagnosis has been eliminated. These measures should be applied at the time of hospitalization. The notion of a suspected infection should be reported at the time of hospitalization, so that these measures can be foreseen in the admission service, before the patient arrives at his/her destination unit;
- during certain procedures in which there is a risk of triggering coughing and the release of aerosols, such as intubation, induced expectoration, bronchial fiberoptic endoscopy, aerosol therapy, it is recommended to use FFP2 masks;
- when the patient must move out of his/her room, he/she should first put on a surgical mask;
- recommendations which are applicable to healthcare workers also apply to visitors: FFP1 masks or FFP2 masks if a multiresistant tuberculosis is suspected;
- in the case of suspected pulmonary tuberculosis, when the direct examination is negative and the diagnosis appears to be highly probable, and requires the initiation of an anti-tuberculosis treatment, in particular in the presence of excavated lesions, the above described measures are to be maintained for the first 15 anti-tuberculosis treatment days;
- in the case of a contagious active tuberculosis, when the direct examination of smears is positive, the above-mentioned measures are to be maintained until such time as the direct microscopic examinations of three consecutive samples are negative.

**R161** Healthcare workers should be trained in the wearing of a mask. Each professional should know how to perform a "fit-check": occlude the filtering surface, inhale and make sure the mask is drawn to the face (because of the suction effect); this should be performed when putting on the mask.

**R162** A person who, in a public or private institution or organization providing care or accommodating elderly people, practices a professional occupation, which exposes him/her to contamination risks, should be immunized against hepatitis B. Proof of this immunity should be provided for any exposed healthcare worker.

**R163** A person who, in a public or private institution or organization providing care or accommodating elderly people, exercises a professional occupation, which exposes him/her to contamination risks, should be immunized against diphtheria, tetanus, poliomyelitis (article L3111-4 of the French Public Health Code).

**R164** Vaccination against typhoid is compulsory, with a recall every three years, for all laboratory staff who manipulate stool samples.

**R165** Female healthcare workers in the childbearing age who are not immunized against rubella should be injected with an anti-rubella vaccine. It is necessary to make sure that no early pregnancy occurs within two months after vaccination, because of a theoretical teratogenic risk.

**R166** Healthcare professionals who are being trained, are in a hiring process, or working, who are not vaccinated against measles, with no prior measles condition (or with an unclear history) and with a negative serology, should receive an injection of a single dose of trivalent MMR vaccine.

**R167** Healthcare workers who are being trained, are in a hiring process or working, should be vaccinated against whooping cough at the time of the ten-year DPT vaccine recall, with an acellular vaccine.

**R168** There is no indication for a routine anti-meningococcal vaccination of healthcare workers. It may however be proposed to the staff of bacteriology laboratories who constantly manipulate samples suspected to be contaminated by meningococci when aerosolization is possible.

**R169** In all healthcare institutions, flu vaccination should be proposed annually to healthcare workers.

**R170** Healthcare professionals being trained, in a hiring process or working, without any prior varicella condition (or with an unclear history) and having a negative serology, should receive two doses of anti-varicella vaccination at four to eight week intervals. In the case of a post-vaccinal rash, the healthcare professional should be removed from the hospital until such time as the skin lesions have dried out.

# Surveillance of health-care associated infections

Whatever the field of application, surveillance is defined as *"a process of collecting, analyzing and interpreting health data on a continuous and regular basis for planning, implementing and evaluating public health practices, together with a wide dissemination of this data to those who will use it"*. Thus, surveillance is not just restricted to the collection of data, but should also help in the improved assessment of the current status of the monitored parameters, uncover specific characteristics, trends and priorities, target the actions to be undertaken, and then document the efficacy of preventative measures to be taken, and possibly, generate hypotheses (for further investigations). This is summarized by the phrase "first monitor, then act". Beyond these epidemiological goals, surveillance may also fulfill regulatory or accreditation requirements, and provide information useful for improving internal and external communication in healthcare organizations (governance, committees, professionals, users).

Surveillance is highly recommended for illnesses associated with a high morbidity and mortality, whose potential for epidemics is strong, or which are the subjects of specific programs of action, that is, essentially each time the collected information is useful for the implementation of healthcare associated actions, at any given level. With a high morbidity (600,000 to 1,100,000 cases each year), an estimated attributable mortality in the range between 1,500 and 4,000 deaths a year, frequent hospital epidemics caused by ever more resistant microorganisms, and several national prevention programs, healthcare associated infections (HAI) meet these conditions. They also induce significant additional costs, a further argument for promoting their evaluation and monitoring.

## Rationale

### What is really known about the efficacy of HAI surveillance?

Several studies pertaining to HAIs have provided an in-depth documentation on the efficacy of surveillance associated with preventative action and benefiting from support provided by trained professionals. The American project *"Study on the Efficacy of Nosocomial Infection Control"* (SENIC) was the first to reveal a significant effect of surveillance (decrease in HAIs by one third) under these implementation conditions. This has been confirmed by the experimental *"National Nosocomial Infection Surveillance"* (NNIS) program, with a decrease in several types of infection, both in surgery and critical care. In Europe, the experience accumulated over time by major surveillance networks leads to the same conclusion: *"PREventie ZIEkenhuisinfecties door Surveillance"* (PREZIES) in the Netherlands, *"Krankenhaus Infektions Surveillance System"* (KISS) in Germany and the *"National program for early warning, investigation and surveillance of healthcare-associated infections"* (RAISIN: = *Réseau d'alerte, d'investigation et de surveillance des infections nosocomiales*) in France (<http://www.invs.sane.fr/raisin>). Several French studies outline this efficacy in the case of surgical site infections, MRSA infections or HAIs in critical care.

It is more difficult to assess the costs and therefore the efficacy of surveillance when considering the time taken to collect and analyze information, which reduces the time left for preventative actions. Several solutions have been proposed to increase this efficacy: dematerializing information circuits, computerizing data collection, targeting selection, implementing rotating or intermittent surveillance, and relaxing the treatment methods once the target rates have been reached.

## What is the expected quality of a surveillance system?

Surveillance quality must be assessed according to operational and scientific criteria:

- Simplicity and acceptability of data collection,
- Availability and timely provision of information feedback,
- Representativeness of monitored patients with respect to treated patients,
- Validity of results, or ability to correctly detect HAI affected patients (sensitivity) with respect to those who do not (specificity).

Also, other aspects will be considered, such as the targeting of situations with a high infectious risk, the ability to adjust infection rates as a function of other risk factors, the use of standardized definitions so that the results are comparable at different times and locations.

In addition to the official French definitions, definitions which are specific to long-term and neonatology care have also been developed, and European consensus definitions have been established within the framework of prior programs such as "*Hospital in Europe Link for Infection Control through Surveillance*" (HELICS) (<http://helices.univ-lyon1.fr/helicshome.htm>) and "*Improving Patient Safety in Europe*" (IPSE) (<http://ipse.univ-lyon1.fr>), now adopted by the European Center for Disease Prevention and Control (ECDC).

One of the recurrent problems of epidemiologic surveillance is the amount and level of complexity of the data to be collected. While the objective of surveillance is to ensure scientific appraisal of the infectious risk and to compare different healthcare institutions (if possible, together with user information), certain adjustments according to risk factors are necessary, with possibly large amounts of data to be collected, thus generating significant work and costs. Conversely, simple indicators will help assess the effort undertaken locally in a given unit and better adapt prevention systems. Therefore, a trade-off is necessary for the collection of data between the normal workload and the collection of additional adjustment data.

## What are the various surveillance methods?

The surveillance systems may be classified according to the following criteria:

- (1) According to their continuity in time:

- Continuous surveillance of new infection cases (annual incidence);
- Intermittent surveillance of new infection cases: incidence during a more restricted period of time, for example, three months a year;
- Surveillance by performing point prevalence studies (on a given day) with a given periodicity, for example, every three months or every year.

(2) As a function of their spatial extent:

- Coordinated surveillance of several hospitals or wards forming a surveillance network,
- Cross-sectional surveillance of an entire hospital (e.g. surveillance of multi-drug resistant infections [MDRO]),
- Surveillance of a ward or a particular specialty (e.g. surgery, intensive care, dialysis, etc.),
- Surveillance of patients according to their underlying pathology or co-morbidity (e.g.: immunosuppressed patients).

(3) According to whether the overall information is collected individually for each patient (patient-based surveillance), or the number of infections (numerator) is estimated relative to already available aggregated data (denominator), such as the number of patients admitted, procedures, dialyses, etc. (ward-based surveillance).

(4) According to the method used to collect data: self-reporting, ward rounds, examination of patient records, use of laboratory results or prescriptions, etc.

(5) According to whether data collection concerns information on HAI prevention practice only. Advantageously, this method also aims at verifying compliance, does not require any adjustment and focuses on the prevention effort. However, the surveillance of the preventative practice often requires manual collection of data (observations) by means of non-standardized methods: it cannot be a substitute for the use of HAI rates as the outcome indicator.

Various data collection methods have been evaluated by several studies. In Great-Britain, one study compared various HAI surveillance methods in terms of their sensitivity, specificity and costs: laboratory-based surveillance, combined with twice weekly clinical surveillance in the wards, was the most sensitive method (76% [95% CI: 59-88%]), with a 100% specificity [95% CI: 98-100%], and only required a third of the time devoted to surveillance in the case of the reference method (since a systematic examination of the records requires 6.4 hours per 100 beds per week). Combining clinical information with microbiological data and therefore, establishing collaborations between microbiologists, clinicians, and hygienists/epidemiologists, are a good indication of efficacy, and also perhaps, of the effectiveness of HAI surveillance.

The computerization of microbiology laboratories and the use of epidemiology software have led to advances in laboratory-based surveillance over recent years. However, clinical information is still required in addition to laboratory results in order to distinguish baseline colonization from infections, but also to locate those infections that have not been microbiologically documented, such as viral HAIs, among others. It is also useful to discriminate between infections which have been imported and acquired within hospitals, and to include the number of samples taken in certain analyses. Finally, the surveillance of multi-drug resistant HAIs can be usefully combined with the surveillance of the consumption of anti-infectious agents.

## In what form are surveillance results expressed?

To measure the risk of the onset of such events in this population, the results of HAI surveillance are expressed in the form of rates, that is, the number of observed events (numerator) divided by the size of the observed population (denominator). The main epidemiologic indicators of HAI frequency are shown in **Table I**: they vary according to the method used.

## What is the advantage of networked surveillance?

Surveillance may usefully be carried out within surveillance networks, such as the RAISIN networks, in France, which are coordinated by the CCLINs and the InVS, as well as other inter-regional networks. This pooling of data helps hospitals benchmark themselves with respect to other healthcare settings, build epidemiologic databases, which can be used to refine indicators (such as rates, assessment according to the type of population at risk, score development), and provide reference data. Moreover, the sharing of work methods is another factor contributing to their standardization and improvement. Within the framework of the RAISIN system, the networks provide a national analysis of the infectious risk in surgery and intensive care, alongside networks focused on multi-drug resistant bacteria, antibiotic use, and blood exposure accidents. For the surveillance of surgery site infections (SSI) and critical care infections, the French surveillance data have been communicated to the ECDC and are being analyzed at the European level.

However, great caution needs to be exercised when performing inter-hospital comparisons: it is not possible to take all rate variability factors into account in the analyses, without making data collection process excessively arduous, even when the protocols focus on the seriousness of the illnesses and on the levels of patient exposure to invasive procedures. In principle, the analysis of temporal changes - both within and between hospitals - does not lead to the same methodological issues.

**Table I - Main epidemiologic indicators for HAI surveillance**

Indicators	Computation	Example
<b>Prevalence</b> of infected patients (or HAIs)	$\frac{\text{Total number of infected patients (or HAIs)}}{\text{Number of hospitalized patients present on the same day}} \times 100$	Prevalence of patients with a HAI = 5.0%, Prevalence of HAIs = 5.4%
<b>Cumulative incidence of HAIs</b>	$\frac{\text{Number of new HAI cases in a given period}}{\text{Number of patients likely to develop a HAI in this period}} \times 100$	Incidence rate of operating site infections for 100 cesareans = 1.1%
<b>HAI Incidence density</b>	$\frac{\text{Number of new HAI cases in a given period}}{\text{Total durations of infection risk exposure of patients over the same period}} \times 1000$	Pneumonia rate in ventilated patients in adult intensive care = 16.9‰
<b>Invasive device exposure ratio</b>	$\frac{\text{Number of days of exposure to medical devices (catheter, respirator...)}}{\text{Number of patients - hospital days in a given population}} \times 1000$	Central venous catheter exposure ratio in intensive care = 65.1%



## What advantages can hospital computerization offer to HAI surveillance?

Many authors have recently published the results of successful HAI surveillance experiments based upon data derived from hospital computer systems: surgical site infections, bacteremias and urinary infections. Automated generation of this data offers the main advantages of streamlining and simplifying data collection, so that it becomes integrated into everyone's routine work, removing duplicates and providing very fast, almost "real time", feedback of information to healthcare teams.

It is therefore recommended that, in the future, throughout all short-stay hospitals, a HAI surveillance system be implemented. This should be integrated as highly as possible into these hospitals' information systems. Simple to use and user friendly, it should allow for: (1) the retrieval of all of the useful information already available in the information system, on a routine basis (medical, paramedical, biological, pharmaceutical, X-ray and administrative records); (2) the configuration of medical and paramedical records in order to collect significant clinical information; (3) fast communication between clinical teams and infection control teams (ICT) of confirmed or suspected infections; (4) automation of the computation and display of indicators and their change over time; (5) the communication of information in accordance with approved procedures.

Computerization does not exempt those in charge from the clinical confirmation of cases of infection, in accordance with the recommended case definitions. This validation should be carried out in meetings jointly organized by the ICT and clinicians.

## How to select the surveillance system: what target, indicators, extent, and access to information?

This decision is made firstly at a national level, within the framework of a HAI control organization. The "dashboard" for the fight against HAIs is based on the extent of SSI surveillance in hospitals, and also on the surveillance of MRSA infections and the consumption of antibiotics. The RAISIN network involves five national networks. Accreditation criteria require healthcare institutions to define their surveillance policy - including the possibility of carrying out inter-hospital comparisons - in combination with practice improvement actions. At a regional level, it is the Nosocomial Infection Control Coordinating Centers (CCLIN) which, in practice, organize the HAI surveillance networks, most often within the framework of the RAISIN network.

However, at the hospital level, it is the Committees for Nosocomial Infection Control (CLIN) and the ICT, which play a fundamental role in the selection of the type of surveillance to be performed according to the sectors at risk and to local possibilities. For that purpose, the following aspects need to be considered: (1) the goals pursued, the scope of surveillance and the general methodology used (in particular the definition of cases), and the means required for that purpose; (2) the information and training of the professionals involved; (3) the identification of patients who have contracted a HAI and the appropriate method for collecting the relevant information; (4) the collection of data to characterize the monitored population; (5) the validation, recording and checking of information; (6) the development of indicators and rapid feedback of information to the professionals of the healthcare teams involved; (7) the communication of this information for reasons of public health, or to allow any concerned hospital to benchmark itself with respect to other institutions (networks... etc.).



Whatever the methodology chosen, the benchmarks and protocols already established and tested will preferably be used in order to benefit from the accumulated methodological experience. In **Table II**, the surveillance levels are scored according to a typology defined on the basis of available resources, to assist in the implementation of this surveillance under appropriate conditions.

An "advanced" type of surveillance (whether computerized or not) is recommended in sectors at risk, such as surgery and adult or pediatric intensive care when they, or the hospital itself, have sufficient staff and/or an adequate level of computerization for this to be performed in a reliable manner. This advanced surveillance involves a more comprehensive collection of information for each eligible patient, thus providing a finer assessment of infectious risks. Moreover, when the unit participates in a network, anonymous and careful comparison of the unit's rates, with those of other units of the same type, helps it benchmark itself with respect to other healthcare facilities.

When the information system or staffing level does not permit advanced surveillance, the hospital should choose one of the methods described in **Table II**. In such a case, the five following activities constitute the minimum surveillance level:

- Participation in the national HAI prevalence survey, every five years;
- "Baseline" surveillance of sectors at risk (in particular, surgery and critical care) through active detection of HAIs, recording of a reduced level of information on each case, and simplified measurement of incidence given by the ratio of the number of infections to an institutional denominator, such as the number of procedures of a given type, or the number of hospital-days;
- Follow-up of multi-drug resistant bacteria by the microbiology laboratory and early warning provision in case of hazardous situations;
- Identification of infections of a particular type which require specific examination during a mortality-morbidity assessment meeting, and/or carrying out external reporting to the Regional Agency for Health (ARS) and CCLIN;
- Collection of statutorily required data as part of regulatory standardized assessments.

**Table II - Typology of HAI surveillance systems in healthcare units.**

Name	Description	Product indicators (examples)	Fields of application
Computerized surveillance	Retrieval of all required information from an integrated information system*	Main HAI surveillance indicators***	Any hospital involved in an integrated information system project
"Advanced" surveillance	Active search for relevant clinical and biological information for all eligible patients	Indicators adjusted to the illness severity level of the monitored patients (RAISIN type of network)	Units at risk capable of carrying out comprehensive collection of information and interested in research e.g.: adult and pediatric intensive care, surgery, dialysis, units providing care to immunosuppressed patients (hematology, pediatric oncology, etc.)
"Baseline" surveillance	Active search for relevant clinical and/or biological information in infected patients and use of institutional denominators	<ul style="list-style-type: none"> <li>SSI rate per surgery type</li> <li>HAI rate for 1000 hospital days</li> <li>Other baseline rates</li> </ul>	Non computerized units at risk, having a reduced information collection capacity e.g.: surgery, obstetrics, dialysis, units providing care to immunosuppressed patients (hematology, pediatric oncology, etc.)
Prevalence survey	Active search for relevant clinical and biological information for all patients hospitalized on a given day	Any prevalence indicator	To be performed at least every five years (or more frequently, at the hospital's discretion) in all hospital wards
Self-reporting	Information communicated through a general-purpose reporting system or by calling upon the infection control team	No statistical indicator (strong under-notification)	Practical utility as an early warning and communication tool in all hospital wards

\*Providing access to medical, paramedical, pharmaceutical and biological records

\*\*Provided adequate configuration of the database has been performed.

## Recommendations

### Surveillance implementation

- R1** Each health or medico-social institution should define its healthcare-associated infection surveillance policies, taking the specificities of its clinical activities, any regulatory restrictions and the means it can deploy for this activity, into account.
- R2** In each hospital, the healthcare professionals, hygienists and epidemiologists should contribute towards the definition of the detailed surveillance protocol(s), with particular attention being paid to the following points: relevance of the selected indicators, periodicity, modalities for the determination and use of indicators, workload and sharing of responsibilities, use of data recorded in the hospital's information system, confidentiality and access to information.

- R3** The persons in charge of the surveillance program should be clearly identified and mandated. They should take the references and protocols already established and tested into account, and should consult, whenever necessary, the reference authorities responsible for the surveillance of healthcare-associated infections (InVS, CCLIN).

### Surveillance under optimal conditions

- R4** The persons in charge of the surveillance program, and the users of its results, should encourage their hospitals to include the surveillance of healthcare-associated infections in the development objectives of their information system. They should actively participate in the collaborative steps taken to develop a computerized surveillance system.
- R5** Whenever a computerized surveillance system is installed, each of the hospital professionals should contribute to the system by identifying those relevant items from medical, paramedical, biological, pharmaceutical, x-ray imaging and administrative files. The hygiene specialists should ensure that the collected information, as well as the automatically produced extractions and analyses, and their restitution and practical use by the healthcare teams, is of a suitable quality.

### Network surveillance in sectors at risk

- R6** If they have the means to contribute efficiently, and in particular if they have a suitably adapted information system, dedicated personnel, and the methodological support of the infection control team, the healthcare units in specialized areas at risk are strongly encouraged to implement an “advanced” surveillance system linked to the national and inter-regional surveillance networks. They have the advantage of being able to be placed within a group of hospitals, and of taking part in collaborative research by contributing data to the national RAISIN databases, coordinated by the five CCLIN and InVS.

### Surveillance in other cases

- R7** In the context of the national inquiry into the prevalence of healthcare-associated infections, each hospital should, on a five-year basis, organize a prevalence survey involving all of its departments. The professionals in the clinical and biological teams and the hygiene specialists should contribute their knowledge and experience to this survey. These prevalence surveys may be organized with a shorter periodicity.
- R8** In the absence of computerized surveillance or participation in a surveillance network, each healthcare unit in a specialty at risk (surgery, obstetrics and critical care in particular) should implement a minimum active identification and computerized recording process for significant healthcare-associated infections, including the following information: type of infection, date of appearance, responsible microorganism(s), code of any eventual surgical act. In collaboration with the MID, the infection control team is responsible for the analysis

and generation of “simple” occurrence indicators and their temporal tendencies: SSI incidence rates, at least those which occurred during hospitalization (% according to each type of operation targeted by the surveillance), incidence rate of other healthcare related infections according to type, and for 1000 hospital days. The healthcare units should propose the most appropriate indicators for their activity, for example: rate of meningitis following an external ventricular derivation, rate of endometritis following Caesarean sections, infection rate on totally implanted venous catheters, etc.

- R9** The laboratory in charge of microbiology should warn both the healthcare and infection control teams in the following situations: results leading to the suspicion of a serious case of healthcare-associated infections, grouped healthcare-associated infection occurrences, unusual or dangerous germs (severe infections, risk of the spread of infection, for example ...) or any other situation corresponding to the criteria of the healthcare-associated infection reporting mechanism.
- R10** All laboratories in charge of microbiology, pharmacies and occupational medicine teams in hospitals contribute to the transverse surveillance systems organized to monitor the evolution (local or general) of multi-drug resistant bacteria, of the consumption of antibiotics, and of blood and body fluid exposure accidents. The data from these surveillance systems are returned to the healthcare teams.
- R11** Whenever it is suspected that a healthcare-associated infection has a localized origin (environmental contamination, errors at the “sharp end”, mistakes, etc.), this infection must be submitted to multidisciplinary analysis and, when applicable, presented to the unit for a mortality-morbidity review. Grouped cases must be submitted to an epidemiological investigation.

## Criteria for evaluating practices

■ Surveillance must be evaluated on a periodical basis. Particularly important criteria are the validity of this surveillance and the time needed before its results are fed back to the relevant healthcare teams. The criteria for evaluating surveillance have been described by the CDC in the United States. ECDC also developed a protocol for evaluating surveillance systems, used in order to assess several European surveillance networks, such as the IPSE, the European Antimicrobial Resistance System (EARSS) networks, etc., and has recently been used by RAISIN to assess its networks. Data validity checks for the HAI dashboard have also been performed by the French Regional Agencies for Health.

## Specificities

■ For institutions accommodating dependent elderly people (EHPAD), surveillance through annual prevalence surveys combining several institutions is proposed. Surveillance of infections of the lower respiratory tract is also recommended, because of the high risk of morbidity/mortality in this population, associated with their possible dissemination throughout the healthcare institution (e.g. influenza, ...).

## Research subjects

■ The 2009-2013 French program for the prevention of hospital-specific nosocomial infections (PROPIN) requests that the collection and use of surveillance data be optimized (Strategic Focus Nr 2.2), but also that research on HAIs be encouraged (Strategic Focus Nr 3.1). The use of surveillance data for research purposes is necessary and should be strengthened, in particular for inter-hospital rate comparisons ("benchmarking"), because of the present scientific uncertainty. In order to optimize HAI prevention, it will be necessary to determine the optimal proportion of effort and resources to be devoted to surveillance and practice evaluation, and the means by which the coherence of both activities can be enhanced. Surveillance of infections in outpatients is another challenge, as is the participation of patients in such surveillance. In addition, it is always important to extend the studies so that they cover the consequences of HAIs: morbidity, mortality the attributable costs.

## Further reading

■ Factsheets relating to surveillance methodology problems, published in the October 2006 to December 2008 issues of the French Society for Hospital Hygiene (SF2H) bulletin, are available under the "Publications" heading on the [www.sf2h.net](http://www.sf2h.net) website.

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# Reporting nosocomial infections

## Context - Regulatory issues

Under law Nr 89-535 of July 1st, 1998 pertaining to the improvement of health monitoring, as established by the Decree of July 26, 2001, external reporting of nosocomial infections (NI) is an early warning system which is an integral part of a more general infection vigilance and surveillance system. It includes:

- 1) Local NI surveillance carried out in each healthcare institution (HI) according to the national recommendations and as a function of the institution's priorities;
- 2) Regional and inter-regional NI surveillance relying on networks that are coordinated by each of the regional NI control coordinating centers (CCLIN) and their local branches (ARLIN);
- 3) National surveillance coordinated by the CCLINs in partnership with the French Institute for Public Health (InVS), within the framework of the National Program for Early Warning, Investigation and Surveillance of Healthcare-Associated Infections (RAISIN network): surgery site infections, blood and body fluid exposure, multi-drug resistant bacteria, antibiotic consumption, infections in the ICU;
- 4) Statutory vigilance systems related to health products (pharmacovigilance, hemovigilance, material vigilance, biological vigilance...);
- 5) Compulsory reporting of certain infectious diseases (articles L3113-1, R3113-1 to R3113-5, D3113-6, D3113-7 of the French Public Health Code); <http://www.legifrance.gouv.fr/> (consulted on May 13, 2010).

Articles R6111-12 to R6111-17 of the French Public Health Code (CSP) describe the characteristics of the reported NIs, the conditions under which information was collected and the reporting methods.

The main objective of reporting, which is action-oriented, is to detect rare, severe or recurrent HAIs, which may require implementing preventative and monitoring measures at a local, regional or national scale. Reporting provides healthcare institutions with the means to formalize their warning procedures when faced with the outbreak of an unusual infection, and allows them to call upon external assistance if necessary.

Reporting is a legal requirement, which any healthcare institution, whether public or private, must comply with. This reporting requirement replaces neither the requirement for vigilance relating to the items, products and devices, which fall under article L1211-7, for hemovigilance, falling under article L1221-13, and for material vigilance, falling under article L5212-1, and for pharmacovigilance, falling under L1111-20, nor the notification and reporting requirements arising from articles R.11-2 and R.11-3 of the Public Health Code. The circular DHOS/E2-DGS/SDSC Nr 21 of January 22, 2004, relating to NI reporting provides recommendations intended for hospitals and their supervisory institutions concerning the reporting criteria, the internal organization of

hospitals and the role played by outside professionals within the reporting system.

NI reporting relies on a system implemented within hospitals (ICTs), five French Inter-regions (CCLIN), regions (ARLIN) and Regional Health Agencies (ARS). In each hospital, this requires that a specialized assessment of the situation be carried out by the CLIN and the infection control chain (in particular, the hygienist), to be validated by the reporting officer. The ARLIN, at a local level, and the CCLIN, at an inter-regional level, may contribute their expertise, in the assessment and management of the infectious risk. The ARS agency then comes into play to ensure that the proposed measures have been implemented, or when the situation requires an inspection to be carried out. It also requires the adherence and participation of all hospital wards.

Those NIs which must be reported externally to the CCLIN and ARS meet the criteria defined under article R6111-13 of the Public Health Code. Hospitals will report the occurrence of any NI meeting one or more of these criteria in a non-nominative fashion, and will collect the relevant information using a standardized reporting sheet.

Reporting may deal with one or more NI cases; the occurrence of grouped NI cases may justify reporting when the characteristics or modes of occurrence of the first case or cases do not allow the criteria to be met in a straightforward manner (the criterion: "other" will then be used). External reporting criteria provided under this decree are as follows:

1) The occurrence of NIs with a rare or particular character, with respect to local, regional and national epidemiologic data, as a result of:

a) either the nature or characteristics of the involved pathogen, or of its anti-infectious resistance profile, such as (non-exhaustive list) *Streptococcus pyogenes* infections, atypical mycobacteria, Panton-Valentine leucocidin (PVL) producing methicillin-resistant *Staphylococcus aureus* (MRSA), imipenem-resistant enterobacteria, etc. For certain pathogens with a particular antibiotic resistance profile, colonization may also be reported externally (as is the case, for example, for glycopeptide-resistant enterococci),

b) or the location of the infection in the affected person(s), for example: endophthalmitis, spondylodiscitis, etc.

c) or the use of a (contaminated) medical device, such as an endoscope, a dialysis generator, etc.

d) or procedures or practices which may expose or may have exposed other persons to the same infectious risk during an invasive procedure;

2) Any NI-related death, if attributable, at least in part, to the infection;

3) NIs suspected to be caused by a germ in the air or in the surrounding air: legionellosis, aspergillosis, etc.

4) Illnesses for which individual data must be statutorily reported to the healthcare authority under article L3113-1, and whose nosocomial origin may be suspected, such as tuberculosis, acute hepatitis B, HIV infections, food-borne illness outbreaks (FBIO), etc.

The list of NIs that must be reported is not restricted to certain pathogens or infectious sites, thus allowing this early warning system to detect any (new) phenomenon: the interpretation of these criteria therefore relies on the hygienist's expertise and on his knowledge of the local, regional or national epidemiology of HAIs.

In each hospital, the healthcare professional in charge of external reporting, as well as his/her alternative representative, are designated by the hospital's manager, following confirmation by the consultative and monitoring body in charge of NI control (article R6111-15).

Internal reporting is based on the reporting, by any practitioner (physician, pharmacist, dentist), midwife or paramedical staff member who, in performing his/her duty within a healthcare institution, observes one or several cases of NI. This report is then given both to the physician in charge of the affected ward, and to the infection control team.

The practitioner of a hospital infection control team will determine whether the case(s) which have been reported to him/her meet the aforementioned external reporting criteria. When this or these case(s) meet(s) one of these criteria, this practitioner, when he/she is not the designated healthcare professional "in charge of reporting", is to remind the reporting officer of the requirement of reporting to the healthcare authorities and the CCLIN. When he/she provides an external report, the reporting officer notifies the head of the unit where the case(s) has/have occurred in public healthcare institutions other than local hospitals, the doctor in charge of the patient(s) in other healthcare institutions, the president of the committee for NI control, when he/she is not the officer in charge of reporting to healthcare authorities, and the legal representative of the institution.

There is no similar HAI reporting system in other countries.

## The reporting circuit in practice

This circuit is schematically shown in Fig. 1. It will however soon be changed, as soon as the ARSs are reformed; it will also be dematerialized (that is, transformed from a paper-based reporting system to a computerized system), as part of the SIN@PSE project conducted by the InVS.



## The role played by the InVS (Institute for Public Health)

This institute provides second level counseling and expertise, as do the CCLINs. These functions are mainly performed through periodically held meetings with the CCLINs, during which each case report is discussed.

The InVS becomes directly involved in an investigation only under exceptional circumstances, when required by the severity of the reported outbreak and/or the resources available for carrying out investigations, on request by the CCLIN or by referral to the Healthcare Authority (either the ARS or the Health Ministry). It may also need to alert the General Directorate for Health (DGS) if required by the potential impact of the reported case on public health.

The InVS receives a copy of each report provided by the ARSs, analyzes its characteristics and severity and checks it against previously received reports. On a regular basis, it analyzes each case report received, in order to detect emerging phenomena (such as glycopeptide-resistant enterococci) or recurring phenomena (*Streptococcus pyogenes* infections, invasive procedure-associated meningitis, etc.). Through regular dialogue between the CCLINs and ARSs, it takes part in the analysis of case reports and may have to ask for details on the method previously used to treat an outbreak.

It plays a key role when a single type of infection is reported in different inter-regional areas (as was the case for the investigation on the *Enterobacter sakazakii* meningitis in neonates, which was linked to a contaminated powder preparation in 2004). Thanks to this comparative analysis of the reports performed at a national level, information can be shared between the CCLINs, and the reported data can also be checked against those originating from other surveillance systems (statutorily reported diseases, surveillance of acute lower respiratory infections in elderly homes — EHPAD —, data from national reference centers, etc.), or against the vigilance systems implemented by the French Agency for Health Product Safety (AFSSAPS).

The InVS also provides an interface with the European warning systems implemented under the auspices of the European Center for Disease Prevention and Control (ECDC). Once a report has been received, it may thus alert the other Member States if the reported event has international implications (example: the emergence in 2006 of PCR-ribotype 027 *Clostridium difficile* infections in France).

## Recommendations

### Organization, training, assessment

- R12** The reporting mechanism for NI is based on the organization of internal reporting, and the training of the various actors within the hospitals concerning the operation and purpose of reporting. It would be advantageous for this internal reporting mechanism to be computerized. Finally, it should be assessed on a regular basis.

## Role of the person in charge of reporting

- R13** The management of each hospital should nominate a person in charge of reporting, who is responsible for: (1) establishing this internal organization through the use of local sources of information related to the NI (laboratory, patient records [DIM encoding],...), whilst ensuring relevant internal communication and informing the caregivers, persons in charge, and clinical department executives; (2) supplying external reports to the CCLIN and to the health authority (ARS).

## Role of the infection control team practitioner

- R14** The practitioner analyses all internal reports in order to evaluate, together with the reporting officer, the NI corresponding to the criteria for external reporting. For any NI requiring an external report, he/she makes an investigation with the help, if necessary, of the available procedures (for example via the CCLIN or the InVS) or by taking direct advantage of the ARLIN or CCLIN team. He/she must also organize the feedback and return of experience within the hospital (clinical departments, CCLIN, head office,...) following any external report, and ensure that the patient or his/her close family is informed.

It is essential that all information relative to the investigation be archived in paper or digital form in order for it to remain reusable (new reports, similar cases, scientific publications, etc.).

## Criteria for the evaluation of practice

■ The assessment of reporting practices may be carried out qualitatively, by checking that the reported events meet one or more of the criteria defined in the Decree.

- The "NI-associated death" criterion, which was subject to intense discussions concerning the selection of external reporting criteria, has indeed proven to be difficult to use, in particular in hospital units with high-risk patients, such as ICUs, where the infection accompanies, rather than leads to death. In 2006, with the aim of improving the reporting quality for this criterion, the CTINILS appointed a working group, which drafted methodology guidelines to assist in the reporting of nosocomial infections based on criterion 2, "any nosocomial infection-related death". January 2007, available at: [http://www.sante-sports.gouv.fr/IMG/pdf/guide\\_methodo\\_decès.pdf](http://www.sante-sports.gouv.fr/IMG/pdf/guide_methodo_decès.pdf) (consulted on May 13, 2010).
- From a qualitative point of view, the evaluation of reporting practice is extremely difficult. The criteria proposed in the Decree provide a basis for such evaluations, but its consequences in terms of the measures taken, and its impact on practice and healthcare organization should also be taken into account... A retrospective evaluation of the relevance of reports sent to the Paris-North CCLIN based on the criteria of 1) severity, 2) epidemic potential, and 3) the CCLIN's or regional branch's involvement, has shown that approximately one report out of two was pertinent.

■ A quantitative evaluation of reporting has been carried out every year since 2007, by the supervisory institutions. These institutions were requested by the Ministry to inspect 10% of those

hospitals in their department, which did not provide a report during any given year.

## Research subjects

■ Evaluating reporting appropriateness in morbidity-mortality reviews: this kind of study would make it possible to identify, *a posteriori*, those cases which might otherwise have been reported, in order to implement suitable means for other similar cases to be reported, and would reveal the degree to which the reporting of these cases would have been of interest in terms of practice improvement.

■ Means for improving the internal reporting system: one of the main obstacles to external reporting is the difficulty for the hygienist and the reporting officer to gain information concerning cases of infection. The main source of information is the microbiology laboratory. Complementary to this indispensable source of information, a culture of reporting should also be initiated and maintained, based on educational support adapted to each healthcare worker.

## Further reading

■ All of the Regional Nosocomial Infection Control Coordinating Centers (CCLIN) update, with variable periodicities, the reporting statistics received on their website.

■ The data supplied by the French Institute for Public Health are regularly analyzed, and published in the weekly epidemiology bulletin (BEH) or on the RAISIN website: <http://www.invs.sante.fr/raisin>, under the heading 'Alert' (consulted on 13 May 2010); this includes in particular the thematic assessments targeting certain types of infection or pathogens (GRE; *C. difficile*) which are not covered by the surveillance systems.

■ The data relating to reports made throughout France since reporting was initiated are as follows:

- From 08/01/2001 until 12/31/2008, 1251 hospitals made at least one report (i.e. approximately 45% of French hospitals), corresponding to a total of 6652 reports concerning 22120 patients. The number of hospitals contributing reports has steadily increased: the number of new 'reporting' hospitals doubled between 2001 and 2008.

■ The reporting of NIs has led to several national alerts, for example:

- an epidemic of ESBL infections and colonizations; this was related to 54 hospitals in 15 French departments, with 209 cases reported between April 2003 and May 2004: <http://www.ncbi.nlm.nih.gov/pubmed/16965700> (consulted on 13 May 2010);
- an epidemic of *Enterobacter sakazakii* infections in newborns, related to the contamination of milk powder preparations for infants: [http://www.invs.sante.fr/publications/2006/infections\\_e\\_sakazakii/infections\\_e\\_sakazakii.pdf](http://www.invs.sante.fr/publications/2006/infections_e_sakazakii/infections_e_sakazakii.pdf) (consulted on May 13 2010).
- Cases of endophthalmitis related to the use of a xylocain gel in 2004: [http://cclin-sudest.chu-lyon.fr/Alertes/2004/06\\_04\\_xylocaine.pdf](http://cclin-sudest.chu-lyon.fr/Alertes/2004/06_04_xylocaine.pdf) (consulted on May 13 2010).



■ In collaboration with the relevant national reference centers, the reporting of NIs has also allowed emerging pathogens to be detected and monitored, such as:

- The emergence of Glycopeptide Resistant Enterococci (GRE): from 2005 until the present day, the reporting of GRE infections or colonizations has been very closely monitored by the CCLIN and the InVS (French Institute for Public Health). From 2001 until June 2008, 382 GRE reports were submitted by 157 hospitals; 196 (51.3%) originated from the Eastern inter-regional area, 118 (30.1%) from the Paris-North inter-regional area (of which 73 were from the 'Ile-de-France' area), 40 from the South-East inter-regional area, 17 from the West inter-regional area and 11 from the South-West inter-regional area. A resolute and coordinated effort at the regional level, combining training, investigation and surveillance, allowed efforts to be pooled, and reporting and follow-up data to be shared, thus achieving an improved management of patients between hospitals, and involving the hospital management and their supervisory institution whenever difficult measures, such as the closing of a healthcare unit, needed to be taken. Our current hindsight indicates that this approach was efficient in the medium term: <http://www.invs.sante.fr/surveillance/erg/default.htm> (consulted on May 13, 2010);
- The emergence of *Clostridium difficile* PCR-ribotype 027 infections (CDI): in 2006 France was affected by the emergence of *Clostridium difficile* PCR-ribotype 027 infections (CDI). The Nord-Pas-de-Calais region recorded 515 cases of CDI from January 2006 to March 2007, in 41 hospitals. Of the 410 strains sent to the National Reference Center (CNR), 65% belonged to the epidemic clone. Outside this region, 118 hospitals had reported 347 cases of CDI. Of the 161 strains sent to the CNR, 7% belonged to the epidemic clone. From April 2007 until December 2008, the reporting of *C. difficile* NIs remained at a high level (16 per month on average), above that of the period preceding the hospital awareness and information program in 2006. The InVS had at that time received only 30 reports of CDI, from 2001 until 2005. The grouped case outbreaks reported in 2007 and 2008 were nevertheless much less significant (median of 3 cases per outbreak) than in 2006, suggesting that these epidemics were progressively better controlled by the hospitals: <http://www.invs.sante.fr/surveillance/icd/default.htm> (consulted on May 13, 2010).

■ The reporting of recurrent outbreaks contributed to the organization of numerous working groups, leading to enquiries, reports or recommendations, which have contributed to the progress in the combat against NIs in France.

■ NI reporting also allowed healthcare-associated infections contracted outside hospitals to be detected:

- when a serious *Streptococcus pyogenes* infection was reported, following a hair micro-graft, the investigations led by the CCLIN and supervisory institutions revealed significant deviations from good hygiene practice, which led to the informing of the exposed patients;
- Reports of *Mycobacterium chelonae* infections handled by hospitals also allowed epidemics related to mesotherapy care (two outbreaks of 16 and 7 grouped cases), or carboxytherapy treatment (8 cases) to be detected. In these three outbreaks, the healthcare was for esthetic purposes.

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# Managing and controlling a healthcare-associated infection epidemic

## Rationale

### Context and definitions

Major epidemics, causing millions of deaths over the centuries, have influenced the history of humanity, significantly impacting thinking, beliefs, collective fears, or even the functioning of societies and economies. The sudden, massive, destructive, and apparently random nature of these outbreaks has profoundly marked the collective unconscious of man. Since the major “plagues” of previous millennia, until the modern scourges of the HIV or influenza infections, without forgetting those of tuberculosis and malaria, which continue to proliferate at the beginning of the 21st century, epidemics have remained mysterious, and have often led to irrational behavior. For a medical hygiene specialist, the emotion conveyed by epidemics, which combines feelings of fear, powerlessness and guilt (including at the nosocomial scale), represents an additional impediment for their efficient and commensurate management.

There are several definitions used to characterize an epidemic, according to whether epidemiological or microbiological criteria are used. For epidemiologists, an epidemic can be defined, for a given pathology, by any increase in the number of cases over a given period of time, with respect to some reference values. The global increase in the frequency of the number of healthcare-associated infections in a ward, a hospital or a health institute, beyond what is normally measured by the epidemiological surveillance system (operating site infections, urinary infections, catheter-related infections, etc.), corresponds to an “epidemic situation”, even if the cases are not related in microbiological terms. However, the ordinarily retained definition for nosocomial situations, and that which is developed in the present chapter, is that of a spatiotemporal increase in the number of infections caused by the same infectious agent (clonal character for a bacterial or fungal strain, same serotype or genotype for a virus), arising from exposure to the same source, or arising from the existence of cross-contamination, in the same geographic space, during a defined period of time.

In an epidemic situation, the attack rate (the number of new cases in a population, over a given period of time, compared with the number of persons exposed to the risk of developing this healthcare-associated infection), which is the preferred indicator, increases beyond its normally observed level.

It is important to distinguish “true” epidemics from “pseudo-epidemics”, which are in fact an artificial increase in the number of observed cases, and can be attributed to an error in diagnosis, a change in the definition of a case in the context of surveillance, or a change in the sampling methods, or in the techniques used in the laboratory.

For infectious agents with a short incubation time, the epidemic is recognized during the patient's stay in the hospital (urinary infection, pneumopathy, gastro-enteritis, etc.); on the other hand, in the case of infectious agents with a long incubation time (tuberculosis, viral hepatitis, prion infections, etc.) the epidemic may be recognized only much later, or even remain totally unnoticed. In the case of bacterial and fungal infections, major colonizing epidemics can arise, which are often detected by the laboratory when analyzing clinical or ecological samples (systematic screening), without the patients having developed an infection. Whatever the epidemic situation, it is important to evaluate the criticality of the infections and their consequences in terms of morbidity-mortality, during the initial phase of the investigation.

## Methods used to manage an epidemic

The locations in which healthcare-associated infection epidemics can occur are various; although they arise most commonly in hospitals, they can also be observed in medico-social establishments or in healthcare centers.

The management of a healthcare-associated infection epidemic involves significant actions in terms of public health. The steps involved in its management are comparatively well established:

- verify the infection diagnosis and the existence of an epidemic;
- define the case;
- measure the extent of the epidemic in time and space;
- formulate one or more hypotheses and test them, where applicable, by means of case-control or cohort analytical surveys, if there is a sufficient number of cases;
- carry out an environmental and microbiological investigation (comparison of strains);
- control the epidemic by preventing the appearance of new cases, through the implementation of immediate control measures, which are then adapted according to the results of the investigation;
- introduce monitoring of each new case, so as to evaluate the efficacy of the implemented measures;
- draft an investigation report.

In the absence of any identified epidemic outbreak, it may be necessary to initiate an investigation in the event of a single case of infection or colonization by a specific pathogen which has either exceptional characteristics in terms of resistance to anti-infectious agents, or a high potential for diffusion. These situations, which could be described as “potentially epidemic”, require particular attention as a result of: i) the seriousness of the pathologies they could produce (group A streptococcus infection, legionellosis, varicella, influenza), ii) the emerging nature of the responsible infectious agent (*Clostridium difficile* ribotype 027, SARS coronavirus) or iii) the emergence of a new antibiotic resistance profile (carbapenemase-producing *Klebsiella*, community-associated *Staphylococcus aureus* or glycopeptide-resistant enterococci, etc.). Whether they be concerned by isolated or grouped cases, the techniques for the investigation and management of some of these specific situations are described in the national (InVS, CsSP of the HCSP) or inter-regional (CCLIN) recommendations; in particular, they deal with isolated or grouped group A streptococcus infections, legionellosis, *Clostridium difficile*, or glycopeptide-resistant enterococci infections. In principle, any affection of epidemic nature is also relevant for

the healthcare personnel. Some reported outbreaks have allowed the occurrence of cases in a healthcare individual to be revealed, in which the latter person had been affected by secondary contamination or had been at the origin of the contamination himself, as in the case of pertussis, scabies, influenza, *varicella*, or measles. These outbreaks require investigation or preventative vaccination campaigns in collaboration with the occupational health service.

Any nosocomial epidemic situation must be reported through the internal reporting channel to the infection control team (ICT), and then, with the shortest possible delay, to the relevant administrations (ARS) and the CCLIN, as required by the DHOS\E2 – n° 21 circular, January 22, 2004.

In the case of an epidemic, the procedures must be carried out by trained personnel (hygiene specialists from the ICT, in collaboration with the regional office or the CCLIN if necessary). A multidisciplinary team must be established in order to organize the epidemic investigation. It should comprise, at least, members of the healthcare personnel from the relevant ward (healthcare executives, nurses, practitioners, department head), ICT representatives, the president of the CLIN (or the forum for consultation and monitoring responsible for the prevention of NIs), a microbiologist, an occupational health physician, a representative from risk management coordination, and a representative from the government administration. This crisis team has the following missions: (i) define the cases, (ii) define and validate the management measures, (iii) evaluate the human and material requirements, and (iv) monitor the epidemic's evolution (number of new cases, seriousness of cases).

## Investigation of an epidemic

The investigation phase of an epidemic may prove to be more or less complex; in some cases, it requires the addition of epidemiological competencies, in microbiology or biostatistics. The epidemiological investigations can require a retrospective cohort investigation or a case-control type of analytical approach. These investigations may be carried out in the context of the search for new risk factors, or in order to direct the preventative measures towards a specific healthcare procedure, or in the context of a more extensive regional or national epidemic. However, the initiation of these investigations can sometimes be slow, and may involve considerable time and resources. They are not made systematically, especially when there are no hypotheses to be tested or when there is only a small number of cases. A comprehensive investigation may not necessarily involve this type of approach. Furthermore, the descriptive stage, corresponding to the time, location and persons involved (epidemiological curve, geographical distribution of cases, summary table), is an essential, and sometimes sufficient prerequisite, allowing hypotheses to be formulated concerning the origin of an epidemic. The microbiological investigation based on comparative phenotyping or, more commonly, genotyping techniques, allows the level of the epidemiological relationship between the identified pathogens to be determined: ribotyping, pulsed-field electrophoresis, sequencing and phylogenetics are the most commonly used techniques, and can vary according to the pathogen involved. The association with other already published epidemics is an additional factor to be taken into account during the investigation and testing of the studied epidemic.

Systematic screening of patients and, occasionally, the healthcare personnel can help in



identifying the mechanism and source of the epidemic. The decision to implement such screening will be taken by the epidemic crisis team. Screening can allow: (i) the reservoir and initial attack rate to be measured, (ii) patient cohorting to be defined whenever cohorting is implemented, (iii) the appearance of new cases to be monitored, (iv) the impact of the preventative measures to be evaluated, and (v) the announcement to be made, when applicable, that the epidemic is under control.

The publication of the results of the epidemic investigation can lead to the dissemination of national recommendations in order to avoid the future occurrence of similar epidemics.

## Management of an epidemic situation

The preventative measures must be implemented as rapidly as possible, since the speed of intervention will partially predetermine their success. They should be established without waiting for the full results of the investigation, since initially adopted generic measures can later be adapted in accordance with the outcome of the investigation.

Early detection of an epidemic is closely dependent on the epidemiological surveillance and alert capabilities of the laboratory, and also on the training and involvement of the healthcare personnel in the management of infectious risks. Conversely, a difficult to control epidemic can lead to the closure of a hospital ward.

The management measures can include, in variable proportions according to the circumstances: (i) so-called barrier measures (reinforcement of hand hygiene, wearing of masks, aprons or gowns, cohorting of patients and healthcare personnel), (ii) institutional measures (adequacy of the healthcare personnel to patient ratio, closing of care units if necessary, creation of a dedicated unit, training of personnel, procurement of specific equipment), (iii) epidemiological measures (surveillance, screening of patients and healthcare personnel if necessary), (iv) clinical measures (treatment of infectious sources, antibiotherapy policies, vaccination), and (v) environmental measures (air, water, medical surfaces and devices).

In some situations, only the setting up of cohorting allows the dissemination of epidemic strains to be controlled. This involves the geographical separation of patients into two sectors: one for the patients defined as corresponding to epidemic cases (according to the definition given for a specific epidemic); the other for exposed (contact) patients who are not considered to be cases, but who are hospitalized during the same period as the identified cases. Occasionally, a third sector is organized for newly admitted patients (in the case of a GRE, for example). Separate healthcare personnel are assigned to each cohort. The setting up of such an arrangement can be difficult in organizational or architectural terms, and may require the use of additional personnel. Involvement of the hospital management in the epidemic control strategy then becomes essential.



# Recommendations

## Crisis team

**R15** It is recommended, in the case of an epidemic situation, which is recognized and confirmed by the infection control team, to: 1) implement a crisis team within the hospital; 2) include at a minimum the hospital director or his representative, the person in charge of the coordination of risk management, the head and the healthcare executive of the affected ward; 3) define the crisis cell's mission: identification of the means of prevention and control of the epidemic, define communication policies inside and outside the hospital, nominate a multidisciplinary investigation coordinator.

## Investigation

**R16** It is recommended that the investigation be carried out by a pluridisciplinary team. The infection control team must be able to coordinate the investigation, in collaboration with the ARLIN and the CCLIN, or the health authority in the case of specific difficulties, or national reference centers or expert laboratories in the case of microbiological investigations.

**R17** It is recommended:

- to confirm the epidemic, and clearly define and identify each case;
- to describe the epidemic in time, place and as a function of the individual characteristics of each case.

**R18** Once the initial measures have been established, it is recommended:

- to develop a hypothesis concerning the relationship between “source, infectious organisms, means of transmission, and favorable factors”, and if possible to test this using analytical methods (witness cases or cohort), if there is a sufficient number of cases;
- to assess the applicability of an environmental or microbiological investigation (comparison of isolated strains).

## Measures to be implemented

**R19** Whatever the type of epidemic, it is recommended to reinforce the application of standard precautions and to propose possible additional preventative precautions, to be adapted to the situation as early as possible. It is very important not to defer the implementation of preventative precautions, and not to wait for the outcome of microbiological and epidemiological investigations, nor for the verification of hypotheses under test.

**R20** It is recommended to assess the applicability of implementing patient and healthcare personnel cohorting, in order to ensure that the preventative measures are efficient.

- R21** It is recommended to assess the applicability of implementing systematic screening of patients, persons in contact with “cases”, and possibly the healthcare personnel, depending on the pathogenic organism responsible for the epidemic, in collaboration with the microbiology laboratory and the occupational health service. In some circumstances, screening of the healthcare workers is not recommended, in the absence of convincing evidence of their role in the pathogen’s transmission. The decision to implement screening implies prior definition of the proposed collective or individual precautions.
- R22** It is recommended to inform the health professionals and visitors of the precautions to be taken. This information must be in written form. Whenever patients are transferred, the receiving hospitals must be informed of the situation.
- R23** It is recommended to assess the applicability of informing patients who have already left the hospital, and who were exposed to the risk of infection.
- R24** It is recommended to organize internal communications with patients, visitors, hospital staff and, if necessary, external communications (authorities, CCLIN, InVS, media, etc.).
- R25** It is recommended to implement monitoring of each new case and thus to evaluate the efficacy of the precautions taken.
- R26** It is recommended to organize an audit of care practices.
- R27** In the case of an epidemic corresponding to the criteria requiring a report, it is recommended to proceed, as quickly as possible, with external reporting to the health authorities and to the CCLIN of any confirmed epidemic situation. The reporting is carried out by the hospital’s officer in charge of the external reporting of HAIs.
- R28** It is recommended to draft an epidemic investigation report in order to encourage the lessons-learned process.

## Specificities

### Investigation of epidemics involving emerging transmissible or antibiotic multi-drug resistant organisms

■ There are many recommendations allowing hospitals to organize the investigation of grouped cases of emerging or multi-drug resistant pathogens of national interest, characterized by risks of regionalization, in situations which are difficult to control in their initial phase, in particular during the transfer of patients between hospitals: *Clostridium difficile*, glycopeptide-resistant enterococci. The specific recommendations for other pathogens of national interest are referenced at the beginning of this chapter.

## Nursing homes for the dependent elderly

■ Recommendations for the management of an epidemic in a nursing home for the dependent elderly were drafted in 2008, within the framework of a partnership between the national Observatory for infectious risks in geriatrics (ORIG), the French society for hospital hygiene (SFHH), and the Regional Nosocomial Infection Control Coordinating Centers.

## Investigation of grouped cases of viral or bacterial infections with long incubation periods

■ This has mainly to do with grouped cases of blood-borne infections, transmitted by HBV HCV, or more rarely HIV, and atypical mycobacterial infections (*M. xenopi*, *M. chelonae*) which share the following features: (i) often being asymptomatic at the first stage of the infection, (ii) being transmitted insidiously, by means of sometimes poorly identified mechanisms, (iii) sometimes being revealed very far from the contaminating outbreak, (iv) requiring the implementation of complex epidemiological and virological investigation techniques, and (v) requiring a recall procedure in order to actively track down patients, who in many cases were exposed several years previously. As opposed to the previously described short incubation infections, epidemics with long incubation periods can be investigated with considerable delays, which makes this process considerably more complex, even though the general methodology remains unchanged: recognition of the epidemic, search for cases (which often requires information concerning the potentially exposed patients, for the purposes of additional investigations), spatiotemporal description of the epidemic, auditing of the healthcare practices, serological investigations based on sophisticated molecular epidemiological techniques, and finally the implementation of verification and evaluation measures.

## Survey of patients exposed to care provided by infected healthcare personnel

■ Although quite rare, the transmission of HBV, HCV or HIV from healthcare personnel to one or more patients has been reported on several occasions. The discovery of infected healthcare personnel involved in invasive procedures may lead to the organization of an epidemiological investigation, the appropriateness of which should be carefully considered, since it can have major organizational, psycho-sociological and medico-economic implications in terms of its implementation and management. Three representative phases can be identified for such an investigation: (i) identify as closely as possible the date at which the involved healthcare personnel were contaminated, in order to determine the size of the potentially exposed population, (ii) identify, inform and screen the patients at risk of being contaminated by the healthcare personnel (this step is particularly complex since it must combine the greatest degree of exhaustiveness, wide dissemination of information, and the strict observance of the affected patients' confidentiality, as well as their psychological support, and (iii) conduct an expert evaluation of the medical or surgical practices of the infected healthcare personnel and of the disinfection / sterilization procedures in the affected healthcare establishment.

## Research topics

■ The quality of epidemic descriptions available in the literature can vary. To assist the investigators in finding information, which can be used to test their hypotheses, a database of epidemics reported in the literature is available. The data for an epidemic investigation can be modeled from studies of controlled interventions, in order to measure the impact of one or several preventative measures.

## Further reading

■ The investigation of a nosocomial infection epidemic can be organized in several stages. Some documents, presented in the form of methodological factsheets, can be helpful in the planning of an investigation:

- Investigation of an epidemic. Newsletter of the French Society for Hospital Hygiene. Hygiene, March 2007, n° 78: <http://www.sfhh.net/> (consulted on May 13, 2010).
- Hospital hygiene techniques 2004, Southeast CCLIN, leaflet n° 2.07: <http://cclin-sudest.chu-lyon.fr/prevention/guides/FCPRI/Sommaire.htm> (consulted on May 13, 2010).
- Procedures to be followed to deal with a nosocomial infection epidemic, North Paris CCLIN, 1994 - <http://www.cclinparis-nord.org/Guides/plaquettesCAT.pdf> (consulted on May 13, 2010).

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# Standard precautions

The “standard” precautions are described in the circular No. DGS/DH/98/249 of April 20, 1998, pertaining to the prevention of contamination by infectious agents borne by blood or biological fluids to patients in healthcare institutions. This text updates the concept of isolation with respect to blood and body fluids. It requires general hygiene precautions, or “standard” precautions, to be implemented by all healthcare workers when providing any form of care to a patient, whatever his/her infectious status. By allowing the risk of cross-contamination to be reduced, their aim is two-fold: to ensure the high quality of care provided to patients, and to ensure the safety of caregivers.

There are seven “standard” precautions, concerning: the washing and/or disinfection of hands, the wearing of gloves, the wearing of gowns, goggles, and a mask, the procedures in the case of contact with blood or body fluids, the management of surfaces, the management of soiled equipment, the transportation of biological samples, linen and soiled equipment.

Some of these precautions are not addressed in this chapter, which deals essentially with hand hygiene, the wearing of gloves, masks and professional garments.

## Hand hygiene

### Rationale

A hand hygiene procedure is one of the fundamental means of preventing healthcare-associated infections (HAI). Indeed, in a relatively old study, MORTIMER illustrated the difference in the rate of *S. aureus* acquisition by a nurse, depending on whether or not she washed her hands (four times more frequently and quickly in the absence of hand washing). More recently, PITTET revealed a reduction in the rate of HAIs when the observance of hand hygiene was improved, even though this outcome was not based on a controlled randomized study. Furthermore, a quite recent study of vancomycin-resistant enterococci has shown that, following hand contact from a caregiver who had been in contact with a colonized site on the patient or his/her environment, 10.6% of the patient’s non-colonized sites in turn became contaminated.

The frequency of hand contamination is estimated to be 17%, following contact with a patient carrying a multi-drug resistant bacterium (MDRO). In the absence of hand hygiene, the hands remained contaminated. Different hand hygiene techniques have varying efficacies. The hands remain contaminated by transitional flora, after washing with a mild soap, but the flora does not persist if it is treated with an alcohol-based product (ABP). Furthermore, hand rubbing with an ABP has a greater efficacy than that of hygienic cleaning of the hands for 30 seconds. Finally, other studies have revealed the superiority of the use of an ABP, in comparison with mild soap.

The length of fingernails, the wearing of false fingernails or nail polish, as well as the wearing of jewelry, are associated with a greater degree of hand contamination.

## Recommendations

**R29** Prior to hand hygiene procedures, the healthcare giver must wear short-sleeved professional clothing, have short fingernails (1 mm or less), with no false fingernails or nail polish, and wear no jewelry (including watches and wedding rings).

**R30** It is recommended to carry out hand hygiene procedures:

- to confirm the epidemic, and clearly define and identify each case,
- immediately before any direct contact with a patient,
- before any clean care or any invasive procedure,
- between contaminating care and clean care, or an invasive procedure with the same patient,
- following the last direct contact with, or care given to a patient,
- after any contact with body fluids,
- before pulling gloves on for care,
- immediately after removing gloves.

**R31** It is recommended, for hand hygiene, to use an alcohol-based handrub instead of simple washing, hygienic washing or surgical washing. If the hands are visibly soiled, it is imperative to first perform simple hand washing.

## Criteria for the evaluation of practices

■ Compliance of the hands: absence of jewelry on the hands and wrists, short fingernails no decoration or false fingernails.

■ Hand hygiene technique or observance.

It is possible to follow national methodologies such as those proposed by the Hospital Hygiene Assessment Task Force (GREPHH): <http://www.grephh.fr/> (consulted on May13, 2010), or by the CCLIN.

## Specificities

■ It is essential to know the limitations of ABPs according to the type of infectious agent. ABP's have no effect on parasites (lice, scabies mites ...), nor on fungi, with the exception of yeasts (tested mainly on *C. albicans*), and have a moderate degree of activity on spore-forming bacteria.

■ The efficacy of ABP's on viruses depends on the contact duration, and on the concentration of the product. The elimination of viruses can be claimed only if the product complies with the French standard NF EN 14476, within a period of time compatible with that used for hand rubbing.

■ When the ABP activity has not been demonstrated, or is uncertain with respect to an isolated or suspected pathogen (e.g. *Clostridium difficile*), the wearing of gloves on clean (disinfected beforehand with an ABP) hands should be preferred. When the gloves are removed, simple cleaning of the hands is to be followed by disinfection with an ABP.

## Research topics

- Identification of features which favor good observance of hand disinfection in the work environment (for example, observance and interruption during care ...).
- Search for the optimal hand disinfection procedure for surgery.
- Search for possible intolerance in patients.

## Further reading

■ WORLD HEALTH ORGANIZATION. WHO Guidelines on hand hygiene in healthcare. First global patient safety challenge. Clean care is safer care. Available at: <http://whqlibdoc.who.int/publications> (consulted on May 13, 2010).

■ FRENCH SOCIETY FOR HOSPITAL HYGIENE (SFHH). Recommandations pour l'hygiène des mains (*Recommendations for hand hygiene*). June 2009. Available at: [http://www.sfhh.net/telechargement/recommandations\\_hygienemain2009.pdf](http://www.sfhh.net/telechargement/recommandations_hygienemain2009.pdf) (consulted on May 13, 2010).

## Wearing of gloves

### Rationale

Gloves are worn to prevent any skin contact with blood or body fluids. MAST showed, already in 1993, that the interposition of the glove's layer reduces the quantity of blood transmitted in the case of a needlestick injury. The material of which the glove is made reduces the inoculated quantity of blood by 46% to 86%.

The DGS/DH/98/249 circular of April 20, 1998 recommends the wearing of gloves whenever there is: *"a risk of contact with blood or any other product of human origin, the mucosa or non-intact skin of a patient, in particular during care with splatter or splashing and needlestick risks (hemoculture, insertion or removal of Catheters, totally implantable venous catheters, blood sampling) and during the manipulation of biological sampling tubes, soiled linen or equipment ... or during care, for which the caregiver's hands have any lesions."* This circular also specifies that they *"must be changed between any two patients, or activities"*.

The wearing of gloves is not a substitute for hand hygiene. Gloves must be picked up with clean hands in order to avoid their contamination. TENORIO showed that the wearing of gloves reduces the transmission of Vancomycin-resistant Enterococci to caregivers' hands; however, it does not completely prevent contamination of the hands, and a hand hygiene procedure is necessary when these are removed.

Environmental contamination through gloved hands is possible; RAY revealed that contact with contaminated surfaces leads to the transfer of bacteria to the gloves.

For reasons of efficiency, powder-free gloves are used, together with hand disinfection by means of a handrub with an alcohol-based product.

The type of glove (sterile, non sterile, material, sleeve length ...) is adapted to the risk related to the expected activity, and to the risk of allergies.

The gloves must be kept in their original packaging.

## Recommendations

- R32** Gloves are always to be worn when there is a risk of contact with blood or any other product of human origin, the mucosa or non-intact skin of a patient, in particular during care with splatter or splashing risks (hemoculture, blood sampling, insertion and removal of venous catheters, totally implantable venous catheter, ...). They must also be worn during the manipulation of biological sampling tubes, and soiled linen and equipment. They are systematically worn during any care for which the caregiver's hands have any lesions (cuts, wounds, abrasions or dermatosis).
- R33** It is not recommended to wear gloves during contact with intact skin. This recommendation is not relevant to the approach used to deal with certain microorganisms (toxigenic *Clostridium difficile*, glycopeptide-resistant enterococcus) for which there are specific recommendations.
- R34** Gloves are to be changed between any two patients or activities (including those involving the same patient). They should be worn just before the contact, care or treatment. They should be removed as soon as the care has been completed, and be disposed of before the wearer touches the surrounding environment.

## Criteria for the evaluation of *practices*

■ Southwest CCLIN, audit methodology concerning the wearing of sterile, single-use gloves, 1999. Available at: [http://www.cclin-sudouest.com/pages/eng\\_gant.html](http://www.cclin-sudouest.com/pages/eng_gant.html) (consulted on May 13, 2010).

## Specificities

■ For surgical or interventional procedures.

Numerous studies have focused on the rate of glove perforation and the efficiency of double gloving. The protection procured during surgery, against blood or body fluid exposure and the cross-contamination of pathogenic microorganisms should not be neglected, particularly in the case of emergency procedures. In a 2003 review from the Cochrane library, TANNER and PARKINSON concluded that double gloving significantly reduces perforations of the innermost glove. In the context of the prevention of the risks associated with blood and body fluid

exposure (BBFE) accidents, during surgical or interventional procedures, it is recommended to change the gloves regularly, and to wear two pairs of gloves, in particular in the case of the lead surgeon, during suturing of the parietal planes.

## Further reading

■ PARIS NORTH CCLIN. Gloves in the hospital, an informed choice, October 1998. Available at: <http://nosobase.chu-lyon.fr/recommandations/Mains/GantPN.pdf> (consulted on May 13, 2010).

■ NATIONAL INSTITUTE FOR RESEARCH AND SAFETY (INRS). Protective gloves for healthcare professions, leaflet ED 118, 2004. (Available at: <http://www.inrs.fr>).

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## Masks

### Rationale

There are two main types of mask: the surgical mask (**Table I**) and the respiratory protective equipment (RPE) (**Table II**).

The EN 14683 standard for “surgical masks” – September 2005, covers, under the same definition, masks used during healthcare procedures and those used for surgical operations. The surgical mask (type I, IR, II, or IIR) is designed to avoid, during exhalation by the wearer, the projection of secretions from the upper airways or of saliva, which could contain infectious agents which can be communicated by the “droplet” (particles > 5 µm) or “air” (particles < 5 µm) transmission modes. When worn by the caregiver, the surgical mask prevents contamination of the patient and the nearby environment (air, surfaces, products...). When worn by a contagious patient, it prevents the contamination of his/her friends and family and of the nearby environment.

**Table I – Performance of surgical masks, according to mask type and to the EN 14683 standard.**

TEST	Type I	Type IR	Type II	Type IIR
Bacterial filtration efficiency (BFE) Expressed in %*	≥ 95	≥ 95	≥ 98	≥ 98
Differential pressure** (expressed in Pascals)	< 29.4	< 49.0	< 29.4	< 49.0
Splash resistance pressure (expressed in mm of mercury)	Not required	≥ 120	Not required	≥ 120

\* The bacterial filtration efficiency is measured on the material of the mask; it does not take facial leaks into account.

\*\* The differential pressure expresses a mask's resistance to the flow of a gas. For equal levels of leakage around its circumference, a mask with a lower value of differential pressure will offer easier breathing to the wearer.

**Table II – Minimum performance required for RPE, according to the EN 149 standard**

Classification	Maximum total leakage	Maximum filter penetration (NaCl and paraffin oil)
PFF1	22%	20%
PFF2	8%	6%
PFF3	2%	1%

The surgical mask also protects the wearer from infectious agents, which can be communicated by “droplet” transmission. Type IR or IIR surgical masks have an impermeable lining which makes them resistant to projections. They are referred to as being “splash-proof”.

The surgical mask does not under any circumstances provide protection against infectious agents carried by “air” transmission. In order to ensure they are protected from air transmission mode microorganisms, caregivers and visitors must wear a particle filtering facepiece type of RPE (PFF). This device must comply with the EN 149 standard. The characteristics of this RPE must be adapted to the type of risk to be avoided (PFF1, PFF2, PFF3).

## Recommendations

**R35** Healthcare givers must systematically wear a surgical splash-resistant mask (standard EN 14683) with safety goggles or a full-face visor when giving care with a risk of blood or biological fluid splattering. These instructions are also applicable to visitors when they are involved in healthcare. The patient must wear a surgical mask (standard 14683) whenever he/she has a cough thought be of infectious origin, and leaves his/her room.

**R36** Healthcare givers and visitors must wear a disposable PFF (PFF1 or PFF2) type of PRE, compliant with the criteria of the EN 149 standard, in the case of the risk of exposure to microorganisms which can be communicated by aerosols. In the case of invasive procedures, whenever there is a risk of exposure to certain types of microorganisms, which can be communicated by droplets or the air, the healthcare givers are to wear a disposable

PFF (PFF1 or PFF2) type of PRE, compliant with the criteria of the EN 149 standard.

**R37** The mask must always be worn in such a manner as to cover the nose, chin and mouth, and must be hermetically applied to the face. It must not be repositioned or worn around the neck.

## Research topics

- Poor compliance in the wearing of masks.
- Resistance to the passage of air and caregiver comfort.
- Harmonization of practices and indications as a function of the type of mask or PRE.

## Further reading

■ FRENCH SOCIETY FOR HOSPITAL HYGIENE (SFHH). National recommendations. Cross-contamination prevention: additional contact precautions. April 2009. Available at: [http://www.sfhh.net/telechargement/recommandations\\_preventiontransmissioncroiseeSFHH.pdf](http://www.sfhh.net/telechargement/recommandations_preventiontransmissioncroiseeSFHH.pdf). (consulted on May 13, 2010).

■ NATIONAL INSTITUTE FOR RESEARCH AND SAFETY (INRS). Protective respiratory devices: which equipment should be chosen? Leaflet ED 4136 2005. Available at: <http://www.inrs.fr> (consulted on May 13, 2010).

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# Professional garments

## Rationale

Professional garments replace everyday clothes; their purpose is to protect healthcare professionals, in accordance with the Labor Code. Cotton releases particles and provides good adherence for microorganisms, contrary to polyester / cotton blends. Several studies have highlighted the contamination of professional garments by different microorganisms (*Staphylococcus aureus*, Enterococci, *Clostridium*), following contact with patients within a period of not more than three or four hours. Indirect contact with the professional garments was found to be a transmission vector for cross-contamination in hospital departments. Article R4323-95 of the Labor Code specifies that whenever the wearing of professional garments is compulsory, the employer is responsible for their cleaning and maintenance.

Single-use gowns or aprons, providing protection for the professional garments, are to be used in specific situations or for specific professional risks. They allow professionals and patients to be protected, during care requiring “standard” precautions (changing of soiled persons, for example) or “additional contact” precautions.

The use of overshoes unnecessarily exposes the wearer to the risk of contamination of his/her hands when they are put on or taken off. No study has demonstrated their usefulness in preventing infections.

## Recommendations

**R38** The professional garments should be adapted to the use for which they are intended. They are to be changed daily and whenever they are soiled. They should be composed of a polyester / cotton mix (most often 65%/35%), allowing them to be washed at temperatures > 60°C. The garments' sleeves should be short, so as to permit efficient hand hygiene procedures. The hair should be clean and tied back.

**R39** A gown or a disposable plastic apron is systematically used to protect the garments, whenever there is a risk of splashing or aerosolization of blood or biological fluids. This protection is also to be worn during the direct care of a patient requiring additional contact precautions.

## Criteria for the evaluation of practices

- Allocation and rotation of garments.
- Visual cleanliness of garments
- Absence of city clothes underneath professional garments.
- Removal of working clothes for any activity not involving care.

## Specificities

■ For surgical or interventional procedures, the EN 13 795 standard series specifies the requirements applicable to surgical drapes, gowns and clean air suits, whether they be single-use or reusable, used as medical devices, for patients, clinical staff and equipment, and designed to prevent the transmission of infectious agents between patients and the personnel during invasive surgical procedures.

## Further reading

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# Cross Contamination

For many years, so-called isolation measures were defined according to the infectious organism's source: enteric, cutaneous, respiratory isolation... In 1996, The Centres for disease control and prevention (CDC), followed in 1998 by the French recommendation guidelines, adapted isolation measures according to the micro-organisms' modes of transmission, which were then added to the standard precautions. In 2007 the concept evolved towards the notion of "additional precautions" (AP) to the standard precautions (SP). The indications for AP are based on: the means by which the infectious organisms are disseminated; the nature of the organism; its longevity in the environment; its resistance to antiseptics and antibiotics; the location and potential seriousness of the infection; the level of (innate or acquired) immunity of the persons at risk.

Cross-contamination is defined as the transmission of certain microorganisms (bacteria, viruses and fungi), from patient to patient or from the environment to a patient, but not from an infected area to a normally sterile area within the same patient. The methods of transmission can be divided into three types:

- transmission by contact (C) between individuals, rarely directly between patients, more often via the hands of the healthcare personnel, either from a source originating from a patient (or his or her close environment), more rarely from a more distant environment;
- transmission via droplets (D) projected while speaking or coughing, either directly or via droplets deposited in the immediate environment of the source case. The contamination takes place through contact of the infectious organism with the mucous membranes;
- Airborne contamination (A) of small dried droplets ("nuclei droplets"), capable of remaining in suspension for long periods and of being carried over greater distances, at least several metres. The contamination takes place through inhalation of the infectious organisms carried by the "droplet nuclei".

One and the same pathogen can have several routes of transmission, for example contact and droplets for the *Syncytial Respiratory Virus (SRV)*.

Only transmission by contact and droplets is discussed in this chapter. The prototype of airborne transmission of an infection is tuberculosis. Other infections fall under airborne transmission: chickenpox, rubella, certain viral haemorrhagic fevers, newly emerging pathogens (severe acute respiratory syndrome - SARS – in 2003). The case of influenza is still being debated, the current recommendations being to consider it as an organism transmitted via droplets or airways in the case of an influenza pandemic. The air-type AP will be discussed in another chapter of this document (cf. Chapter on professional risks and vaccination).

# Cross-Contamination through contact

## Rationale

### Introduction, targeted bacteria

Cross-contamination is frequent. Several studies carried out during critical care, involving the systematic analysis of the strains found in samples taken for diagnostic purposes, have shown that 15 % to 35% of these had cross-contamination as their origin. This percentage is certainly higher (although not tested) for freely transmitted strains of bacteria, as opposed to clinical strains. Cross-contamination concerns strains that are resistant or responsive to antibiotics.

Bacterial resistance in hospitals is a dynamic phenomenon. It can be classified according to its frequency (emerging, epidemic or endemic character), and according to the mechanisms leading to the dissemination of the micro-organisms and their commensal (part of normal human flora) or saprophytic character.

The targeted bacteria are the following:

- Methicillin-resistant *staphylococcus aureus* (MRSA),
- Extended Spectrum BetaLactamase-Producing Enterobacteria (ESBLE),
- Imipenem-resistant *Acinetobacter Baumannii* or *Acinetobacter Baumannii* sensitive only to imipenem,
- Cephalosporinase-Hyperproducing enterobacter in neonatology (but not in adults),
- Imipenem-resistant *Pseudomonas Aeruginosa*, associated with other resistances,
- Bacteria more sensitive to antibiotics, but which are responsible for an epidemic.

**Table I - main hospital resistances observed in 2009:**

	Frequency	Functional Characteristics	Mechanism	Other Characteristics
MRSA	++ (Decline)	Commensal	Cross Contamination>> Selection Pressure	Old and established epidemic Emergence of Community-associated MRSA
ESBLE*	++ (Increase)	Commensal	Cross Contamination + Selection Pressure	Community origin possible ( <i>E.coli</i> ) Risk of imipenem-resistant ESBLE
resistant <i>A. baumannii</i>	+	Saprophyte	Cross Contamination>> Selection Pressure	Epidemic in critical care
GRE	Emerging	Commensal	Cross Contamination>> Selection Pressure	Carrier/infection ratio ≈ 10
<b>HPCase</b> Enterobacteria	+	Commensal	Selection Pressure Only	No epidemic in adults
resistant <i>P. aeruginosa</i>	+	Saprophyte	Cross Contamination + Selection Pressure	Possible Environmental Source

\* Extended Spectrum BetaLactamase-Producing Enterobacteria

\*\* Glycopeptide resistant enterococcus

MRSA and ESBLE are the two multi-drug resistant bacteria warranting the use of Additional Contact Precautions (ACP), since they are commensal and are spread mainly by cross-contamination. Other bacteria may warrant measures in addition to ACP:

- if they are even more resistant or newly emerging (GRE), or if they are still non multi-resistant, but with a strong dissemination potential (*Clostridium difficile*);
- because of their highly pathogenic character, virulent nature and strong potential to disseminate within the community, for example the strains of community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA), which are the source of the vast majority of cases of cutaneous infection (cf. specific recommendations of the HCSP - French Higher Council for Public Health).

The same is valid for other pathogenic organisms (scabies mite).

Apart from the dissemination of MDRO, cross-contamination also concerns bacteria that are responsive to antibiotics, but which are more difficult to detect in the laboratory. The application of SP should prevent transmission of these bacteria. ACP indications also apply to some epidemics, for example viral infections (gastro-enteritis, pneumonitis) in pediatrics, extended care and rehabilitation (ECR), or long-term care situations.

## Epidemiological Situation

MRSA is the most frequent MDRO in France. National monitoring figures show that in 2008 24.5% of *S. aureus* bacteremia were MRSA (data from EARS-Net – the former EARSS European Antimicrobial Resistance Surveillance Network) and that MRSA were found in 10% of healthcare-associated infections in the 2006 national prevalence survey. In 2006, the MRSA rate was 0.55/1000 hospital days within the “MDRO Network of the national program for early warning, investigation and surveillance of healthcare-associated infections” (BMR-RAISIN). The rates of MRSA in France have been in decline for approximately ten years.

ESBL enterobacteria were described at the beginning of the 80s and caused epidemics in the critical care sector in France towards the end of the 80s (*Klebsiella pneumoniae*). ESBLE are now hosted by numerous enterobacteria: *Escherichia coli* (approximately 50% of ESBLE), also *Enterobacter spp.* and *K. pneumoniae*; these are found all over the world. Apart from hospital-disseminated strains (which are again on the increase), a worldwide epidemic of strains of new enzyme-producing (CTX-M) ESBL *E. coli* is currently developing, initially emerging and spreading within the community, before being imported into hospitals. ESBLE rates, after a decline during the 90s, are on the increase (0.17/1000 days of hospitalisation in 2006), with significant regional variations.

*A. baumannii* is a saprophytic bacteria, an opportunistic pathogen which is often a MDRO. It is rarely responsible for Healthcare Associated Infections (HAI) (0.3% of HAI in the 2006 prevalence survey.) It is more often found in critical care (1.6% of HAI, with significantly varying rates according to location and units with high level of care and antibiotics use. It can be responsible for epidemics, warranting extensive monitoring measures, and can lead to the restriction of



admissions or the closure of the ward. It has a prolonged survival in the environment.

*P. Aeruginosa* is an opportunistic pathogen frequently found in critical care (pulmonary infections), naturally resistant to antibiotics, with the potential to create therapeutic difficulties in case of multi-resistance. The majority of infections have the endogenous flora of patients as their source, however epidemics via cross-contamination are possible. The relative importance of an endogenous origin or cross-contamination varies considerably from one ward to another. *P. aeruginosa* colonises humid environments, which can (in rare cases) constitute an epidemic reservoir.

Bacterial resistance is increasing world wide, with the description of even more resistant MDROs, in particular GRE and carbapenem-resistant ESBLE through carbapenemase production. When a patient is repatriated from a country in which there is an epidemic outbreak, he or she may import multi-drug resistant strains, which can be the starting point for a hospital epidemic (cf. Specific Recommendations of the HCSP - French Higher Council for Public Health).

## Control Measures

Despite numerous studies undertaken to evaluate MDRO control strategies, very little evidence-based data is available. In fact, individual measures have rarely been evaluated one by one, and the evaluation of the impact of bundle control strategies is complicated (confusing factors, insufficient methodological criteria, short time span, difficulties in generalising the conclusions of a study). Nevertheless, analysis of the literature has allowed recommendations to be established, which were recently updated in France. These recommendations are complementary to the good practice recommendations for antibiotics.

The control of cross-contamination relies above all on the observance of SP, in particular with regard to hand hygiene. These are discussed in another chapter. ACP have been proposed because SP are not adhered to in all circumstances.

The choice between SP and ACP will depend on the epidemiological situation and the observance of SP. ACP will be most useful in situations where SP are not strictly adhered to. However, if it is shown that there is good observance of SP, the Nosocomial Infection Control Committee (CLIN), or the equivalent consultation and follow-up organisation, may then decide to favour SP only, for the purposes of cross-contamination control: by making alcohol-based products widely available, by increasing the observance of hand hygiene (both quantitatively and qualitatively), through best practice in the wearing of gloves, a good knowledge of the epidemiology of MDRO, and expertise of the CLIN and the ICT.

The main elements of the ACP consist in screening, alerting and informing, geographically isolating, and wearing protective clothing and equipment. The CLIN identifies the micro-organisms warranting additional measures, as well as the screening policy, on the basis of the ICT's expertise, in accordance with the national recommendation guidelines, and according to the local epidemiological risks for patients and the community, and the known data from the observance of SP.

## Screening

In order to help identify carrier patients, screening upon admission to the hospital is sometimes recommended and repeated during the patient's stay (daily checks). Screening upon admission to critical care, or to medicine-surgery-obstetrics, allow the number of carriers to be identified, who otherwise would have remained undetected and nevertheless contributed to dissemination of the bacteria, to be doubled.

This policy should be defined by the CLIN, targeting services, situations or multi-drug resistant bacteria. If a patient is found to be a carrier, the same measures as for an infected patient should be applied. Generally speaking, the screening process will concern:

- target bacteria (MRSA, EBLSE) or clearly identified epidemiological situations;
- All admitted patients, or, if targeted screening has been decided upon, only those at risk of being a carrier;
- Wards at high risk of importation or contamination (critical care), while screening of extended care and rehabilitation (ECR) patients, and even more so, of long term care patients is rarely justified;
- Wards capable of implementing ACP, where benefits can be expected from ACP, as compared to SP.

The main MRSA-carrier risk factors are:

- known previous carriage
- Transferral from an endemic situation sector, particularly from ECR or long term care;
- hospitalisation within the previous year, especially if it was long-term and in a sector at risk;
- presence of chronic skin lesions
- a recent course of antibiotics contributing to acquired carriage persistence.

It is much more difficult to define a ESBLE-risk patient profile, because of the intricate epidemiological mechanisms of these strains, combining emergence and spreading within the community (CTX-M enzyme-producing ESBL *E.coli*), their circulation within the hospital, and the resurgence of hospital strains (*K. pneumoniae*, *Enterobacter* spp.). Admission from an ECR or long term care sector, or from a Nursing Home for the Dependent Elderly is a known risk factor.

Rapid techniques (PCR) allow a response to be obtained within hours of screening. The relevance of obtaining a result within a few hours has not been proven, for cross-contamination control compared to chromogenic culture media (MRSA, ESBLE, GRE...), which has recently become available.

For MRSA, nasal samples, combined with sampling from another site (possible chronic skin lesions) allow good sensitivity to be achieved. The usefulness of including a digestive sample (perineum, rectum) and/or a throat sample is currently being evaluated. For ESBLE a rectal sample is sufficient, and for *A. Baumannii* and *P. aeruginosa* a rectal and throat (or tracheal aspiration) sample are necessary.

## Additional Contact-type Precautions

If the screening concerns multi-drug resistant bacteria only, other measures that are part of ACP are applied to other infectious organisms, whose control warrants ACP, for example *C. difficile*, certain viral infection epidemics in pediatrics, ECR or long term care.

A screening policy can be envisaged only if special measures are taken for patients found to be carriers.

The rapid transfer of information from the laboratory and the signalling of multi-drug resistant bacteria carriage, by means of a logo that is specific and identical for all multi-drug resistant bacteria, improves hygiene behaviour, in particular the observance of hand hygiene. This observation remains debatable, although it has been clearly demonstrated in France, where the observance increased from 60% to 71% if the patient was placed in ACP. The alert starts in the bacteriology laboratory (identification by a specific logo on the strain's antibiogram). The same logo is placed on the patient's clinical file, and on his or her door; the consenting ward is warned before transferring the patient to another care setting.

An alert system, computerised if possible, allows for a warning to be raised should the MDRO carrying patient be rehospitalised. In fact, the carriage of multi-drug resistant bacteria can last several months or years, especially if the micro-organism is commensal (MRSA, EBLSE) and if the patient has chronic illnesses facilitating carriage persistence (chronic skin lesions, antibiotics).

An **individual room** is recommended for a patient who carries one of the target bacteria, and several studies suggest that the risk of transmission to patients in neighbouring rooms is lower than that of transmission to a neighbouring patient in a double room. If several patients carry the same strain of multi-drug resistant bacteria, they can be grouped together in one room, or in the same section of the unit. If an individual room is not available, technical-type ACPs are recommended.

**Hand hygiene** indications are the same for ACP and SP. Hand hygiene must in addition be used after any contact with the patient's close environment, which is usually contaminated by the bacteria carried by the patient, and before leaving the room.

The **wearing of gloves** (disposable, non sterile) is often one of the suggested ACPs. However, they can be a barrier to hand hygiene, and fail to be changed between consecutive care activities with one patient or between different patients. The wearing of gloves, when poorly executed, can in fact increase the risk of cross-contamination. They should be changed between each activity and each patient. SP indications therefore apply to the wearing of gloves.

Apart from SPs, the **protection of clothing** during potentially contaminating care activities is an effective method for limiting cross-contamination. Its indications are limited to direct care. The single-use waterproof plastic apron is the protection garment of choice rather than the gown, which does cover the fore-arms, but is not waterproof and is not always disposed of after use.

The wearing of **splash-resistant masks** (otherwise known as surgical or care masks) by the caregiving personnel is recommended within SP practice, in the case of the risk of splashing of biological fluids. In a cross-contamination context, it can prevent the caregiving personnel from acquiring multi-drug resistant bacteria, in particular the nasal carriage of MRSA. The wearing of a surgical mask is recommended if the patient presents with a symptomatic respiratory infection, from a micro-organism falling under ACP, in particular MRSA.

## Carriage Decontamination

The most extensive experience gained with decontamination has been obtained for MRSA. The usefulness of community decontamination, aimed at limiting dissemination, has not been demonstrated in situations where there is an endemic-epidemic MRSA situation such as in France, whereas it is useful in the context of a “search and destroy” strategy as applied in Scandinavian countries and the Netherlands. For individual purposes (decontaminating a carrier patient in order to avoid him or her contracting a MRSA infection), decontamination appears to be useful in situations where there is a high risk of infection, for example before high-risk surgery or with a patient wearing a long-term venous catheter.

In the first instance, the decontamination process combines a nasal ointment (mupirocine) with washing/showers using antiseptics, for a patient who does not produce a positive clinical sample.

For other multi-resistant bacteria (EBLSE, *A. Baumannii*, *P. aeruginosa*, ERG...), the usefulness of decontamination has not been proven. Research is currently being undertaken to compare the use of washing/showers with antiseptics for carrier-patients only, or for all critical care patients.

## Specific Measures

Certain micro-organisms may warrant appropriate measures within ACP practice:

- In the case of prolonged persistence of *C. difficile* in the environment of a carrier-patient, and a lack of effectiveness using alcohol-based products on spores, the ACPs applied to this micro-organism include the wearing of gloves upon entry into the room and hygienic hand-washing after contact, associating hand-washing with a mild soap, followed by an alcohol-based handrub (ABHR).
- The environment should be cleaned using bleach, the only effective disinfectant on spores.
- ACP have no effect on scabies, thus necessitating a return to hand-washing, sometimes followed by an alcohol-based handrub (ABHR).
- *A. baumannii* persists for long periods in the environment, and requires particular care to be taken when cleaning the environment. *P. aeruginosa* can also have an environmental reservoir.
- The sometimes explosive character of certain *A. baumannii* epidemics in critical care may justify a reduction in the number of patients cared for: limiting admissions, or even closure of the ward.

- Certain multi-resistant bacteria may lead to complementary measures being taken, either because they are emerging (GRE, carbapenemase-secreting ESBL enterobacteria...), or because they are difficult to control (*A. baumannii*), or finally because traditional ACP proves to be ineffective. In these cases, the separation of cases and contact patients is sometimes proposed, as well as the designation of specific health care personnel for the carrier-patients (“cohorting”).

ACP cannot be uniformly applied to all care units. The choice between SP and ACP can depend on the level of observance of the SP (see above); but it will also depend on other aspects: intensity of care required by the patients, availability of personnel and equipment, type of multi-drug resistant bacteria. It will thus be more straightforward to implement ACP in critical care or medicine-surgery-obstetrics units than in ECR units, and even more so than for long term care. In the case of the latter types of sector, SP are preferred.

## Other Measures

In order to avoid contamination through the shared use of equipment, small reusable pieces of equipment should be individualised whenever possible.

In accordance with the French law of March 4<sup>th</sup>, 2002, the patient, as well as his family circle and the medical and paramedical caregivers, including technical support centre staff, and external caregivers looking after these patients, should be informed of carriage and of the implementation of ACPs.

The training of medical and paramedical staff is indispensable for the programme's success. Practice observance audits and feedback of information are also decisive factors.

## Unnecessary Measures

Despite lack of proof of their effectiveness, some measures are still sometimes used. These must be abandoned in ACP practice:

- The confinement of a carrier patient to his or her room, closing of the door to the room;
- Placing patients at the end of an operation or examination programme, or limiting access to toilets/showers, to shared rehabilitation equipment, if an appropriate bio-clean-up has been carried out;
- Separate treatment of dishes and washing;
- Separate disposal of infectious hospital waste (IHW) and non-infectious hospital waste (NIHW) of these patients;
- Different handling of reusable medical material from the usually recommended system;
- Measures other than hand hygiene for visitors: gowns, gloves and shoe covers.

## Recommendations

Based on the “National Recommendations. Cross-contamination prevention: additional contact precautions (French Society for Hospital Hygiene (SF2H, April 2009)”:

**R40** The Standard Precautions (SP) are applicable to all patients; additional precautions are used to complement these.

**R41** Additional Contact Precautions (ACP) are associated with SP for patients carrying emerging, potentially highly cross-contaminating microorganisms, models of which are given by MRSA, GRE (glycopeptide-resistant enterococcus), *Clostridium difficile*, ESBLE (Extended-Spectrum BetaLactamase-Producing Enterobacteria), etc.

**R42** The precautions to be implemented are complementary to the SP (with a privileged role reserved for hand hygiene using alcohol-based hand-rubs). The indications for the wearing of disposable gloves do not differ in such ACP situations (they remain restricted to cases of exposure to biological fluids or blood). The wearing of a disposable gown or plastic apron over the professional garments is broadened to all cases of direct contact with the patient.

**R43** If the use of ACP has been decided for a given patient, these must be maintained throughout his/her stay in medicine-surgery-obstetrics. In the case of a patient carrying MRSA, provided a decontamination strategy is applied and its efficacy has been verified, the precautions may be lifted following two negative screenings.

**R44** Following the well-informed choice made by the CLIN (or equivalent consultative and monitoring authority), ACP may be associated with SP for:

- Methicillin resistant *Staphylococcus aureus*;
- Imipenem-resistant *Acinetobacter baumannii*;
- *Acinetobacter baumannii* sensitive only to imipenem;
- Extended-spectrum betalactamase-producing enterobacteria
- Cephalosporinase Hyper Producing Enterobacteria in neonatology;
- *Pseudomonas aeruginosa* with resistance to imipenem associated with other resistances;

**R45** The CLIN (or equivalent consultative and monitoring authority) may define a cross-contamination prevention strategy, in between purely “SP” and “SP + ACP” if all of the following conditions are met:

- Availability of alcohol-based products close to the locations used for healthcare;
- High level of hand hygiene observance, measured on the basis of a large number of observations;
- High level of alcohol-based product consumption, with data available for each department;
- High level of use of ABHR (Alcohol-Based Hand Rub) for hand hygiene;
- Good practice in the wearing of gloves;
- Expertise / solid experience of the infection control team and the CLIN;
- Solid knowledge of microbial epidemiology, based on screening samples (notion of

prevalence).

**R46** The CLIN (or equivalent consultative and monitoring authority), in the context of the general hospital policies:

- Defines a screening policy for these microorganisms, including MDRO, in agreement with the national recommendations (which microorganisms, for which patients, in which epidemiological context, according to which technique – concerning the sampling site and the microbiological technique);
- Keeps this policy regularly up to date;
- Adapts it to the needs of each different hospital department (critical care, general medicine, surgery, ...) and of the local epidemiological history, whether or not this relates to multiresistant bacteria.

**R47** The dissemination of information is organized as follows:

- The laboratory explicitly mentions (or notifies) the identification of one prioritized organism per hospital, and whether the samples indicate an obvious infection or colonization;
- A reporting policy for patients carrying a bacterium justifying ACP is defined by the CLIN or the hospital (distribution of logos, computer-based material, ...);
- The eventual screening of these microorganisms is coupled with the return of results to the teams and the implementation of ACP.

**R48** The organization of healthcare for patients under ACP should take the infectious risk into account:

- Use of individual rooms, grouping of patients in the same area of a unit, sectorized organization of healthcare (as opposed to sequential care), with all of the actors being informed (technical platforms, part-time caregivers, ...);
- The status of a patient “having to be put under ACP” should not preclude his/her permission to visit the technical platform for physiotherapy, the shared living spaces ... in the case of patients justifying ACP for an open infectious site, but should lead them to be accompanied by specific hygiene precautions.

**R49** The individualization of reusable equipment should be preferred in the room of a patient for whom ACP is applicable. Only limited quantities of materials should be stocked in the patient's room. It is not necessary to systematically dispose of unused disposable material in the room of a patient for whom ACP is applied, including patients who are MDRO carriers. Similarly, no specific treatment is required for dishes, utensils and dirty washing in the case of a patient for whom additional contact precautions are applicable.

## Criteria for the evaluation of practices

This list is extensive and should be discussed in order to extract a minimum of five relevant indicators.

### Hospital setting indicators



- Percentage of individual rooms (ACP).
- Availability of alcohol-based product dispensers, and of toilet equipment (SP and ACP).

### Practice indicators

- Reporting of the carriage of micro-organisms in accordance with the policy defined by the hospital.
- Rate at which the necessary means for ACP (alert system, alcohol-based hand-wash products, gloves, apron, individualised equipment) are made available, following alerts from the laboratory.
- Consumption of alcohol-based hand-wash products in each ward, according to the national ICSHA indicator, (SP and ACP).
- Observance rate of hand hygiene and glove use (SP and ACP), for patients with or without ACP (ACP only).
- Informing the patient and the family circle of the patient's carriage.

### Result indicators

- Rate of multi-resistant bacteria: MRSA, for each ward (critical care) and hospital, and according to the national indicator.
- Other multi-resistant bacteria, depending on the local epidemiology.
- Distribution of imported and acquired cases.

## Research topics

- Should preference be given to well respected SP only, or also to ACP?
- Usefulness of an individual room.
- Respective impact of the various individual ACP measures.
- Usefulness of combining ACP with decontamination.
- Strategies for the screening of multi-drug resistant bacteria, in particular MRSA and ELBSE.

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# Cross-Contamination by droplets

## Rationale

This occurs when saliva droplets containing infectious organisms are projected while speaking or coughing. Because of their large size, they are deposited in the patient's immediate proximity (a distance of one metre is usually quoted). Contamination occurs through contact with the mucous membranes, either directly through the emission of droplets, or indirectly through hands contaminated by contact with the immediate environment of the source case, which are then brought into contact with the mucous membranes (eye, nose, mouth).

The main infectious organisms falling under Additional Droplet Precautions (ADP), are those present in the upper airways and the ear-nose-throat are:

- RSV - respiratory syncytial virus (ADP and ACP)
- influenza virus (ADP, airway contact precautions are under discussion)
- adenovirus (ADP and ACP)
- meningococcal (ADP)
- whooping cough, diphtheria (ADP)

In reality, the characteristics of contamination by air or by droplets are not as clear-cut as indicated above. Situations and pathogenic organisms exist, which combine several transmission routes. Thus, the main route for transmission of influenza is by droplets, but contamination by air is also possible, sometimes warranting air-type additional precautions. The same is true for SARS or viral haemorrhagic fevers (VHFs), for which the novelty (SARS) or the severity of the infections (VHFs) represent decisional factors in the choice of prevention measures.

## Recommendations

Measures are therefore taken in close proximity to the case source. They include:

### **R50** Precautions to be applied to source patients:

- Patient to be placed in an individual room, or grouping of patients affected by the same pathology in a shared room or in the same unit;
- Wearing of a surgical (so-called healthcare) mask in the presence of other persons, use of disposable handkerchiefs and frequent hand hygiene;
- Restriction of the patient's movements beyond his/her room, and the wearing of a surgical mask when appropriate.

### **R51** Precautions to be applied to healthcare workers:

- Wearing of a surgical (so-called healthcare) mask and safety goggles for any near contact at a distance closer than one meter from the patient;
- Hand hygiene for any contact with source patients or their immediate surroundings: the alcohol-based products must be effective on infectious agents which can be transmitted

by droplets.

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# Environment and Circuits

## Air

### Rationale

The air in hospitals can represent a contamination vector for patients at risk. The main infectious pathologies acquired in hospitals clearly identified as having been associated with air contamination are invasive mycoses due to fungi, especially the *Aspergillus* type, and certain surgical site infections. Whether it be for surgical site infections, or even more so for invasive mycoses, the characteristics of the host and the way he or she is cared for play a major role in the development of an infection, starting from a single contamination: thus the risk of infection in the operating room, associated with airborne contamination, is particularly well documented in orthopedic surgery and in hospitalisation units.

The risk of invasive mycoses from air contamination by fungal spores is highest in haematology units. Neutropenia is a major risk factor (neutrophil counts of less than 500/mm<sup>3</sup> for at least two weeks, or less than 100/mm<sup>3</sup> regardless of the duration). The accumulation of several factors increases the risk even more clearly: immunosuppression, colonisation of the airways by *Aspergillus*, or an antecedent of aspergillosis, allograft of haematopoietic stem cells.

In each hospital, the analysis of the pathologies treated and the procedures carried out should allow for zones to be identified according to the risk of airborne infection, the first stage of a comprehensive strategy to control air quality in the fight against healthcare-associated infections. With this same goal of controlling air quality in mind, the hospital shall keep itself informed (in liaison with the local Public Works Department) of any sizeable construction work being carried out in the neighbourhood, which could potentially have an influence on air quality (construction of commercial buildings or road infrastructure within a five kilometre radius).

High-risk zones should be vigilantly and continuously monitored by the CLIN and the infection control team. Within each hospital, a multidisciplinary team will be in charge of:

- setting up and keeping up to date all information concerning equipment installed for the purposes of air quality control (ventilation and filtering systems, characteristics of the ventilation equipment...) in a single document: the sanitary air notebook;
- classifying the hospital wards into risk zones. A biocontamination risk zone is a geographically defined and delimited location. The classification scale ranges from 1 to 4, with the highest risk level being represented by zone 4;
- proposing adaptations of the methods, according to the evolution of the patients' characteristics and their modes of care. Several arrangements have proven their effectiveness in the prevention of air-associated infection risks:
  - In units with patients at risk of aspergillosis, the use of rooms with positive pressure, equipped with an air treatment system and an airlock, but also mobile air treatment units and beds equipped with laminar airflow isolation **system**.

- in the operating room, only a unidirectional airflow system (laminar air flow) enables the performance expected in zone 4 to be achieved, in terms of particular contamination and decontamination kinetics.
  - in order to implement “air” isolation, negative pressure rooms provide a maximum level of confinement, as used in the case of multi-drug resistant *Mycobacterium tuberculosis* or Avian influenza;
- implementing and adapting maintenance procedures for technical equipment;
  - implementing and adapting care procedures for patients at risk;
  - proposing and following a microbiological monitoring programme for high risk zones;
  - defining a control policy for the application of procedures;
  - ensuring the traceability of all actions;
  - defining procedures for use in case of abnormal test results, or in case of an internal or external intervention capable of modifying the nature or the level of risk;
  - defining a communication strategy (for both routine and crisis situations) together with the clinical services (involving management / team leaders in particular), with the microbiology laboratory (in order to remain informed of air-associated infections acquired within the hospital), and with the CLIN (to collate the observed results and follow their evolution).

## Recommendations

These recommendations complement or are a reminder of the measures written down in the technical manuals, related to the implementation of good practice for the prevention of air-associated infectious risk (cf. the paragraph “Further Reading” below). Air-associated infections acquired within a hospital fall under the reporting system (cf. “Further Reading”).

**R52** The hospitals are to establish a pluridisciplinary team in charge of the global air quality strategy. This team includes representatives from the infection control team, the technical and/or biomedical services management, the head of the laboratory responsible for analysis of the air quality, at least one biomedical technician, and representatives of the healthcare personnel (executives and/or doctors), the occupational health doctor, and a specialist in risk management if the hospital has such an employee (“environmental group”: which may be common to air, water and construction work).

**R53** Those units which have *aspergillus* risk patients (neutropenics with an aplasia of less than 500 granulocytes for more than two weeks, or less than 100/mm<sup>3</sup> for any duration, immuno-suppressed patients, whose airways are colonized by *aspergillus* or who have a history of *aspergillus*, allografted patients) are to implement an organization to deal with:

- Identifying aspergillus risk patients;
- Verifying that the accommodation conditions correspond to the patient’s level of risk (protective isolation for very high risk patients);
- Limiting the patient’s movements and, in the case of absolutely necessary movements, providing adapted protection (e.g. PFF1 type protective breathing apparatus and protective garments for a patient under laminar flow);
- Planning of microbiological air and surface surveillance (to test for Aspergillus).



#### **R54** The operating room organization allows:

- It to be ensured that the rooms are qualified on a regular basis (at least once per annum);
- It to be ensured that training in biocleaning and surface and equipment cleaning procedures is given to all new personnel who are assigned to such tasks;
- It to be ensured that the cleaning and maintenance of the rooms is traceable;
- Periodic microbiological tests to be defined and organized with the infection control team, in order to verify the efficiency and correct application of the cleaning procedures;
- Process verifications (filtering, overpressure, flow rate, air renewal rate) to be planned;
- The level of overpressure to be verified and recorded daily, before the rooms are opened;
- A procedure to be defined for restarting the rooms, following an interruption of the ventilation system.

### **Criteria for the evaluation of practices**

- Traceability of the application of procedures
- Surveillance of airborne infections acquired within the hospital
- Annual audit (measurements, samples, corrective actions) submitted to CLIN

### **Specificities**

- Close collaboration between: Infection control teams (ICT), construction managers, biomedical staff, microbiology and parasitology laboratories.

### **Research topics**

- Efficiency of a continuous monitoring strategy for aspergillus air-contamination, in terms of achieving full control of invasive aspergilloses in haematology patients.

### **Further reading**

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## Water

### Rationale

The uses of water are highly varied, thus increasing the ways in which patients can be exposed to the risk of water-associated contamination by micro-organisms: food and sanitary habits, medical practice (care, disinfection of medical material and equipment...), technical practices (water production systems for dialysis, supply of air cooling towers ...)

Within the public water supply system, certain incidents or forms of construction work may temporarily alter the hospital's water supply quality. For this reason, the hospital must ask the management of the public works department to keep it informed of any construction work or incidents which may affect water quality.

Within the hospital, water can be either a reservoir or carrier of micro-organisms such as *Pseudomonas aeruginosa*, *Legionella pneumophila*, atypical mycobacteria, etc. These micro-organisms can multiply easily within the water supply systems when the water storage, circulation or filtering conditions are defective (backwaters, insufficiently high temperature for sanitary hot water production, scaling of piping ducts, hot water cylinders or of tap components, defective or poorly maintained air-conditioning systems). Moreover, all tap components are susceptible to retrograde infection from bacteria colonising or infecting the patients (splashing while disposing of biological products, washing hands, etc.).

Thus, the control of water-associated infectious risk within hospitals relies on the design and maintenance of water supply networks, the maintenance and upkeep of water distribution points, adaptation according to each patient's vulnerability and exposure to the different uses of water, and the knowledge of microbiological criteria to be applied to each of these different water uses.

This control of the water environment forms one of the elements of the strategy needed to fight against healthcare-associated infections. As such, it should be subject to continuous vigilance on the part of the CLIN, and the Infection Control Team / EOH, whose role is:

- to implement and keep up to date the synoptic tables of the hospital's internal network(s) (sanitary water notebook);
- to divide the hospital up into risk zones;
- to list the different forms of water use, and propose and adapt microbiological criteria for each of these;
- to implement and revise procedures for the maintenance of water supply equipment, hot water production systems, dialysis systems, technical systems, swimming pool water, tap components, drains, outlets, flushing), and ensure the traceability of all actions;
- to propose and adhere to a microbiological monitoring programme with defined thresholds (target, reporting, action);
- to define a control policy (audits) to assess the application of procedures;
- to define procedures to be applied in the case of abnormal test results, or in the case of internal or external interference with the network, and to ensure the traceability of all corrective measures taken;
- to define a communication strategy (for both routine and crisis situations) together with the clinical services (involving the management in particular), with the microbiology laboratory (in order to remain informed of water-associated infections acquired within the hospital), with the CLIN (to collate the observed results and monitor their evolution), and with the management of the communications department (if there is one), of the technical services, or even the top management of the hospital.

## Recommendations

These recommendations complement or are a reminder of the measures drafted in the circulars and technical manuals, related to the implementation of good practice for the prevention of infectious risk associated with legionella or the maintenance of water supply networks. Water-associated infections acquired within a hospital fall under the reporting system (cf. “further reading”).

**R55** The hospital is to organize the global strategy for appropriate control of the water quality, by establishing a pluridisciplinary team associating the infection control team, the pharmacist (in charge of dialysis water), the person in charge of the technical department, the person in charge of the laboratory which undertakes the water analysis, at least one technician in charge of the water system, and representatives of the healthcare workers (executive staff or doctors), and a specialist in the management of risks, if the hospital has such an employee (“environment group”: which may be common to air, water and construction).

**R56** The organization of water risk management foresees, within each department, that:

- professionals receive training on the risks associated with water, in particular those related to legionella, and to the cleaning procedures for drinking fountains, refrigerated

drinking fountains and icemakers, for all new personnel assigned to such tasks;

- the traceability of the application of the cleaning procedures for drinking fountains (descaling and disinfection) as well as the traceability of filter changes (for filtered water supply taps) is ensured;

## Criteria for the evaluation of practices

- Microbiological water tests
- Traceability of procedures
- Surveillance of water-associated infections

## Specificities

- Close collaboration between: Infection control teams (EOH), technical staff, and hygiene and microbiology laboratories.

## Research topics

- Role of water distribution points in *Pseudomonas aeruginosa* contamination in hospitalised critical care patients.

## Further reading

■ French General Directorate for Health (DGS) circular - DGS/VS 4 no. 98-771 of December 31<sup>st</sup>, 1998, concerning best practice for the maintenance of water networks in hospitals as well as preventive measures for legionella-related risks in installations and buildings at risk, with public access. Available at:

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## Construction Work

### Rationale

In all hospitals, although construction work, be it extensive or simple maintenance, is a necessity, it significantly increases the risk of contamination of the environment via:

- the air, through increased dust levels and very high levels of airborne filamentary mould spores;
- water, either through direct contamination or through water stagnation during the construction work.

Documented construction work-related Healthcare-associated infections are most often the result of:

- moulds (fungi), with *Aspergillus* spp. as the principal etiological agent associated with these infections, in particular *Aspergillus fumigatus*, without ignoring the other strains (*A. flavus*, *A. niger*, *A. terreus*...) or other fungi (*Fusarium*, *Zygomycetes*, *Rhizopus*...);
- To a lesser degree, bacteria, with a clear predominance of *Legionella* strains (*L. pneumophila*, *L. bozemanni*...), without however ignoring other bacteria such as *Nocardia asteroides* or even *Bacillus* spp.

The sources of these micro-organisms include moulds, dust or earth contaminated by fungal spores or bacteria.

There are numerous potential locations: extensive construction work, but also handling of suspended ceilings, of fibrous insulation material, roll-down blind structures, flame-retardant materials, window joints, and also computer ventilation systems, failure to maintain ventilation systems... (this list is not exhaustive).

The physiopathology of infections varies according to the etiological agent, but in each case the response of the host plays a crucial role in the development of illness and the consequences can be very serious, even fatal, in neutropenic haematology patients. Neutropenia is a major risk factor (a neutrophil count rate of less than 500/mm<sup>3</sup> during at least two weeks or less than 100/mm<sup>3</sup> regardless of the duration). The accumulation of several factors increases the risk even more clearly: immunosuppression, colonisation of the airways by *Aspergillus*, or antecedent of aspergillosis, allograft of haematopoietic stem cells.

In France, although no reference or national guidelines exist, recommendations have been published by AP-HP (Paris University Hospitals Group) and the South East, and South West Regional Nosocomial Infection Control Coordinating Centres (CCLIN) of France. A technical guide will be published shortly by the SF2H – French Society for Hospital Hygiene.

The prevention of infectious risk during construction work in a hospital requires the coordination of multidisciplinary collaboration before, during and after the construction work (engineers, hygienists, technical staff, (para)medical staff in charge of the ward concerned...) in order to:

- evaluate the risk (ex.: tables from the South West CCLIN);
- draft procedures;
- adapt the hardware equipment (elimination of dust, waste, ventilation control, circuit control, water network management...);
- adapt human equipment (clothing and movement of labourers as well as infectious risk training for technical staff who need access to care wards...);
- manage the risk with regard to patients before, during and after the construction work: identify at risk patients and units (aplasia, transplants, corticosteroid therapy patients, burns, operating rooms, critical care, neonatology...) and the measures to be implemented (move to another ward or personal protection measures to be discussed, according to the risk evaluation and the duration of the construction work);
- inform personnel of adjacent wards of the construction work to be carried out, and make them aware of the risk (e.g. 'works summary' leaflet to be disseminated within the units concerned as well as adjacent units);
- Trace all construction work, including 'minor construction work'.

Occasional maintenance work (hole drilling, replacement of joints...) is also a source of infectious risk. The susceptibility of exposed patients should always be taken into account before carrying out such work, either to defer the construction, or to temporarily move the patient. In the case of urgent construction work a protocol should be drawn up, authorised and disseminated.

## Recommendations

**R57** Major construction work may justify the removal of the affected hospital department or unit to a different area, which is suitable for the correct functioning of healthcare activities. The zone under construction must be isolated by means of sealed partitioning, and a protocol defining the movement of persons, construction materials and debris in space and time must be drafted, validated and posted in the construction zone. The adjacent departments are informed, must keep their doors and entry locks closed, and increase the frequency of cleaning in the areas adjacent to the construction zone. The movement of patients at risk within these areas is to be forbidden.

**R58** Minor construction work may be carried out in a functioning unit, provided that:

- the risk is evaluated (taking into account the patients at risk, in particular those who are immunosuppressed, and using a risk evaluation grid ...);

- the persons in charge are identified;
- the intervention methods are formally planned (who, what, where, when, how) and the protocols are validated;
- dust accumulation is limited (tools with integrated dust receptacles, dust vacuum cleaner with HEPA filters, humidification by means of water pulverization during all construction work which could produce dust: drilling of holes, removal of false ceilings, ...), sealing of air vents in premises isolated for construction work and testing of the air quality is carried out if necessary (close to the units at risk);
- the doors are kept closed (those of the patients' rooms, as well as those of other areas in the department);
- cleaning is enhanced to several times daily, and is recorded;
- the reporting of any dysfunction (insufficient or unapplied precautions) is clearly organized, and corrective measures are promptly implemented.

**R59** A department may be reopened, following construction work, only if:

- the air-conditioning system has been verified (extraction gratings cleaned, air quality compliant with the expected values);
- the microbiological quality of the water corresponds to the expected values (revivable aerobic flora, absence of *Pseudomonas aeruginosa*, legionella ...);
- very careful cleaning of the rooms has been carried out;
- in the case of a unit at risk, the tests for the presence of *Aspergillus* have been carried out and the results correspond to the expected values;
- a visual evaluation of the rooms has been carried out by the person in charge of cleaning operations, or by a health service executive.

## Criteria for the evaluation of practices

■ Monitoring of nosocomial aspergilloses and legionella

■ Auditing of practices during construction work:

- on the worksite (in agreement with personnel in charge of the worksite and in accordance with security measures),
- in adjacent wards

■ Summary of any failures / malfunctioning and corrective measures taken to be reported to the pluridisciplinary team ('environment group') or to the CLIN.

## Research topics

■ Infectious risk control (in particular fungal infections) and construction work.

## Further reading

■ ASSISTANCE PUBLIC HOPITAUX DE PARIS (AP-HP, Paris Hospital Administration). Invasive nosocomial aspergillosis and hospital construction work. Recommendations. AP-HP Guide. Paris. 1993.



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■ Record of contagious diseases in Canada. Construction work-related nosocomial infections in healthcare patients – Mitigating the risk of aspergillosis, legionellosis and other infections. 2001: 58 p. Available at:  
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## Hygiene of the premises

### Rationale

Hygiene of the premises involves three main aspects:

- visual cleanliness, which is fundamental to the reception of patients, and to the confidence and visual attractiveness inspired by a hospital or a ward;
- all surfaces, which can be secondary vectors for the transmission of pathogenic bacteria: these become contaminated during care;
- the control of microbiological contamination of surfaces in dust-controlled areas, which is indispensable to the quality of medical procedures carried out in these sectors.

The architecture and surface linings must facilitate housekeeping and cleaning of surfaces; furniture and decoration must be kept to the strict minimum, be ergonomic and easy to clean. The premises must be uncluttered and be kept tidy, to simplify their cleaning. Cleaning of ventilation ducts, fans, air-conditioning systems, and the descaling of taps and fittings must be planned in accordance with a predetermined policy.

General hand hygiene recommendations and the wearing of protective clothing (gloves, plastic apron, etc.) are governed by policies, which must be complied with by the cleaning personnel.

## Recommendations

### **R60** Each hospital must:

- classify the premises according to the risk of infection;
- define a hygiene policy for the premises (equipment, methods, cleaning products, cleaning frequency) in accordance with the predetermined level of infectious risk;
- appoint a person in charge of hygiene of the premises, whose main assignments, in collaboration with the ICT, are to supervise the drafting of data sheets and procedures, coordinate the hygiene policies for the premises throughout the hospital (selection of equipment and cleaning products, organization ...), introduce cleaning service evaluations and take part in the organization and training of the personnel responsible for cleaning the premises;
- prefer ergonomic and hygienic cleaning methods which avoid any redistribution of microorganisms (sweeping, wiping with a damp cloth, washing flat surfaces);
- if the hospital appoints an external service provider, implement contract specifications which includes technical provisions (descriptions of the relevant zones, frequencies, cleaning products, equipment, clothing, training of the personnel, service evaluation, etc.);
- implement a training course for the cleaning personnel (recruitment training, and continuous professional training), which is regularly renewed and assessed, taking the specificities of the infectious risk areas into account.

### **R61** The management and usage procedures for cleaning products provide for:

- limiting the number of products available for the cleaning of the premises, in order to avoid confusion, misuse and inappropriate mixtures;
- cleaning the floors with a detergent or detergent-disinfectant, except for floors soiled by biological liquids, in which case a disinfecting detergent must be used (operating rooms, laboratories ...);
- verifying adherence to instructions for the use of cleaning products (dilution, expiry date, contact duration);
- labeling and dating of bottles, and avoidance of the mixing of products, in order to prevent any professional chemical risk ("cleaning product" technical datasheets prepared for this purpose);
- selection of cleaning products taking into account efficiency standards related to the expected objectives.

### **R62** The cleaning methods are subject to validated policies, staff training and planned assessments. These shall ensure that the following principles are taken into account:

- the cleaning equipment is to be in good condition, clean and specifically assigned to high infectious risk areas;
- the floor cleaning methods should make use of damp wiping, "flat cleaning" (using flat mop systems) and mechanization using autoscrubbers whenever possible (dry sweeping is prohibited, with the exception of outside areas);

- if used, vacuum cleaners must be fitted with filters which prevent the discharge of dust;
- steam cleaners are an efficient, ecological approach which is economical in terms of water and cleaning product consumption: in particular, they are recommended for extensive cleaning and for areas which are difficult to access;
- surfaces are cleaned using wipes (mops) which are disposable or re-usable (in the latter case, there shall be a sufficient quantity of wipes, and a used wipe shall not be dipped again into the detergent-disinfectant bucket); sponges are prohibited;
- cleaning must be carried out from top to bottom, and from the cleanest towards the dirtiest area; the chosen method must avoid re-soiling of an already cleaned surface;
- dirty linen, waste material and equipment must be removed before cleaning;
- complementary disinfection (sprays, aerosols) is reserved for a limited number of exceptional situations, such as an uncontrolled epidemic from a microorganism with a high potential for survival in the local environment;

**R63** Room cleaning is organized in such a way as to:

- ensure daily cleaning of the rooms, after washing and dressing, in the patient's presence. It is not indispensable, in the case of a patient requiring complementary hygiene precautions, for his/her room to be cleaned last, if the cleaning operations are under good overall control: the mops and wipes are to be changed for each room;
- clean, every day, all surfaces which are frequently touched by patients and care givers during healthcare operations;
- meticulously clean a patient's room (bed, toilets, cupboard, upper surfaces) following his/her discharge;
- in order to mitigate fouling and dust accumulation in certain areas, plan and ensure the traceability of comprehensive cleaning: air-conditioning vents, light fittings, radiators ... The frequency of comprehensive cleaning shall be adapted in accordance with the type of premises and the specific nature of the hospital (long-term care, nursing homes for the dependent elderly ... ).

## Criteria for the evaluation of practices

■ The cleanliness of the premises and contamination of surfaces must be evaluated, particularly in risk-prone areas: visual cleanliness and dust accumulation; observation of practices.

■ The routine microbiological inspection of surfaces is not useful, except in high risk sectors (operating rooms, interventional rooms, clean-rooms, hematology, etc.). It may also be recommended in health-care sectors following renovation or construction works, in the case of epidemics or infection clusters.

## Specificities

- Cleaning of operating rooms and clean-rooms (pharmaceutical preparation).
- Cleaning of premises in units receiving severely immunosuppressed patients (bone-marrow transplant units).

## Research topics

- Benefits of anti-bacterial surface coatings.
- Benefits of new micro-fiber textiles for the cleaning of surfaces.

## Further reading

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<http://www.cclin-sudouest.com/recopdf/EntretienBO%20VD.pdf> (consulted on May 13th, 2010).
- French Ministry for Health, Family and Handicapped, **Direction générale de la santé, Direction de l'hospitalisation et de l'organisation des soins. CTIN. Surveillance microbiologique de l'environnement dans les établissements de santé. Air, eaux et surface**. 2002. 78 p. Available at:  
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[http://www.sf2h.net/publications-SF2H/SF2H\\_LPD-2009.pdf](http://www.sf2h.net/publications-SF2H/SF2H_LPD-2009.pdf) (consulted on May 13th, 2010).

## Linen

### Rationale

Under normal conditions (treatment, handling, storage), linen contains only a few microorganisms, which generally originate from the environment and with little pathogenic activity (*Bacillus sp. Micrococcus*). Clean linen contaminated by microorganisms was found to be the cause of nosocomial infections in weak patients (neonates), because of substantial malfunctions in the treatment and packaging processes.

Linen becomes quickly contaminated after it has been brought into contact with the patient. Microorganisms isolated from soiled linen are cutaneous bacteria (staphylococci, corynebacteria) or digestive bacteria (enterobacteria), which may sometimes be multidrug resistant. Strictly anaerobic gram-negative bacteria (*A. baumannii* and *P. aeruginosa*) can also be found, in particular in mattresses. Samples taken from sheets of patients infected by methicillin-resistant *Staphylococcus Aureus* (MRSA) comprise MRSA in 60% of cases with a higher frequency in the case of wound and urine infections. In care units, the contamination of clean linen results generally from insufficiently disinfected hands; soiled linen may contaminate hands, caregivers' clothes and

the environment and contribute to cross-contamination by microorganisms.

In laundry services, infections have been reported to affect the cleaning personnel who do not observe hygiene rules (failure to wear gloves for handling soiled linen, eating while in the linen sorting room...): minor salmonellosis, Q fever, scabies, hepatitis A or hepatitis B. BBFEs related to sharp or cutting objects in soiled linen bags are not exceptional in the laundry services. Clean linen contamination is exceptional when the laundry processing chain abides by the prevailing recommendations (circuit, products, processes, quality assurance).

## Recommendations

**R64** Clean linen must be stored in a special-purpose room, which does not communicate with areas allocated to other functions. The size of this room must be adapted to the amount of linen, and rotation of the stock must be ensured. Its design must make it easy to clean: no humidity, smooth, rot-proof surfaces, no areas prone to dust accumulation, and coved skirting. The room must be cleaned on a regular basis. Any professional entering the room must be wearing clean clothes and have disinfected his/her hands. If the linen supplied by the dry-cleaning service is covered with a plastic protection, this must be left in place during linen storage, and removed only when used. The usefulness of sterilizing linen has never been demonstrated, including for weak patients (hematology, neonatology...).

**R65** The supply trolley used by care givers during clothes changes and serial toilet care must be stocked daily with care adjusted quantity of linen. The supply trolley must be emptied every day and cleaned by humid wiping with a detergent-disinfectant. A supply trolley used for clean linen only should be preferred, with dirty linen being placed into a separate collection bin.

**R66** The professional garments must be changed every day, and whenever they are soiled. Their cleaning must be organized internally or through a sub-contractor, by the hospital. The frequency with which bed linen is changed depends on the patient and the care he/she receives: daily changing of linen is not necessary for able-bodied patients. Only the quantity of linen needed for a patient's care and the making of his/her bed should enter the room. Special mattress covers intended for the prevention of bedsores must be cleaned between patients, and destroyed as soon as they appear to no longer be impermeable.

**R67** The management of dirty linen within healthcare units must observe the following hygiene rules:

- systematically carry out hand hygiene before handling clean linen, and following the handling of dirty linen;
- avoid any contact between dirty linen and one's professional garments;
- handle dirty linen with care, in order to avoid the dissemination of microorganisms into the environment;
- wear disposable gloves when handling linen soiled by biological liquids, and do not touch the face with one's hands during work;
- verify there are no foreign objects in the pile before eliminating dirty linen;
- observe prior sorting, to simplify the work of the dry-cleaning personnel;

- prohibit the depositing of dirty linen on the floor or the furniture of a room, or at any intermediate location between the room and the collector;
- when removing the linen to the collector, use the non manual opening system, do not fill the bags by more than two thirds of their capacity, and do not transfer dirty linen from one bag to another;
- do not bring the collector trolley into the rooms;
- prohibit the storage of linen bags in the patient's room, even if he/she requires additional precautions;
- following their closure, take the linen bags directly to the dedicated storage room (ventilated, and well cleaned) at least once a day, without dragging them on the floor;
- clean and disinfect the linen bag holders every day;
- if the domestic types of washing machine are used in some units, monitor their usage and cleaning by means of precise and validated cleaning protocols.

## Criteria for the evaluation of practices

■ The microbiological samples taken from clean linen at different stages in the linen circuit, which must be chosen based on the analysis of the critical points for their control (RABC method: Risk analysis and bio-contamination control).

■ Audits of practices in hospital units (sorting) and laundry units (circuits...).

## Specificities

■ For long-term stays, the patient's linen cleaned in the hospital may be stored in the patient's room in a closet which is kept clean.

■ In case of scabies or pediculosis, the linen must be treated with antiparasitic products and be transferred to the processing chain without intermediate storage.

■ For patients about to undergo surgery, pre-operative linen is to be provided by the hospital (no personal linen) and it is strongly advised not to use 100% cotton textiles in the operating room.

■ In the laundry service, in accordance with the principle of forward motion, the clean and dirty circuits should be separated (areas, vehicles and transport trolleys) with staff assigned for each purpose. Linen should be carried within closed containers, which should be cleaned on a regular basis, as is the case for the transport vehicles. Staff assigned to dirty linen sorting should wear protective garments and adapted protective items (gloves, masks). Under no circumstances should they touch clean linen. They shall be trained in the prevention and observance of appropriate behavior in case of an accident, in particular BBFEs. In addition to compulsory vaccinations, the hepatitis A vaccination is recommended.

## Research topics

■ Certain manufacturers provide fabrics with antibacterial properties; their benefit for reducing nosocomial infections has not yet been investigated.

■ From the standpoint of sustainable development, each hospital should consider the rational use of single-use linen.

## Further reading

■ SOUTH-EAST CCLIN. Professional garments in healthcare institutions (Les tenues professionnelles dans les établissements de santé). 2008. 64 p. Available at [http://nosobase.chu-lyon.fr/recommandations/Personnel/Guide\\_tenuesCCLINSE\\_2008.pdf](http://nosobase.chu-lyon.fr/recommandations/Personnel/Guide_tenuesCCLINSE_2008.pdf) (consulted on May 13th, 2010).

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■ SOUTH-EAST CCLIN. Evaluation Manual. A tool for evaluating the function of linen in hospitals and elderly homes - within care units or medical-technical services (Manuel d'évaluation. Outil d'évaluation de la fonction linge en établissement de santé et en EHPAD - Au sein des unités de soins ou des services médico techniques. 2009. 19 p. Available at [http://cclin-sudest.chu-lyon.fr/Audit/Manuel\\_dévaluation\\_audit\\_linge.pdf](http://cclin-sudest.chu-lyon.fr/Audit/Manuel_dévaluation_audit_linge.pdf) (consulted on May 13th, 2010).

## Food

### Rationale

Food safety in hospitals is a prerequisite in the management of nutritional care. The feeding of each hospitalized person should be adapted to his/her needs and should be entirely risk-free. The failure to suppress the infectious risk may lead to food-borne illness outbreaks (FIOs), which are diseases that require compulsory reporting and are defined by the onset of at least two cases with similar symptomatology, which, in general are of the gastro-intestinal type and can be traced back to the same food origin. Preventing FIOs requires good practice in terms of food hygiene based on the HACCP (*Hazard Analysis Critical Control Points*) method, recognized as a reference method for preventing food-related hazard, in the French ministerial decree of September 29th, 1997, setting out the hygiene conditions applicable in catering establishments, followed thereafter, since 2006, by the EC 178/2002 regulation of the European Parliament and by the EC Council of April 29th, 2004, relating to food hygiene. The observance of a continuous cold or hot chain is a fundamental aspect in the prevention of FIOs.

The seven HACCP principles are recalled here:

- ❶ conduct an analysis of, and evaluate the potential food hazards of an operation;
- ❷ identify the critical control levels and points in the operation at which food safety hazards can



occur;

- ③ establish which of these points are critical for food safety (the so-called "critical control points");
- ④ establish and implement, at each of these critical control points, control procedures to ensure that critical limits are not exceeded;
- ⑤ establish corrective actions to be implemented when a control shows that a critical control point is no longer under control, or was not under control at a given time;
- ⑥ establish and implement specific verification procedures to monitor the efficiency of all of the procedures thus implemented;
- ⑦ periodically, and upon each change in the operation being studied, review the food hazard analysis, critical control points, as well as their verification and monitoring procedures.

The regulatory bases for food safety consist in:

- implementing, applying and maintaining one or more permanent procedures developed on the basis of the HACCP principles;
- implementing preventive measures relevant to good hygiene practice for each of the potential food hazards that have been identified;
- keeping the procedures used and duly documented available for the official services, in view of possible inspections;
- ensuring the traceability of all products and all production steps.

In healthcare units, food safety requires:

- entire dedication of the catering service to patient food management; it should not serve as a rest area for the personnel; it is furnished according to the "principle of forward motion" with a clear separation between clean and soiled sectors; its design must make it easy to clean (use of materials that are easy to clean and disinfect, continuity of the skirting with the floor);
- drafting, validation and evaluation of a protocol for the maintenance of the catering area; this protocol should ensure that the counter tops are cleaned with a food-grade detergent-disinfectant before the meals are received;
- that the refrigerator in the catering area be devoted exclusively to the storage of food for patients; its temperature should be controlled and plotted at least once a day (between 0°C and +4°C); a daily and periodical maintenance procedure should be drafted, validated and evaluated;
- that the refrigerator contents be checked daily; all outdated, defective or non-dated items should be discarded;
- the storage of food in compliance with the temperature information printed on the packaging and with the use-by date (UBD) or best before end date (BBD).

## Recommendations

These are regulatory and are relevant throughout the food chain.

The critical control points are analyzed and their enforcement is ensured both in healthcare units and in kitchens during meal preparation. The objective is to avoid the growth of pathogenic agents that may be present, or any recontamination by the inert or living environment.

**R68** Food safety is governed by rules and the resulting measures are applied throughout the food chain, as well as inside the healthcare units. The main points are related to:

- temperature control of food until the time when it is eaten (absolute observance of the cold and hot chains up until the last meal is served);
- traceability of all products and all production steps;
- observance of hygienic conditions and cleanliness of the storage areas;
- observance of hygienic conditions when the meals are served;
- training of the personnel, in particular of the person in each healthcare unit, who is responsible for distributing the meals.

## Criteria for the evaluation of practices

■ External checks performed by Governmental services (in particular the Directorate for Veterinary Services); which monitor, survey, but also assist the institutions in improving their food safety procedures.

■ Internal checks:

- self-checks to verify the observance of the "alert-action" procedures and values (critical limits); as well as inside healthcare units;
- traceability and sampling of control meals in order to identify sources of accidental contamination.

■ Patient assessment (analysis of outpatient questionnaires).

## Specificities

### Drinking water

■ Water from the distribution system: drinking water of Q.1 grade (cold water not subjected to any processing within the institution).

■ Bottled water cooler and food-grade ice: water of Q.2 grade (special-purpose waters that are processed within the institution); intervention and maintenance protocols should be planned for such production systems, as well as regular microbiological checks.

## Enteral feeding

■ This is a nutritional care procedure, which requires the insertion of a gastric catheter intended for often under-nourished, weak or even immunosuppressed patients.

It is important to:

- observe hand hygiene and asepsis when handling the catheter;
- favor the use of closed systems and sterile industrial preparations;
- keep the system closed (use the lateral insertion site for drug administration);
- organize care so that the nutrition sequences take place at other times than the contaminating care practices (nursing, ablutions, urine or stool handling,...).

## Infant formula rooms

■ This is a specific unit, exclusively dedicated to the reconstitution of milk preparations and specific nutritional foodstuff for pediatric and maternity care units.

Useful recommendations are available in the AFSSA guide: [http://nosobase.chu-lyon.fr/recommandations/Maternite/afssa\\_bib.pdf](http://nosobase.chu-lyon.fr/recommandations/Maternite/afssa_bib.pdf) (consulted on May 13th, 2010).

## Nutrition in a protected sector (neutropenic patients in hematology services)

■ Because of their strongly immunosuppressed condition, feeding such patients requires:

- validated specific procedures that are implemented and audited on a regular basis;
- training of staff and informing of the families;
- excluding certain types of food.

## Nutrition in geriatrics

■ This specificity only relates to the presentation of meals in a minced and mixed form, as such transformations lead to contamination throughout the food, thus requiring risk analysis and specific procedures to be carried out when preparing such meals.

## Introduction of food by relatives

■ According to article R.1112-48:

- visitors and patients should not introduce any alcoholic beverages or medication into the institution, except when agreed upon by the physician as far as medication is concerned;
- the unit manager shall refuse, in the patient's own interest, to provide him/her with food products or beverages, even non-alcoholic ones, which are not compatible with the prescribed dietary pattern;
- those food products and beverages that are introduced without any authorization are handed back to the visitors or otherwise destroyed.

However, for the patient's wellbeing, it is possible to accept the introduction of certain food products, provided they are authorized by the unit and written down on the patient's records.

## Research topics

- Appropriateness of surface coatings with antibacterial properties.

## Further reading

■ Ministerial Decree of September 29th, 1997, which specifies the hygiene conditions that are applicable to social catering establishments. Available at:

<http://www.legifrance.gouv.fr/.affichTexte.do?cidTexte=JORFTEXT000000750248&dateTexte=20081104&fastPos=1&fastReqId=899890847&oldAction=rechTexte> (consulted on May 13th, 2010).

■ Regulation no.: 178/2002 of the European Parliament and the Council of January 28th, 2002, which lays down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures for food safety matters, as well as the memorandum DGAL/SDSSA/N2004-8193 of July 28th, 2004 (layout of EC regulatory documents that constitute the "hygiene" package, adopted on April 29th, 2004, with provisions applicable starting on January 1st, 2006. These regulations are available from the following websites:

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## Waste

### Rationale

The waste produced when providing care is of various types: non-infectious hospital waste (NIHW, French: DAOM), infectious hospital waste (IHW, French: DASRI), chemicals, radioactive waste. Anatomic pieces are not considered as waste when recognizable. Soft IHW items (gloves, dressings,...), needles and sharp IHW, whether they have been in contact with biological fluids or not (needles, scalpel blades, razors, ...) and non-soft IHW items (drainage flasks, intubation probes,...) should be distinguished. Waste-related infectious risks in hospitals are still subject to discussion; the only objective facts are the blood and body fluid exposure events affecting healthcare professionals in charge of sampling waste when needles and sharps have not been appropriately managed. Regulations applicable to healthcare waste have been developed in an active and binding way and take the negative psychological impact of healthcare-related waste into account.

Incontinence protections and sanitary towels are considered as NIHW both in the hospital and at home. When a patient requires additional hygiene precautions (contact, air, or droplets), it is recommended to remove any waste produced during healthcare within the IHW chain; the advantage of this recommendation is questioned, but may improve the management of additional hygiene precautions in healthcare units.

Any producer of healthcare-related waste is responsible for this waste, until it has been entirely eliminated. Each institution should organize waste elimination with due respect for its environment and the organizational scheme implemented by local authorities. A referral person specialized in waste processing should be assigned to work with the hygiene team, organize sorting and elimination, train the staff, draft protocols, investigate and carry out the necessary corrective actions when a waste-related undesirable event has been reported.

Waste sorting should be carried out immediately after waste production, as close to the patient as possible (during medical-technical procedures within the patient's room, within the examination, consultation or operating room), based upon a simple typology, known and accepted by all. During care provision or medical-technical procedures, an efficient sorting method would integrate at least three waste categories: the NIHW, soft IHW, and pricking and sharp IHW (which will be processed within the IHW chain). High performance sorting should ensure removal of NIHW from IHW. In sectors where chemical and radioactive waste is produced, a specific recovery and collection device should be installed.

Packaging appropriate for the collection of waste should always be made available, and chosen according to prevailing standards (with a yellow color according to the international code for infectious waste identification) and suited to the size and amount of waste; several types of packaging should be available in each institution: a collector for needles or sharp or cutting objects (NSCOs, French: OPCT), bags with different colors to collect NIHW and soft IHW items, combined double-walled plastic cases for non-soft IHW items if these are produced in large amounts. These primary packages are placed in movable, washable and disinfectable containers having an appropriate size and efficient closure systems; each container should clearly be identified as being intended for NIHW or IHW by means of a color code.

The waste storage area, which is intended for the collection of packaged waste (bags, sharps, combined cardboard-plastic cases), may also accommodate dirty linen; it should be identified, located outside the healthcare unit, close to the discharge circuit (lift); it should be ventilated, non-heated (and possibly cooled), with a surface area adapted to the number of containers to be stored. Wall coatings should be strong and easy to maintain; a floor bung is indispensable. The door to the waste storage room should be kept closed. A person should be designated to maintain this storage room at least once daily.

The centralized warehousing area accommodates containers brought in from several sectors in the hospital; it should be located at a good distance from other hospital areas, windows and air inlets. Access should be simplified for transport vehicles. An nearby area for the cleaning of containers should allow the bins to be cleaned whenever they are emptied. If such a warehousing area cannot be made available, it may be replaced by an outside fenced area, which should be perfectly closed (tamper-proof, and preventing the entry of animals, ...). No waste bags should be

transferred from one bin to another.

Vehicles intended for the transportation of IHW containers should be cleaned on a regular basis; discarding slips should be completed each time a bin is transported to the disposal area.

The time spent between the production of IHW items and their incineration or disinfection varies according to the amount produced: 72 hours for a quantity of more than 100 kg per week, seven days for a quantity of less than 100 kg per week.

In "Healthcare-related waste: how to discard it?" (Déchets d'activité de soins : comment les éliminer ?), a book recently published by the Ministry for Health, it is stated, regarding mini-collectors and needle boxes, that *"in all cases, the collector size should be adapted to the amount of waste produced, to ensure that the latter is discarded as frequently as is required by hygiene constraints. The duration of packaging use (between its opening and closure) should be subject to internal assessment between the healthcare unit staff, the CLIN and the infection control team. For mini-collectors and needle boxes, regulatory discarding time limits should be agreed upon between the final closure of a package and its incineration or pre-processing by disinfection"*. This guide also provides recommendations: a) for those institutions which discard the IHW generated by other producers, in particular those which produce five kilograms of waste per month or less; b) concerning the IHW produced at the patients' home, when they receive homecare, in the case of "door-to-door" collection by an external service provider.

## Recommendations

**R69** The hygiene rules to be observed in healthcare units are as follows:

- during care, place the individualized waste collection bag and the Needles and Sharp or Cutting Objects (NSCO) container near to the patient;
- prohibit the introduction of the waste collector trolley into rooms;
- prohibit the storage of IHW in a patient's room, except in cases where there is a considerable and continuous production of waste during the course of the day (critical care for example);
- when waste is removed in the collector, use the non manual opening system;
- never fill the bags up to more than two thirds of their capacity, and do not transfer waste from one bag to another;
- during transportation to the storage room, at least once a day, ensure that the waste containers are perfectly closed and are clean on the outside; do not place the bags on the floor, do not leave waste in clean areas;
- wear gloves during the transportation of the bags to the storage room, and observe hand hygiene procedures after removal of gloves;
- keep the bag holders clean by means of humid wiping with a detergent-disinfectant once a day, and whenever they are soiled.

## Criteria for the evaluation of practices

■ An observation audit to assess the use of NSCOs, sorting quality, and the observance of good practice at all levels in the waste disposal circuit.

## Specificities

■ Only those anatomic pieces that are recognizable require specific processing, including traceability up to the crematorium. This circuit is indispensable for any hospital which performs surgical operations. Placenta is classified as IHW waste: it should be disposed of through the IHW chain, and it is forbidden to freeze it for "recycling" purposes.

■ Waste material produced in medical analysis laboratories, in particular growth media and chemical waste, should comply with the above-described principles, but may be subject to certain specificities according to the nature of the products or microorganisms.

■ Radioactive waste and waste generated when preparing cytostatics are subject to specific processing, in the same manner as batteries, pacemakers, dental amalgams,...

## Research topics

■ Reuse of NIHW items in healthcare institutions, reduction in chemical waste and single use.

## Further reading

■ FRENCH SOCIETY FOR HOSPITAL HYGIENE (SF2H). Preventing infectious risks in medical biology analysis laboratories (Prévention des risques infectieux dans les laboratoires d'analyse de biologie médicale). Hygiènes 2007; 15(6). 121p. Available at:

[http://www.sf2h.net/publications-SF2H/SF2H\\_guide-hygiene-en-biologie-2007.pdf](http://www.sf2h.net/publications-SF2H/SF2H_guide-hygiene-en-biologie-2007.pdf) (consulted on May 13th, 2010).

■ Interministerial circular DHOS/E4/DGS/SD7B/DPPR/2006/58 of February 13th, 2006 relating to the disposal of waste generated by anticancer treatments (Circulaire interministérielle DHOS/E4/DGS/SD7B/DPPR/2006/58 du 13 février 2006 relative à l'élimination des déchets générés par les traitements anticancéreux). Available at:

<http://nosobase.chu-lyon.fr/legislation/Dechet/2002/ci130206.pdf> (consulted on May 13th, 2010).

■ NATIONAL RESEARCH AND SAFETY INSTITUTE (INRS). Infectious waste. Disposal of IHW and related waste. Prevention and regulation (Déchets infectieux. Elimination des DASRI et assimilés. Prévention et réglementation). ED 918. 2006. 32 p. Available at:

[http://www.inrs.fr/hm/dechets\\_infectieux\\_elimination\\_dasri\\_assimiles.html](http://www.inrs.fr/hm/dechets_infectieux_elimination_dasri_assimiles.html) (consulted on May 13th, 2010).

■ MINISTRY FOR HEALTH AND SPORT. Healthcare-related waste: How to discard them? (Ministère de la santé et des sports. Déchets d'activités de soins : comment les éliminer ?). 2009, 90 pages. Available at:

[http://nosobase.chu-lyon.fr/recommandations/Ministere\\_Sante/2009\\_dechets\\_ministere.pdf](http://nosobase.chu-lyon.fr/recommandations/Ministere_Sante/2009_dechets_ministere.pdf) (consulted on July 11th, 2010).



# Urinary tract infections

## Rationale

### Epidemiology of nosocomial urinary tract infections

According to the latest national prevalence survey on nosocomial infections, carried out in 2006, urinary tract infections are still the most frequent form of nosocomial infections (3.3% of nosocomial infections, with a prevalence of 1.63%) although, contrary to previous surveys, asymptomatic bacteriuria (colonization) may not have been taken into account. These are observed in many medical, surgical or rehabilitation specialties in adults or elderly people.

In the literature, catheter-associated infections (symptomatic bacteriuria) are the most frequent (65% to 80%) form of nosocomial urinary tract infections (NUTIs).

Long-term care units for geriatric or neurology patients are characterized by a high urinary infection or colonization rate, and thus constitute a reservoir for multidrug resistant organisms (MDROs).

In France, the additional cost of nosocomial urinary tract infections is estimated at approximately €574 (laboratory, radiological exploration, surgery, antibiotic expenses), excluding hospitalization and indirect expenses. Preventive actions against nosocomial urinary tract infections have a relatively low cost-benefit ratio, since they entail costs which are lower than those of other nosocomial infections, despite their high prevalence.

### Established facts relating to prevention

Most of the published epidemiologic data concerns patients requiring bladder voiding assistance or treatment for incontinence (indwelling catheterization, penile sheath, absorbent protections), for whom preventive measures have proven efficient. Only a few studies relate to patients who have not undergone any invasive procedure. Urethral catheterization (UC) is associated with a maximum infectious risk. The absence of any invasive procedure and any means other than indwelling catheterization are significantly correlated with less frequent urinary infections.

### Indwelling urethral catheterization

Indwelling Catheter-Associated Urinary Tract infections (CAUTI) are the most frequent of infections associated with care provided in healthcare settings. Urethral catheterization is often resorted to in hospitals (9.4% of patients included in the 2006 prevalence national survey). The infectious risk is related to the catheterization technique, the duration of catheterization, the type of catheter and the patient's condition. The risk is higher in the case of an IUC. The risk of acquiring a iCAUTI is estimated to lie in the range between one and seven infections per 100 days under IUC, that is, the risk increases with increasing duration of catheterization. Nearly 50% of patients

catheterized for more than 7 to 10 days had a bacteriuria. The bacteria reach the bladder, either through an intraluminal pathway or through an extraluminal pathway. Extraluminal contamination may be caused by the caregiver's hands or the patient's perineal colonization. Intraluminal contamination is caused by the backflow of contaminated urines from the drainage bag back to the bladder (which is the reason for strongly recommending a non-return system) or by bacterial growth along the sidewalls. A reduction in indwelling CAUTI may be obtained through proactive and permanent prevention policies, which combine various precautions with bladder catheterization good practice.

## CHOICE OF CATHETER

Catheters impregnated with silver or an antiseptic appear to reduce the risk of infection, as is the case with catheters coated with a hydrogel. There are many publications, but only few cost-benefit studies, which combine or compare several types of catheter. Silicone-coated catheters appear to lead to fewer local complications in humans, and to a lower risk of long-term encrustation. Catheters lubricated with hydrogel coatings appear to be preferable for iterative catheterization. This data needs further confirmation through other studies, before their use can be generalized.

A small diameter (gauge) and a balloon with a volume of less than 10 ml appear to reduce irritation and indwelling CAUTI risk for indwelling catheterization. However, following urology surgery, it is necessary to preserve a large diameter for the purposes of clot evacuation.

## CATHETER PLACEMENT

This is a procedure for which good aseptic practices are recommended, although there is no randomized study establishing the benefits of an aseptic technique or specific antiseptic treatments. The use of well tolerated antiseptics, local anesthesia and lubricants as well as catheter insertion by a well-trained professional, seem to be associated with reduced trauma and CAUTI. Antibioprophylaxis before catheterization is not useful.

## CARE TO BE PROVIDED IN CASE OF IUC

Closed drainage and aseptic technique reduce the risk associated with open drainage. The advantage of a pre-connected and sealed system has been demonstrated by a small number of studies. There is only little demonstrated data relating to the optimum frequency for catheter or drainage bag replacement. The backflow of urine may cause an infection; a recent study has shown that different results were obtained, depending on the type of non-return system used. It is necessary to place the bags at a low level, however without allowing them to come into contact with the floor. It is not necessary to add an antiseptic to the bag. There is neither need for antiseptic genital cleaning, nor for systematic cleaning of the urinary meatus. Bladder irrigations or instillations have no preventive benefit. Continuous bladder irrigation with two-way catheters is however used in post-operative urology.

## **PATIENT EDUCATION, TRAINING OF HEALTHCARE PROFESSIONALS AND PERSONS INVOLVED IN CARE GIVING**

The role of the patient's and his/her family's education is important in the prevention of infections and the early diagnosis of risk situations. Training of caregivers in the prevention of such infections has proven efficient.

### **Alternatives to catheterization: penile sheath, suprapubic catheter, evacuative catheterization**

#### **PENILE SHEATH**

The use of a penile sheath as an alternative to indwelling catheterization in men without bladder retention or obstruction, who are able to cooperate, has been subject to few studies, except in the case of comparisons with other methods. It is associated with fewer urinary infections than IUC.

The chosen equipment or the way healthcare is provided seems to influence skin tolerance. No correlation with infectious risk, including replacement frequency, has been shown.

#### **SUPRAPUBIC CATHETER**

The suprapubic catheter, which was initially developed for situations of urethral damage, has been extended to other applications. It is associated with exceptionally low urinary infection rates (in comparison with indwelling catheterization or intermittent catheterization), and with the delayed onset of such infections. However, some studies point to possible severe complications and the required involvement of urologists to supervise both the patients and healthcare professionals, thus reducing its use to a limited number of indications.

#### **INTERMITTENT CATHETERIZATION**

The use of intermittent catheterization, which avoids the equipment having to be kept in place, has been associated with a reduced rate of urinary infections with respect to IUC, for the same patients. It is more specifically used for para- or tetraplegic patients, but also during the postoperative period, and in maternity or geriatrics units. The estimation of bladder volume by means of appropriate ultrasonographs allows catheterization to be restricted to those cases for which it is absolutely necessary.

In the case of iterative urinary catheterization performed by the patient himself/herself (self catheterization), the use of sterile equipment for each catheterization has not shown any advantage over "clean" catheterization.

Antisepsis has not proven to be beneficial with respect to simple cleaning and the use of preventive antibiotics, antiseptics or cranberry extracts have not proven to have preventive advantages. Repeated antibiotherapy leads to the selection of resistant germs.

For self-catheterization, the development of patient education programs has proven to be efficient, as has been the provision of lubricated catheter kits.

## Other aspects

The intake of cranberry extracts has been proposed for the prevention of urinary infections. Because of the fructose and proanthocyanidin-based substances it contains, this product supposedly prevents the adhesion of bacteria, in particular *Escherichia Coli*, to the uroepithelial cells which line the bladder mucosa. An assessment of this measure has recently been carried out as part of a meta-analysis, and concluded that cranberry syrup efficiently prevents urinary infections in women with recurring urinary infections, but has no effect in patients with neurologic bladders who require catheterization, whatever the method used.

## Recommendations

The prevention of urinary infections relies on a global patient care approach, combining:

- a global approach to hygiene for patients, healthcare providers and the care provided,
- hydration of patients in accordance with the season, their age and pathology,
- specific measures for care provided in the urogenital area.

## General precautions

- R70** Isolated cases of incontinence are not an indication for the use of an indwelling urinary catheter. It is recommended to use alternative methods (absorbent protections, penile sheath, iterative bladder catheterization), exposing the patient to a lower risk of infection, rather than permanent catheterization.
- R71** The best adapted method for the situation of each patient should be evaluated and recorded in the patient's file. Periodic re-evaluation is necessary and must also be traceable. Any indwelling or sub-pubic catheter should be removed as soon as possible.
- R72** The use of ultrasound imaging of bladder volume to define the best-suited drainage method and the most suitable periodicity, in the case of drainage catheters, must be developed in all specialist services.
- R73** The systematic search for bacterial infections (bacteriuria) is not recommended. The treatment of asymptomatic bacterial infections (bacteriuria) is not recommended. This must be limited to specific indications, such as the treatment of a patient in the case of a surgical operation with an infectious risk.
- R74** Health professionals must be trained and have practice in the various catheterization techniques and in the care of catheterized patients. The patients and their families must be

educated in their role in the prevention of UI (Urinary Infections) (and be trained and have experience if they are to carry out catheter insertions themselves).

## Indwelling bladder catheterization

**R75** Choose material with which one is familiar, which is adapted to the clinical needs, and which takes the expected duration of the catheterization into account. Choose a catheter with as small a diameter as possible; a 10 ml balloon is normally sufficient for an adult; in urology a larger diameter and a balloon with a greater capacity are recommended. Use a sterile single dose of lubricant or anesthetic.

**R76** When the catheter is inserted, the IUC must be connected to a sterile collection bag allowing closed-circuit drainage. Verify that the system cannot become disconnected, apart from the case of essential clinical needs such as the changing of the bag in accordance with the manufacturer's instructions.

**R77** Other precautions:

- disinfect the hands and pull the gloves on, before any manipulation of the IUC (including emptying); disinfect the hands following removal of the gloves;
- make aseptic use of the sampling site whenever urine samples are taken;
- place the bag so as to avoid any reflux and prevent it from coming into contact with the ground;
- empty the collector bags regularly to avoid any reflux; use a clean recipient for each patient in order to limit contamination of the drainage cocks;
- do not put any antiseptic product in the bag, do not implement any antibioprophylaxis;
- do not systematically change the catheters, except in the case of specific indications given by the manufacturer;
- routine personal hygiene is sufficient in the case of an IUC;
- irrigations or instillations of the bladder must not be used for the systematic prevention of urinary infections;
- It may be useful to change an IUC in the case of a urinary infection, but this change must not be made before at least 24 hours of correctly adapted antibiotic treatment;

## Penile sheath

**R78** Routine patient hygiene must be carried out; special attention must be paid to the patient's cutaneous condition, and to drying after washing. The use of antiseptics is not recommended. Daily changing may be proposed, to be adapted according to the devices used.

## Suprapubic Catheter

**R79** Catheter insertion should be performed by a trained surgeon: follow aseptic technique at a surgical level (pre-operating shower, antisepsis combining cleansing, rinsing, drying, and application of an alcohol-based antiseptic, operator's clothing, protective sterile drape, and aseptic insertion). The catheter should be connected to a sterile collector bag for closed drainage. Ensure that the system cannot be disconnected except for good clinical reasons, e.g., changing the drainage bag in line with the manufacturer's recommendations.

**R80** Other precautions:

- decontaminate the hands and put gloves on before manipulating the system (including when emptying the drainage bag);
- decontaminate the hands after removing the gloves;
- obtain urine samples from a sampling port using an aseptic technique;
- place the drainage bag so as to prevent reflux, and avoid contact with the floor;
- empty the urinary drainage bags frequently enough to prevent reflux; use a clean container for each patient so as to avoid contamination of the urinary drainage cocks;
- do not add antiseptic solutions into urinary drainage bags;
- do not change the catheter unnecessarily, except when specified by the manufacturer;
- bladder irrigation or instillations should not be used for the routine prevention of urinary infection;
- any clinical sign of an infection along the path of a catheter through the abdominal wall should be investigated promptly.

## Evacutive or iterative bladder catheterization

**R81** Isolated evacutive catheterization is carried out with the same level of asepsis as urethral catheterization using a closed urinary drainage system. Specific pre-connected equipment is preferred, to prevent contamination of the environment.

**R82** Iterative catheterization, in contrast, is a "clean" procedure only intended for the prevention of cross-contamination.

**R83** Other precautions:

- select familiar equipment and prefer self- or pre-lubricated, disposable equipment; if this kind of equipment is not available, the same catheter can be re-used several times in outpatients, provided it is washed and dried;
- select a urethral catheter with the smallest diameter possible, except in surgery or maternity departments, where an adequate diameter will be chosen to ensure fast and complete evacuation of the bladder;
- clean the urinary meatus with soap and water, rinse; before each catheterization, apply antisepsis for a single evacuation catheterization;
- decontaminate or wash the hands before catheter insertion;
- ensure personal hygiene is observed routinely.

## Criteria for the evaluation of practices

■ The surveillance of nosocomial urinary infections, whether it be performed on a continuous or discontinuous basis, is both a decision-making tool for an efficient prevention policy, and a tool for assessing ongoing programs.

■ Audits for the assessment of practices related to bladder catheterization (insertion, care, patient education) are efficient tools and existing national or local recommendations make it more straightforward to define the main points to be included in such a program. On the HAS Website, it is possible to find a national report on the evaluation of the practices of inserting and monitoring indwelling catheters:

[http://www.has-sante.fr/partial/upload/docs/application/pdf/su\\_-\\_rapport\\_final.pdf](http://www.has-sante.fr/partial/upload/docs/application/pdf/su_-_rapport_final.pdf) (consulted on May 13th, 2010).

Various healthcare institutions have also published this type of study.

## Specificities

### Preventing urinary infections in urological surgery

■ In urological surgery, nosocomial urinary infections (NUIs) occur after an endoscopic procedure, prostatic biopsy or conventional surgery (infection of the surgical site and catheter-related infections). Generalizing the monitoring of pre-surgery sterility of the urine, combined with the reasoned use of antibioprophylaxis, has led to a decrease in this type of NUI.

■ The prevention of urinary infections goes hand in hand with the prevention of surgical site infections in this specialty. Its main aspects are:

- screening and treating bacteriuria before surgery,
- the required observance of antibioprophylaxis procedures (indications, administration mode).

### Preventing urinary infections in intensive care units

■ The 2006 survey on nosocomial infection surveillance in adult intensive care units performed by the RAISIN network revealed a urinary infection rate of 6.46 per 100 patients, a catheter-related urinary infection attack rate of 7.82 per 100 patients with urinary catheterization, and an incidence rate of 7.94 per 1000 catheter-days. This data is available at: ([http://www.invs.sante.fr/publications/2007/rea\\_raisin/rea\\_raisin\\_2006.pdf](http://www.invs.sante.fr/publications/2007/rea_raisin/rea_raisin_2006.pdf)). These rates have been steadily decreasing over the years.

■ The main risk factors are: the duration of the stay in an intensive care unit, the severity score at hospital admission, the female gender, and above all, the duration of catheterization.



■ In terms of prevention, the following priorities have been pointed out by the fifth SFAR-SRLF common consensus Conference for "Preventing nosocomial infections in intensive care, exclusive of cross-contamination and new-born" (*Prévention des infections nosocomiales en réanimation, transmission croisée et nouveau-né exclus* - <http://www.sfar.org/t/spip.php?article410>):

- the indications for, and durations of bladder catheterization should be restricted;
- a bacteriuria should not be systematically sought after in asymptomatic patients;
- no urinary catheter change should be performed in the case of an asymptomatic bacteriuria;
- the urinary catheter should be inserted by trained personnel, in order to avoid contamination during the procedure;
- a closed urinary collection system should be made available, without however requiring the use of sophisticated drainage systems;
- the use of impregnated urinary catheters (with antiseptics, antibiotics, silver) should be avoided;
- no irrigation or antimicrobial system should be used within the urinary drainage system.

### Preventing urinary infections in geriatrics

■ In long-term care, urinary infections are the most frequent type of infection, with their recognized risk factors being age-related modifications (prostatic hypertrophy, local estrogen deficiency), co-morbidities with neurological bladder and difficult bladder emptying (Parkinson's disease, stroke after-effects, ...), and urinary catheterization.

■ Urinary colonizations are also quite frequent, from 25% to 50% in women, and from 15% to 40% in men. With respect to non-colonized patients, those who are colonized are more dependent, and more often dementia-suffering, incontinent, and bedridden. Bacteriuria is the main cause of bacteremia in long-term care, especially in catheterized patients, and is the main reason for initiating an antibiotherapy.

■ The prevention of these infections is thus an important requirement in these units, and it is important to note that, besides acute medical situations requiring diuresis surveillance, or 24-hour urine collection for biochemical or hormonal assays, urinary incontinence is by no means an indication for long-term urinary catheterization.

### Drainage catheters in maternity and gynecological surgery

■ The development of an occasional sterile drainage catheterization, with the same asepsis level as IUC, leads to a reduction in urinary infections. The marketing of self- or pre-lubricated catheters with a built-in collector bag has enabled its widespread use because, of its simpler and more comfortable handling.

■ In maternity wards, a sterile drainage catheter may be used during epidural deliveries. The use of a closed and sterile system, which includes a self- or pre-lubricated catheter with the same asepsis level as for IUC, has led to a reduction in the patient's urinary infection risks, and in the contamination of the environment by urine.

■ In gynecological surgery, it also helps avoiding the use of IUC. Secondly, it may be replaced, for procedures that are associated with problems of retention lasting several days, such as in lower gynecological surgery, with a clean self-draining catheter, provided that the patients are trained in this type of care.

### Auto/hetero catheterization in functional rehabilitation

■ Rehabilitation units have widely developed auto or hetero-catheterization techniques.

■ Clean catheterization has been proposed as a replacement for sterile drainage catheterization: the patient's personal equipment is cleaned and dried, and re-used for a determined period of time. Using this method, it has been possible to keep costs down, without increasing the infectious risk.

■ Single-use sterile equipment is also available and is very easy to handle, with catheter lubrication to reduce the risk of urethral stenosis. This equipment, which is highly appreciated by users, would need a more in-depth assessment, since its benefits with respect to infections and stenosis have not yet been established. Advantages in terms of ease of use and tolerance of these new devices should make them the preferred choice, whenever they are available.

■ The dissemination of equipment enabling non-invasive monitoring of the residue has made it possible to better adapt the catheterization rate and techniques, in order to reduce the risk of urinary infection, which still remains one of the major sources of complication in these patients.

### Research topics

The following topics have been identified:

■ Catheters coated with antiseptics: there is no formal proof of any advantage, according to a Cochrane analysis, in spite of a possible benefit for catheterizations lasting less than a week.

■ Indications for cranberry juice in a hospital setting: studies in chronic incontinent patients would be useful.

■ Suprapubic catheter benefit-risk analysis.

■ Investigation of long-term lesions according to the type of catheter. In particular for self-lubricated catheters and iterative drainage catheters: it is necessary to evaluate their benefit with respect to urethral stenosis.

- Comparative studies with respect to "clean catheterization".
- Studies pertaining to factors favoring or reducing adherence to recommendations by patients and caregivers.
- Study of monitoring techniques allowing catheterization to be ceased as soon as it is no longer useful.

## Further reading

The reader may refer to the following available documents:

- CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC).

Healthcare Infection Control Practices Advisory Committee. Guideline for prevention of catheter-associated urinary tract infections 2009. 67 p. Available at:

[http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/CAUTI\\_Guideline2009final.pdf](http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/CAUTI_Guideline2009final.pdf) (consulted on May 13<sup>th</sup>, 2010).

- FRENCH-SPEAKING SOCIETY FOR INFECTIOUS DISEASES (SOCIÉTÉ DE PATHOLOGIE INFECTIEUSE DE LANGUE FRANÇAISE) (SPILF), FRENCH UROLOGY ASSOCIATION (ASSOCIATION FRANÇAISE D'UROLOGIE) (AFU). Consensus Conference: nosocomial urinary infections in adults. 2002. Available at: <http://nosobase.chu-lyon.fr/recommandations/Urologie/iun02-long.pdf> (consulted on May 13<sup>th</sup> 2010).

- Recommendations specific to urology surgery. Available at: <http://www.uroweb.org/> (consulted on May 13<sup>th</sup> 2010). (consulted on May 13<sup>th</sup>, 2010).

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# Respiratory infections

## Rationale

### Context

Pulmonary infections acquired during patient care within a medical setting, which by definition are not present at the time of the patient's admission, develop under various clinical conditions, leading to the differentiation between several categories of pneumonia, not including community infections:

- Classical types: pneumonia acquired in a hospital, or nosocomial pneumopathies and mechanical ventilation associated pneumonia (MVAP) in critical care patients;
- Healthcare-associated pneumonia, and pneumonias occurring in nursing homes for the dependent elderly. These forms of pneumopathy, conventionally classified as community infections, in fact create microbiological and therapeutic problems of the same type as the preceding form of infection.

Pulmonary infections are one of the most common types of infection acquired in hospitals, just before or after urinary infections, depending on which study is referred to.

### Mechanism

A pulmonary infection arises from the microbial growth in the normally sterile lung tissue. Although its pathogenesis is complex, the main mechanism involved is the transit of germs, which have colonized the oropharynx, into the subglottic airway. The isolated germs can be endogenous (corresponding to the germs in the patient's flora, which may have been modified by colonization by germs acquired in the hospital, with or without the selective influence of an antibiotherapy or a previous pathology), or exogenous (generally introduced during tracheal suction). Most infections arise from the inhalation of germs produced by oral-pharyngeal colonization; this is related either to micro-inhalations resulting from the displacement of secretions around the cuff, or to inhalations which can occur under various circumstances (impaired consciousness, choking) and are facilitated by inefficient coughing. Colonization of the upper respiratory tract occurs very rapidly in all intubated patients, thus explaining its frequent occurrence in critical care patients.

### Prevention

In simple terms, means of prevention are classed according to whether they are based on medication or not.

## Non-medicinal means

### NON-SPECIFIC MEANS: CROSS-CONTAMINATION PREVENTION

Here again, cross-contamination prevention is vital, even though it is difficult to distinguish from the certainly significant proportion of endogenous pulmonary infections, since this is related to the development of an infection at a site, which is often already colonized. The updated recommendations are described in the recently published formal expert consensus of the SF2H. With regard to the prevention of respiratory infections, the following aspects should be noted:

- Any form of respiratory care places the caregivers in contact with potentially contaminated biological fluids, and hand disinfection by means of an alcohol-based handrub must be strictly imposed for all manipulations of the ventilation equipment (respirator, ventilation tubes) or in the case of respiratory kinesitherapy;
- The most contaminating procedure is without any doubt that of endotracheal suctioning, for which the wearing of gloves is recommended. It is also recommended to use a sterile, disposable suction catheter whenever an open tracheal suctioning system is required. Even if no formal recommendation can be made with respect to the wearing of sterile rather than non-sterile gloves during the tracheal suctioning of an intubated patient, apart from the cost factor, it is logical to prefer the use of non sterile gloves, associated with the use of a sterile gauze. Manipulations of the suction catheter are made using the “no-touch” technique for suctioning via the suction catheter. Some units use a single, ready-for-use sterile glove;
- Colonization or infection of the respiratory tract by multiresistant germs, for example Methicillin resistant *Staphylococcus aureus* (MRSA), can lead to the implementation of Additional Contact Precautions, or even Additional Droplet Precautions. This implementation of additional precautions is included in a policy defined by the CLIN, according to the level of observance of standard precautions (cf. chapter on cross-contamination).

### SPECIFIC MEANS

#### TYPE AND DURATION OF VENTILATION

- The use of non-invasive ventilation (NIV), whilst respecting its indications, is to be preferred whenever possible. Despite the difficulties inherent to a comparison between the two techniques (are intubated patients, and those who are successfully ventilated with a mask, any different?), several therapeutic trials have shown that there is a lower risk of pneumopathy with NIV.
- The earliest possible weaning of a patient from the ventilation system allows the period of intubation, which is known to be the greatest risk factor in the appearance of pneumopathies, to be reduced. This certainly requires the use of weaning procedures, which have been subjected to numerous trials in which a reduction in the risk of pulmonary infection was not the main objective. From these studies, it has been found that there are several valid weaning techniques. This no doubt indicates that the existence of a rationalized approach to weaning and extubation, according to a validated technique, is a factor contributing to a reduction in the duration of intubation. The control of sedation, a major factor in weaning, has been studied in many papers, showing that regular breaks in the use of sedation allow earlier extubation.



However, the effect of such breaks on pulmonary infections has not been studied.

- The prevention of iatrogenic extubation through good management of sedation and a fair and efficient tying procedures sometimes allows re-intubation, a recognized risk factor in the development of a nosocomial pulmonary infection, to be avoided.

## **INTUBATION**

- Oral-tracheal intubation is believed to lead to less pneumonia than nasotracheal intubation. The explanation can probably be found in the lower frequency of sinusitis, a risk factor in pneumonia revealed by early, but well conducted studies.
- A biofilm forms on the surface of intubation tubes and, in some cases, could be a factor leading to the appearance of pneumopathies. A recent trial with intubation catheters containing silver salts has shown some benefits. However, this clinical trial is currently the only one of its type, and, in view of the associated additional costs, must be viewed with caution.
- The cuff must be sufficiently inflated to avoid the risk of inhalation, however over-inflation of the cuff can lead to ischemia of the tracheal mucosa, a factor which promotes tracheal stenosis far more commonly than in the past. It is considered that the pressure must be strictly maintained within the limits between 20 to 25 cm H<sub>2</sub>O (15 to 18 mm Hg) and 30 cm H<sub>2</sub>O (22 mm Hg). Monitoring of the cuff pressure must therefore be included as part of the multiple daily monitoring of a ventilated patient.

## **TRACHEOTOMY**

- The appearance of techniques for early percutaneous tracheotomy has aroused considerable interest in this technique. As many studies have shown that a tracheotomy reduces the period of ventilation and allows earlier weaning, a decrease in the frequency of MVAPs could logically be expected. However, clinical trials and meta-analyses have not confirmed this expectation.

## **SUCTIONING**

- The subglottic airway suction of secretions accumulating above the cuff has been analyzed in several studies, which conclude, in particular, the reduction of early pneumonia. The additional cost associated with the use of a specific tube with a specific suction channel is real, although not excessive. However, this technique is seldom used (difficulties in inserting the correct tube when the patient is not intubated during critical care, numerous failures of the technique meaning that it is not strictly recommended by the 2008 SFAR/SRLF consensus conference), and needs further evaluation as a consequence of the still insufficiently demonstrated compromise between benefits and risks.
- The use of closed suction systems (more expensive) has not demonstrated any obvious superiority in three recently published meta-analyses. For reasons of ease of use, some professionals nevertheless recommend these for multi-resistant germ infections, in the case of tuberculosis or ventilation in the prone position.

## **CIRCUITS**

- Humidification of the airways can be achieved using two types of device: heat and moisture

exchange filters (HME) which, according to recommendations based on clinical studies, need to be changed every 48 hours, and humidifiers. Recent models of the latter have a heating wire, which prevents liquid condensation inside the circuit. A recent meta-analysis found no difference between these two techniques, with respect to mechanical ventilation associated pneumonia. The indications for these types of device are thus based on other parameters such as the volume of secretions, the risk of filter clogging, or of a mucous plug, with precautions for use specific to each type of device.

- The frequency with which circuits should be changed was studied in the 1990's, and the three studies usually cited reached the same conclusion, i.e. that there is no benefit to be added from scheduled circuit changes. The circuits should be changed only if they are soiled, since more frequent changes contribute nothing in terms of prevention, and lead to an increase in costs.

#### **STOMACH TUBE AND ENTERAL FEEDING**

- There is no doubt that the presence of a stomach tube favors the risk of frequently occult inhalations. It is important to distinguish between the context of an intubated patient in critical care, for whom it is difficult to avoid the use of a stomach tube (in particular since digestive motility disorders can occur, which are promoted by sedation), and that of a patient in a post-operative phase, as discussed below.
- The stomach tube is frequently used for enteral feeding, and has a well-proven nutritional efficiency. Nutrition administered further down the digestive system, by means of a tube penetrating through the pylorus, does not contribute any greater benefit in terms of the risk of inhalation.

#### **KINESITHERAPY AND POSITION OF THE PATIENT**

- The patient's position undoubtedly plays an important role, with the strict dorsal decubitus position favoring more micro-inhalations than the semirecumbent position at 45°. A therapeutic trial has confirmed the usefulness of this maneuver, which is theoretically simple to implement, in order to reduce the frequency of MVAP. However, later studies have revealed the difficulty of maintaining critical care patients, who are more frequently inclined at 25°-30°, or even at 10°-15°, in this position. However, it is still recommended to avoid the prone position for care other than that requiring this position, or for reasons of clinical limitations, particularly in traumatology.

- Respiratory kinesitherapy is not intended for the prevention of pneumonia only. In critical care, it has not been shown to have an independently beneficial effect on the rate of pneumonia, due to a limited number of modest and inconclusive therapeutic trials. It is shown, later in this document, that this therapy is included in the recommendations for the post-operative phase. Recent studies reveal the degree to which early damage to the diaphragm occurs when the latter is put to rest through the use of controlled mechanical ventilation. Two techniques allowing improved access to the posterior zones have been proposed, the ventral decubitus position, and rotating beds, however neither has demonstrated any efficiency, which could justify their recommendation.

## **Medicinal means**

### **PREVENTION OF STRESS ULCERS**

Interactions with stress ulcers have been a subject of discussion in the past: initial studies tended to show an increase in the frequency of artificial ventilation associated pneumonia, when a product decreasing gastric acidity (antiH2 for example) was administered. It was hypothesized that with the increase in pH, a rapid multiplication of gastric bacteria increased the colonization of the oropharynx. Later studies did not confirm this, and the selection of anti-ulcer medication should not be motivated by a desired change in gastric pH.

### **ANTIBIOPROPHYLAXIS**

Antibioprophylaxis has been proposed in order to avoid the occurrence of pneumonia, in particular in comatose patients. The results of related studies are not conclusive. The consensus conference did not recommend the systematic use of antibioprophylaxis in this context.

### **CARE OF THE ORAL-PHARYNGEAL CAVITY**

Oral-pharyngeal decontamination using antiseptics is based on the use of chlorhexidine or povidone-iodine. This has been studied in heart surgery and critical care patient populations. Therapeutic trials, showing a decrease in the incidence of MVAP, with no decrease in overall mortality rate, tend to support such an approach. The same consensus conference concluded that “one should probably apply regular naso- and oral-pharyngeal decontamination, using an antiseptic solution”. However, in France, there is no form of chlorhexidine available at the concentration (2%) used in the most recent studies.

### **SELECTIVE DIGESTIVE DECONTAMINATION**

This involves the elective suppression of oral-pharyngeal and intestinal flora using non-absorbable antibiotics. It is the source of one of the most persistent controversies in critical care. As a result of the likely pathogenicity of the vast majority of respiratory infections (inhalation through the oropharynx, colonized by a bacterial flora evolving over time, and influenced by anti-infectious treatments), it appeared logical to the proponents of this approach, in the 1980's, to propose local decontamination of the pharynx and digestive system, preceded by a general antibiotherapy of short duration, in order to allow sufficient time for the decontamination to be effective. At the beginning of intubation, and during the first days of MV, the patient's ordinary flora

is inhaled, leading to the majority of cases of so-called early pneumonia. Secondly, from the fifth day, a modified flora, consisting essentially in Gram-negative bacilli (GNB) or hospital bacteria, will be responsible for so-called late pneumonia. Numerous therapeutic trials have been carried out, using an association of polymyxin or colistin, with an aminosidine (gentamicin, tobramycin), and an antifungal molecule such as amphotericin B. Other molecules have been proposed, often with a systemic use, thus exceeding the requirements of local decontamination. Cephalosporins have often been used for the general administration of antibiotics. Antibiotics are used in the form of a paste or gel applied to the oropharynx, or a solution administered by means of a stomach tube. More than 50 therapeutic trials have been carried out on non-selected critical care populations or on targeted groups (mainly post-operative or post-trauma patients), often demonstrating a reduction in the rate of pneumopathies. The recurring question is that of the impact of such a prevention policy on the bacterial ecology. This issue is no doubt viewed under a different light in the majority of trials carried out in Northern Europe, where the spontaneous occurrence of MDROs is low, as opposed to a country such as France where the rate of MDRO is still high. The impact on mortality varies between trials, however it is known to be difficult to demonstrate the excess of mortality in a pathology for which the attributable mortality is low, when patients are rapidly and efficiently treated. A recently published therapeutic trial, concerning a group of thirteen Dutch critical care units, shows a decrease in mortality and the rate of bacteremia. The French consensus conference on the prevention of nosocomial infections in critical care concluded, with considerable prudence, that *“In adults, selective digestive decontamination (SDD), associated with systemic antibiotherapy, should probably be recommended. However, its implementation still calls for a specific description of the methodology (selection and posology of molecules, duration of the SDD and the antibiotherapy) and the target population. The use of such a strategy requires heightened surveillance of the bacterial ecology in the unit. Its use in units with a high prevalence of methicillin resistant staphylococci or vancomycin resistant enterococci should probably not be recommended. The long-term impact of this strategy on the bacterial ecology still remains to be determined.”*

## Prevention of post-operative pneumopathies

Post-operative pneumopania require the use of specific preventive measures. They are entwined with other respiratory complications, such as atelectasis or respiratory failure of cardiac origin, or related to pre-existing respiratory pathologies. Of course, the location of the surgical site plays a role.

- Pulmonary expansion using incentive spirometry, respiratory kinesitherapy and post-operative positive pressure ventilation has shown only limited beneficial effects.
- Pre-operative cessation of smoking (a period of six to eight weeks is normally proposed, according to the SFAR expert conference) has shown only limited beneficial effects.
- Operative techniques play a role, and by promoting faster recovery of the respiratory functions, laparoscopic surgery, rather than laparotomy, could reduce infectious pulmonary complications.
- Anesthetic techniques also play a role: the use of prolonged action curare rather than molecules with a short-term action; epidural anesthesia combined or not with general anesthesia has not shown beneficial effects as clearly as expected. Efficient patient-controlled post-operative analgesia (PCA) has been shown to be beneficial.

- In certain cases, the insertion of a naso-gastric tube appears, through gastric decompression, to have a slightly beneficial effect. However, in most cases, early removal of the stomach tube is desirable.
- Total parenteral or enteral feeding, as opposed to the absence of nutrition, has shown no difference, with the exception of clear cases of malnutrition.

## Global approach

The prevention of infections relies on measures, many of which have been individually validated in the context of classical clinical trials. However, such measures are all the more efficient when they are part of the framework of a global strategy. They have been analyzed in numerous studies in which the rate of infection was measured before and after the implementation of such a set of measures. Although these studies are considered by some to have a lower methodological quality, they are the starting point in a process towards the improvement in the quality of care. This set of measures is thus often included in what is referred to as a global strategy, or a ‘bundle’ of measures. In practice, observance evaluation can be achieved in the form of itemized lists, which are most often validated on a daily basis. These lists, referred to as check-lists, used with success in other fields such as surgery or the care of serious septic conditions, are a modern approach to care assessment, which simultaneously combine a reminder of a set of important preventive measures, and the evaluation of their observance.

## Recommendations

### Non-specific means

- R84** Use an alcohol-based handrub before and after contacting an intubated, ventilated or tracheotomized patient, before and after manipulating an artificial ventilation device used in a patient, with or without gloves. Gloves are used for manipulating respiratory secretions or equipment contaminated with such secretions. These gloves should be removed immediately after the manipulations, in combination with an alcohol-based handrub. A disposable sterile suction catheter should be used when open tracheal suction systems are employed.

### Specific non-medicinal means

#### Reduce intubation time

- R85** Prefer the use of NIV and adhere to known indications. A weaning algorithm and analgesic sedation (avoiding unnecessary ventilation extension tubes) should be used to reduce intubation time.

## Intubation, respirator circuits and stomach tube

- R86** The use of an oral tracheal tube is preferred in adults. The pressure in the intubation catheter balloon should be maintained between 25 and 30 cm H<sub>2</sub>O (between 20 and 25 cm H<sub>2</sub>O in children). It is not necessary to replace respirator circuits, except when they are visibly soiled. If filters are used, they should be replaced every 48 hours. The stomach tube should be removed as soon as possible, however its removal should be weighed up against the potential benefits of enteral feeding.

## Kinesitherapy and patient's position

- R87** The patient should be placed in a semi-seated position, as close as possible to an angle of 45°. A respiratory *kinesitherapy* treatment should be carried out, even in ventilated and sedated patients.

## Selective oral-pharyngeal and digestive decontamination

- R88** A nasal and oral-pharyngeal routine decontamination by means of an antiseptic solution should be carried out.
- R89** In adults, SDD combined with a systemic antibiotic treatment has proven efficient in certain groups of patients. However, uncertainties still remain as to the choice and dosage of molecules, and the duration of SDD and antibiotic treatment. Resorting to this strategy implies improved monitoring of the bacterial ecology in the department. Its use should preferably not be recommended in units with a high prevalence of methicillin-resistant staphylococci or vancomycin-resistant enterococci. The long-term impact of this strategy on bacterial ecology still remains to be assessed.

## Overall care

- R89** In spite of the sometimes low level of evidence of each of the individual recommendations, they should all be applied.

## Criteria for the evaluation of practices

- The level of knowledge of healthcare professionals can be evaluated. A good example of a questionnaire on the knowledge of State Certified Nurses is provided in a study of critical care nurses in Europe.
- Numerous studies on the implementation and evaluation of global strategies have been published. These are referenced in the manuscript of one of the experts from the SRLF/SFAR consensus conference.

## Specificities

■ The various studies carried out on this topic tend to concentrate on MVAPs, in the specific context of critical care. However, although more rare, non-critical care pneumopathies occurring in elderly patients are attracting growing interest. Indeed, these occur in patients presenting with specific conditions: frequent colonization by resistant germs, possible difficulties with swallowing, difficulties of diagnosis.

■ Similarly, the prevention of pneumonia in a perioperative context has certain specific aspects. Active post-operative kinesitherapeutic care is indispensable, especially in patients at risk. Preoperative cessation of smoking must begin at least six to eight weeks prior to the operation. Anesthetic techniques using short-term action products should be preferred, and good post-operative pain care must be implemented.

## Research topics

■ The role of the patient's underlying conditions, in particular those in a critical condition, for whom there is a still poorly understood state of secondary immunosuppression.

■ Prevention, through the implementation of global strategies, is currently being studied. The evaluation of process indicators is thus preferred, since in the field of VAP, the result indicators are highly subject to variations, which have nothing to do with the quality of care (the case mix in particular).

■ The problem of digestive or oral-pharyngeal decontamination is on-going, both in terms of its applicability in specific populations, and as a function of the unit's bacterial ecology and its impact on this bacterial ecology.

■ Finally, some technical means of prevention, such as intubation tubes designed for subglottic airway suction, or tubes impregnated with antiseptics, require new studies in order to determine whether or not they have any indications.

■ The evaluation of the implementation of preventive measures, using the check-list technique, should be submitted to further clinical studies.

## Further reading

Two summary documents provide a synthesis of various aspects related to this topic:

■ FRENCH SOCIETY FOR HOSPITAL HYGIENE (SF2H). National recommendations. Prevention of cross-contamination: additional contact precautions. Formalized expert consensus. Hygienes. 2009. Available at: [http://www.sf2h.net/SF2H\\_english/SF2H\\_contact-precautions-guidelines-2009.pdf](http://www.sf2h.net/SF2H_english/SF2H_contact-precautions-guidelines-2009.pdf) consulted on May 13<sup>th</sup>, 2010).

■ FRENCH SOCIETY FOR ANESTHESIA AND CRITICAL CARE (SFAR). 5<sup>th</sup> consensus conference.



Prevention of nosocomial infections in critical care – cross-contamination and newborns excluded. 2008. French version available at: [http://www.sfar.org/docs/articles/102-ccons\\_inrea\\_sfarsrlf09.pdf](http://www.sfar.org/docs/articles/102-ccons_inrea_sfarsrlf09.pdf) (consulted on May 13<sup>th</sup>, 2010).

■ Finally, the following references should also be included:

- The SFAR expert conference on perioperative smoking. French version available at: <http://www.sfar.org/article/151/tabagisme-perioperatoire-ce-2005> (consulted on May 13<sup>th</sup>, 2010).
- Handling of acute lower respiratory infections in collective establishments for the elderly, prepared under the authority of the French Ministry of Health. French version available at: [http://nosobase.chu-lyon.fr/recommandations/Ministere\\_Sante/2008\\_EHPAD\\_ministere.pdf](http://nosobase.chu-lyon.fr/recommandations/Ministere_Sante/2008_EHPAD_ministere.pdf)

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# Surgical site infections

The prevention of surgical site infections (SSIs) is centered on the perioperative period, in particular that corresponding to the patient's presence in the operating room, for which the principle of increasingly aseptic conditions is applied. However, this is prepared in advance of the surgical procedure, and includes, amongst other measures, skin preparation, and is continued throughout the operation, based on the monitored rate of SSI. This chapter deals with surgical procedures themselves, and other related interventional procedures (cardiology, radiology, gastroenterology, etc.).

## Rationale

### Epidemiology of nosocomial surgical site infections

In terms of frequency, SSIs represent the third form of healthcare-associated infections. The results from the 2006 national prevalence survey led to a national SSI prevalence rate of 0.76%, representing 14.2% of nosocomial infections. The monitoring of SSIs by the CCLIN surveillance network indicates a 1.5% incidence rate, for 965128 surgical procedures between 1999 and 2006. The total number of surgical procedures carried out in France is estimated at seven million per year, and the number of SSIs at between 140000 and 200000.

The SSI rate varies between 1% and 20%. This variation is observed as a function of:

- the surgical specialty, the type of procedure, and its location; for example, in neurosurgery the SSI rate varies between 0.3% for procedures involving cranial or peripheral nerves, or the lymph system, to 3.1% for the external derivations of the CSF;
- the specificities of the surgical procedure; for example, the prevalence of SSI following a cholecystectomy varies between 0.3% in the case of laparoscopic surgery, and 1.0% in the case of a cholecystectomy using laparotomy;
- the score attributed by the National Nosocomial Infections Surveillance (NNIS) system, which takes into consideration the class of contamination of the surgical procedures, the patient's condition before the procedure estimated according to the ASA (American Society of Anesthesiology) anesthetic risk score, and the duration of the procedure; as an example, the prevalence rate can be multiplied by two or three (Caesarean sections), or three or four (full hip prosthesis), for a NNIS score ranging from 0 to 2 or 3;
- the urgent or programmed character of the procedure; globally, urgent surgical procedures have a higher SSI rate than those which were scheduled. In the case of Caesarean sections, the variation can range by a factor of one to ten.

Epidemiological surveillance reveals a decrease in SSI rates in programmed surgery. In surgery for hernia of the abdominal wall, the SSI-RAISIN (Surgical Site Infections - National program for early warning, investigation and surveillance of healthcare-associated infections) evaluation notes that the rate of incidence decreased by 69% between 1999 and 2006. This decrease in SSI rates is also observed for cholecystectomies, appendectomies, full hip prosthesis, Caesarean sections, breast surgery and colon surgery.

Concerning the cost of NIs, including SSIs, Douglas evaluated the total cost of NIs in the USA at 6.65 billion dollars (\$) every year, for a prevalence of the order of 4.5%. In the case of SSIs, the estimated cost of an infection varies between \$10443 and \$25536. By studying 26 publications, of which 8 dealt with SSI, Anderson estimated that the cost of SSI varies between \$2527 and \$29367.

The costs savings, which could be expected from a reduction in the number of SSIs, are estimated to be \$52000 for every 5 avoided SSI. In a recent review of 13 studies carried out since 2000, the increase in the length of hospital stay in the case of an SSI ranged from 4.9 days in the case of breast surgery, to 32 days in the case of cardiac surgery, if the infection was due to a methicillin resistant *Staphylococcus* (MRSA). The additional cost ranges between \$3859 and \$56607 (i.e. between 2817 € and 41319 €). The variation ranges between 59% and 80% of the total cost of each patient's stay. Depending on the type of surgery, the increase in costs associated with SSI ranges between 34% and 226%, and the increase in the duration of the patient's stay ranges between +48% and +310% (comparison between non-infected patients and those having a SSI). Finally, SSIs are directly or indirectly responsible for the death of patients in approximately 4% of cases.

### Physiopathology, contamination pathways

Contamination of the surgical site occurs mainly during the pre-operative phase. The microorganisms originate generally from the patients themselves, having been already present either at the surgical site (self-contaminating or higher contamination classes of surgery), or in their skin flora (clean surgery). In clean cardiac or orthopedic surgery, it has thus been shown that the *S. aureus* germs responsible for SSI are in 75% to 80% of cases identical to those present pre-operatively, in the operated patient's nose.

The flora of personnel in the surgical team is rarely involved. Contamination through contaminated equipment, which is very rare, has now become exceptional with the recent reinforcement of rules concerning the sterilization and disinfection of equipment, and the use of sterile, disposable equipment.

The transmission pathways of microorganisms are not perfectly understood. They can be airborne, hand-carried, or have a contiguous origin, from the endogenous flora (cutaneous, digestive, ...).

The airborne pathway requires the involvement of two associated phenomena, the existence of microorganisms (aero-biocontamination) and that of inert particles (aero-contamination), some of which serve as bacterial carriers. The microorganisms originate in the saprophytic flora normally found in air (rarely pathogenic), and in human commensal flora (mainly *Staphylococcus aureus*, coagulase negative *staphylococci*, and occasionally Gram-negative bacteria) released by human organisms (operated patients and operating team). The particles are released by individuals (scales, skin appendages, respiratory droplets and droplet nuclei) and textiles (clothing of the operating team and surgical drapes); the quantity is proportional to the number of persons in the operating room and to their movements and comings and goings, and to the quality of the textiles (non-woven and poly-cotton materials releasing less particles than cotton, and being more impervious to particles).

Some factors favor the occurrence of an SSI in the case of a surgical site contamination: presence of necrosis of the tissues, of a hematoma, a foreign body, a prosthesis or an implant, or poor vascularization.

An SSI related to post-operative contamination can however arise. In surgery of the digestive system, it is often caused by loosening of sutures; in traumatology, an SSI can occur if the surgical site could not be closed at the end of the operation (loss of substance). Post-operative contamination through drains or dressings is very rare.

As in any healthcare unit/ward, the observance of standard precautions is required, with no particular exceptions. It may happen that some patients correspond to a special case, as for example the case of a tuberculosis patient. The hospital ward must inform the operating personnel, so that specific measures can be implemented.

## **Risk factors**

These can be classified into two main groups: risk factors associated with the patient's underlying conditions, and risk factors associated with the surgical procedure.

### **Terrain related factors**

These are numerous: age extremes, underlying diseases (diabetes, immunosuppression), obesity, malnutrition, infection of another site, prolonged prior hospitalization, smoking. The expert conference on perioperative smoking (SFAR, 2005) dealt with the risks in surgery associated with smoking, the proven benefits of not smoking before and after surgery, and the perioperative methods for dealing with a smoker patient in the case of a programmed operation.

### **Factors related to the surgical procedure**

Among the risk factors related to the surgical procedure itself, the Altemeier contamination class is the most important. There are other risk factors: emergency surgery, prolonged surgery, surgeon's experience, hemorrhagic surgery or difficult hemostasis, need for early surgical revision.

The disregard of preventive measures corresponds to a third group of risk factors.

Although the classification of SSI risk as a function of the risk factors uses the NNIS score, the latter does not allow individual predictions of SSI risk to be made. The comparison of stratified rates between surgical units with similar activities should allow inter-comparisons to be made, with the differences in stratified rate theoretically reflecting the quality of the preventive measures. This concept is debated by some, in particular because the stratification of SSI rates using the NNIS score does not take differences in patient's underlying conditions sufficiently well into account, does not allow suitable stratification to be established for all types of surgery, and because the recording of SSI is not always uniform from one unit to another.

## Established aspects of prevention

The reduction in the number of SSIs is based on the implementation of prevention programs. In the United States, the SENIC (Study on the Efficacy of Nosocomial Infection Control) project led to the evaluation, in the years from 1970 to 1976, of the efficacy of surveillance associated with specific prevention measures. The reduction in the NI rate ranged between 19% and 35%, and was as high as 57% in the case of SSIs. The program proposed in the USA in 2009 is based on five priorities, including SSIs, over the following five years. Its aim is two-fold:

- reduce the SSI incidence rate,
- improve the observance of SSI preventive measures.

In France, one of the aims of the program for the prevention of nosocomial infections (PROPIN) during the 2009-2013 period, is to reduce by a quarter the incidence rate of surgical site infections for every 100 procedures (including deep infections), for the case of certain targeted, low infection-risk operations (correction of an inguinal or abdominal wall hernia, cholecystectomy, prosthetic orthopedic surgery, Caesarian delivery, breast surgery).

## Surveillance

Surveillance is one of the elements of SSI prevention. Few studies have revealed the impact of surveillance itself on SSIs. POULSEN observed that, outside the context of a specific prevention program, surveillance allowed the SSI rate to be decreased. Over a seven-year period, ASTAGNEAU *et al.* observed that the SSI rate decreased, without being able to demonstrate the existence of a causal relationship between surveillance and the observed decrease.

As far as surveillance methods are concerned, the current SSI-RAISIN program recommends two months of surveillance of all operations undertaken in a given unit per year, with a compilation of infectious risk adjustment factors, in particular the elements of the NNIS score, and surveillance of all SSIs up until the thirtieth post-operative day. An alternative approach proposed by the RAISIN is the surveillance of priority operations for a period of six months. Alternative or complementary surveillance methods have been proposed, or are currently being developed:

- online data entry and transmission, with automatic feedback to the units and hospitals concerned. Such a program is currently being developed under RAISIN's authority;
- surveillance based only on SSI-related revision surgery, which is of interest in clean surgery;
- automated data collection, through the interfacing of computerized databases used for other applications (CCAM, administrative data, data collected in the operating room, bacteriological data, ...);
- individual analysis of cases, in particular through morbidity-mortality reviews, for SSIs in very low risk surgery, ophthalmology for example;
- identification of suspect SSI cases in computerized medical records ("data mining").

The aim of these alternative or complementary methods is to simplify the data collection process. They must in no way replace the vital interest of surveillance: i.e. discussion and validation of suspected SSIs with the surgeon, feedback of infection rates to the surgical teams,

and the use of surveillance data for the implementation of preventive actions, and the verification of their efficacy.

## **Pre-operative prevention**

The prevention of SSIs begins during the pre-operative period. The risk factors must be evaluated during the surgical and anesthetic consultations, which may be difficult in the case of an emergency operation.

## **PRESENCE OF A PRE-EXISTING INFECTION**

This is a recognized risk factor, and the surgical procedure must be postponed whenever possible, except when the infection is the reason for which surgery is required. Treatment of the infection is a pre-condition for the surgical procedure.

## **SCREENING FOR THE CARRIAGE OF *S. AUREUS*, MRSA AND OTHER MDRO**

The *S. aureus* carriage rate in the population is approximately 30%. *S. aureus* is the most commonly responsible pathogen for SSI in clean surgery, in which it has been demonstrated that nasal carriage is a SSI risk factor. Although the 2004 consensus conference held by the French Society for Hospital Hygiene (SF2H): “Pre-operative management of infectious risk” did not recommend systematic pre-operative screening of *S. aureus* carriers, a recent study has demonstrated the usefulness of such screening and of the decontamination of *S. aureus* carriers as a means of preventing SSI in high-risk patients, which is the case in the majority of cardiac surgery patients.

The prevalence of MRSA carriage in patients when admitted for surgery varies from one ward to another, and ranges from approximately 3% to 5%. The main risk factors associated with MRSA carriage are:

- the transfer from another hospital, in particular ECR - long term care, or a recent hospitalization,
- patients older than 75 years,
- the presence of chronic skin wounds or lesions.

The SF2H consensus conference recommended nasal MRSA screening in at-risk patients admitted for programmed cardiac or orthopedic surgery, and did not recommend the systematic use of mupirocin decontamination to prevent the occurrence of SSIs in MRSA carriers. The recent recommendations of the SF2H aimed at cross-contamination prevention (additional hygiene contact precautions) do not deal with individualized MRSA screening for the prevention of SSI, but recommend screening and decontamination in a similar situation, that of high-risk MRSA carrier patients.

Concerning other MDROs, there is no demonstrated advantage to be found in screening in the context of surgery.

## **PREOPERATIVE SHOWER AND ORAL HYGIENE**



The aim of taking a shower (or of bedside washing) before a surgical procedure is to eliminate transient flora and reduce resident flora. Although the usefulness of showering is not disputed, the value of using an antiseptic soap is debated. The reference publication is that of CRUSE and FOORD, dealing with a series of more than 69000 surgical procedures. They observed that the risk of SSI is lower if the patients shower before the operation with a chlorhexidine antiseptic soap, than if they do not shower, or do so with a normal soap. Since this date, numerous publications have debated the usefulness of antiseptic soaps during a preoperative shower. An analysis of sixteen studies published between 1983 and 1992, of which nine were selected (including more than 10000 patients), concludes that the use of disinfectant products during a preoperative shower or bath does not lead to a decrease in SSIs. In the name of the “Working Party on infection control in operating theaters” WOODHEAD *et al.* conclude that a preoperative shower using a chlorhexidine soap does not reduce the incidence rate of SSIs. Several studies have revealed the influence of preoperative showers on skin flora, without revealing any reduction in SSIs. The reading group from the SF2H 2004 consensus conference found only two papers reporting results in favor of the efficacy of a preoperative shower using an antiseptic product, as opposed to seven, of which five were randomized, which do not allow any difference to be revealed. The difficulty of such an analysis lies in the heterogeneity of the additional measures, associating in particular an antibiotherapy, shampoo, etc., for highly different surgical operations.

The observance of good oral hygiene, in particular for cardiovascular surgery, appears to be a significant element in the prevention of SSIs.

## HAIR REMOVAL

Since the study of CRUSE and FOORD, unanimous agreement has been found on the risk associated with shaving of the surgical site with a razor. According to both the North American and French (SF2H) recommendations, the use of a razor for skin preparation must be banned.

Hair removal using clippers may be recommended for some types of surgical procedure; depilatory hair removal cream has an advantage for small surfaces; its drawbacks are the risk of a skin allergy, the high cost of such products, their slow or even inadequate action in the case of significant hairiness.

*In fine*, if hair removal is necessary, the use of clippers or a depilatory hair removal cream should be preferred, whilst taking heed of their possible constraints and contraindications. Shearing is indicated only in situations where the presence of hair can lead to a surgical risk, in which case limited hair removal may be required.

## Prevention in the operating room

Prevention is based on antibioprophylaxis, the patient’s clothing whilst in the operating room, surgical disinfection of the hands, the clothing of the professionals in the operating room, the preparation and protection of the surgical drapes, air quality, and discipline.



## ANTIBIOPROPHYLAXIS

Antibioprophylaxis is relevant only to operations in the Altemeier contamination classes I and II, whereas classes III and IV are relevant to curative antibiotherapy. It is indicated for all types of class II surgery, and for prolonged class I types of surgery in which the risk of SSI is small, but serious, or if the introduction of prosthetic equipment is foreseen. In class II surgery, the reduction in the rate of SSI due to prophylaxis is greater than 50%.

Its aim is to inhibit the growth of potentially pathogenic microorganisms, present or introduced during the surgical procedure itself.

The antibiotic must have a long half-life, an antibacterial spectrum which is active for the normally encountered organisms, minimal undesirable side-effects, and a good level of concentration at the surgical site. The antibiotics used are generally first generation (cefazolin) or second generation (cefamandol, cefuroxime, ceftiofur) cephalosporins.

The antibioprophylaxis must be initiated in the operating room, not more than one hour before incision, and be limited to the perioperative period, not exceeding 24 hours after the procedure, the latter duration not having been shown to improve the antibacterial efficacy.

The recommendations of the French Society for Anesthesia – Critical Care (SFAR) related to antibioprophylaxis were updated in 2010.

Currently, for regulatory reasons of safety and traceability, it is mandatory to use the “patient safety in the operating room” checklist, developed by the HAS (French National Authority for Health), which amongst other aspects mentions the implementation of antibioprophylaxis.

## PATIENT’S CLOTHING IN THE OPERATING ROOM

Depending on the type of surgery, opinions tend to differ. The SF2H recommendations specify that, following the preoperative shower, the patient be dressed in clean, if possible non-woven, clothing. Others consider that the patient could re-dress with his/her own clothes. In France, it is customary for the patient to be transferred to the operating room in specific attire. The 2008 recommendations of the National Health Service recommend that the patient be dressed in specific attire, to simplify care in the operating room, adding that the comfort and dignity of the patient must be respected.

## SURGICAL HAND DISINFECTION

Surgical hand disinfection before any surgical procedure is needed in order to eliminate transient flora and reduce resident flora. Several studies have revealed equivalent efficacy for an alcohol-based handrub and a surgical hand washing, in terms of SSI risk. Hand-rubbing is preferable for reasons of skin tolerance, speed, and a decrease in water supply maintenance requirements. The recommendations conclude that surgical hand disinfection should be preferred in the operating room. It is important to acquire a technique, which ensures disinfection of all parts

of the hands, including the back of the hands and the forearms, up to the elbows. Hand disinfection must be preceded at least by washing with a mild soap, at the beginning of the operation. For surgical hand disinfection in the operating room, it is recommended to use an alcohol-based product of proven efficacy.

The English recommendations from 2008 encourage the use of nail brushes and nail cleaners during hand washing, when entering the operating room. In its most recent version, the SF2H recommends limited nail brushing at the time of hand washing, when entering the operating room. This practice is particularly important if the hands are visibly soiled.

Carriage of gram-negative bacteria is higher in professionals with false fingernails than in those who do not wear such ornaments. The wearing of false fingernails, as well as watches and wedding rings, is generally prohibited in health care, and in operating rooms in particular.

## **PREPARATION OF THE SURGICAL DRAPES**

### **Draping**

Draping with waterproof drapes must protect as large a zone as possible, including the full surgical site. The advantages of using adhesive drapes near to the incision site, in particular in abdominal surgery, obstetric gynecology and orthopedic surgery, has not met any formal consensus. In a meta-analysis of five trials, the English recommendations conclude on the absence of any reduction in SSI, depending on the use (or not) of adhesive drapes. It has not been formally demonstrated that the use of adhesive drapes impregnated with an antiseptic affords an advantage in terms of SSI reduction.

The drapes must be made from a material, which is impermeable to liquids and viruses.

### **Disinfection of the surgical site**

The four-step preparation of the surgical site is effective in reducing the risk of SSI: cleansing with an antiseptic soap, rinsing, drying, and disinfecting with a disinfectant of proven efficacy, which is left to dry in air.

The disinfected zone must be considerably larger than that concerned by the incision. The aim is to reduce the skin flora, including resident flora, for the duration of the operation. This explains the advantage of using disinfectants with a long-lasting effect, in addition to qualities of tolerance, non-toxicity, of not being absorbed through the skin or mucous membranes, and of having a rapid effect and a good drying capacity.

The 2004 Cochrane group review retained six randomized trials, comparing different preoperative skin disinfection protocols. Although two studies compared an iodine-based product in an alcohol-based solution with an aqueous PVPI (Povidone-iodine) solution, none of these studies was able to assert the superiority of any one preoperative, surgical site disinfectant above any of the others.

Alcohol-based products have the advantage of having both good antimicrobial and fast drying properties. The use of a disinfectant in an alcoholic solution is preferred for the disinfection of the operating area, with the exception of some products' contraindications, in particular for those not suitable for the mucous membranes for example.

If the operation requires the use of an electric scalpel, it is essential to wait until the disinfectant has dried completely before making the first incision.

## **CLOTHING OF THE SURGICAL TEAM IN THE OPERATING ROOM**

The attire of personnel in the operating room must prevent, as far as possible, the risk of dissemination of germs from their skin and hair. A tunic-trouser suit, with shoes reserved for the operating room, is normally recommended.

In 1999 the CDC recommended the wearing of a sterile gown, sterile gloves, and in the case of surgery with a needlestick injury risk, the wearing of two pairs of gloves.

The wearing of gloves has two purposes: to provide a barrier against the dissemination of the surgeon's and assistants' transient and resident skin germs, and avoiding contamination of the hands by blood and exudates from the operative wound. The wearing of two pairs of gloves considerably improves impermeability and reduces the risk factor in the case of a needlestick into the gloves. The drawback of this approach is that of discomfort and a loss in dexterity. The wearing of two pairs of gloves may be indicated for surgical procedures with a high risk of perforation, such as orthopedic surgery, in order to protect the surgeon's hands, in particular for his/her protection against the risk of viral contamination.

Ideally, the clothing worn in the operating room should be made of a disposable, non-woven material. It is recommended that the surgical team wear disposable sterile gowns, made of a non-woven material. The clothing should be completed by the wearing of a surgical mask.

All authors are in agreement in emphasizing that the wearing of over-shoes is not beneficial, all the more so since there is a real risk of contamination, when they are put on or removed. In France, the wearing of operating room shoes is normally recommended. Although no study has demonstrated a relationship between this practice and the risk of SSI, operating shoes provide wearer comfort and can protect the personnel from injury whenever a blunt or sharp-cutting object falls to the ground.

## **AIR CONDITIONING**

Air contamination (inert particles and microorganisms) is the reason for using an air-conditioning system, the aim of which is to provide clean air (filtration), to avoid the entry of contaminated air from neighboring zones (over-pressure), and to draw suspended particles and microorganisms (renewal or mixing rate) towards the exterior. There is a persisting debate on the control of air flow, between a non-unidirectional (turbulent) and a unidirectional (laminar) flow. Various studies carried out in the 1980's in class 1 surgery, in particular involving the implantation of a joint prosthesis,

suggest that the reduction in the incidence of SSI is above all related to antibioprophylaxis, and that the unidirectional flow provides an additional reduction only. In class 2, 3 or 4 surgery, since most infections find their origin in the patient's flora, the use of a unidirectional flow is thus not a decisive factor in SSI prevention.

## OPERATING ROOM DISCIPLINE

The aim of observing discipline in the operating room is three-fold:

- to avoid distractions which could adversely affect the correct execution of the operation,
- to avoid movements and drafts, which are a potential source of infection in clean surgery such as orthopedic surgery,
- to respect the principle of progressive asepsis.

To that end:

- the operating room doors must remain closed as far as possible,
- movements of personnel must be kept to the strict minimum,
- the operating environment must be respected, by limiting movements inside the room to the strict minimum (persons present, anesthetic team, nurses).

## DRESSING OF THE SURGICAL WOUND

Different types of dressing are available; practices and indications vary, according to surgical specialties and teams. Most surgeons opt for a dressing within 48 hours of the surgical procedure. The most important factor is the surveillance of the surgical wound.

## OTHER MEASURES

Strict control of the blood sugar level during the preoperative period, whether the patient be diabetic or not, is a recommended measure (the SSI rate doubles when the blood sugar level is higher than 2 g/l in the post- or perioperative phase).

Other preventive measures are currently under discussion: maintaining a constant body temperature during surgery (this has been proven in colorectal surgery), use of additional oxygen by means of perioperative ventilation. The efficacy of the perioperative use of local antibiotics (gentamicin cement in orthopedic surgery, gentamicin-collagen dressings in clean surgery) has not been demonstrated.

### Postoperative prevention

The wound must be inspected daily.

Dressing changes must respect the asepsis rules: hand hygiene using an alcohol-based handrub. After 48 hours, unless otherwise indicated, it is often possible to no longer make use of a dressing.

The application of creams, disinfectants or cosmetics is strictly contraindicated unless medically prescribed. The education of the patient and his/her friends and family is justified, and should include advice concerning local and general alert symptoms. Instructions in general hygiene practice should be provided to the patient.

Aspiration of drains is carried out in a closed system (suction drain); their manipulation is carried out under strictly aseptic conditions; the injection of any substance or medication must be avoided; they must be quickly removed.

## Recommendations

- R91** SSI surveillance should be implemented in the framework of the control panel for nosocomial infections, and according to one of the nationally recommended methodologies.
- R92** Report SSIs according to the criteria defined in the July 2001 decree defining the manner in which NIs should be reported.
- R93** Before any surgical procedure, a pre-operative shower (or toilet) should be requested, by observing the procedures decided by the relevant institution, in agreement with the surgical teams and the ICT.
- R94** To prepare the skin of the patient to be operated, if hair removal proves necessary, it should preferably be performed with clippers; except for contraindications, antisepsis should be applied in the form of an antiseptic alcoholic solution; the size of the disinfected area and of the draped operating field should be much larger than that of the incision area.
- R95** Provide the patient with antibioprophylaxis whenever this is found to be necessary, by observing the recommended procedures for administering antibiotics (product, dose, administration time, possible reinjection, duration).
- R96** Adhere to surgical hand disinfection procedures using an alcohol-based product, after washing the hands if they are visibly soiled.
- R97** Adhere to the wearing of specific clothing adapted to surgical procedures, to safety-based behavior (to be implemented according to the "patient safety in the operating room" check-list) and to the necessary discipline in the operating room.
- R98** Ensure appropriate air conditioning in the operating room, which should include filtration, overpressure, a renewal rate and flow control, which are adapted to the surgery to be carried out.

## Criteria for the evaluation of practices

- Preparation of the patient to be operated.
- Surgical antibioprophylaxis based on the criteria used by the HAS.
- Quality of hand hygiene in the operating room.
- Drafting of preoperative (anesthetic and surgical) records.

## Specificities

- In outpatient surgery, the patient is informed of the practical details of the surgery, during a consultation with the surgeon and the anesthetist, in particular with regard to the need to take a preoperative shower on the morning of the operation. One of the difficulties is to monitor SSIs, since patient follow-up often takes place only with his/her general practitioner.
- The use of interventional radiology must follow the same principles as surgery: pre- and perioperative asepsis. The installation of pacemakers and TIVC should observe the same principles.

## Research topics

### Surveillance

- Study of the effectiveness of surveillance.
- Innovative surveillance methods: repetitive prevalence surveys, introduction of hospital information systems.
- Impact of new interventional techniques (robotics).

### Prevention

- Methods for the preparation of operated patients, in particular the preoperative shower using an antiseptic product, compared with a mild soap.
- Study of the use of various antiseptic products for the preparation of the surgical field.
- Impact of screening for MRSA and identification of patients at risk.

### Dressing

- Usefulness of new types of dressing.

## Further reading

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# Infections associated with intravascular devices

## Rationale

The use of intravascular devices (IVD), peripheral venous catheters (PVC), central venous catheters (CVC) and totally implanted venous catheters (TIVC), affects an increasing number of inpatients, regardless of their type of stay, as well as outpatients. Thus, almost 25 million PVCs are inserted in France every year, and two thirds of CVCs concern hospitalized, non-critical care patients. The use of IVDs leads to the observation of local and general infections as well as bacteremia. According to the national survey on the prevalence of healthcare-associated infections 2006, infections associated with intravascular devices represent 10% to 20% of the total number of care-related infections and are most often linked to coagulase negative staphylococci, to *Staphylococcus aureus*, and to aerobic gram-negative bacilli. The duration of catheterization has an effect on the bacteria colonization mechanism. The initial risk is linked to the insertion, responsible for the so-called extraluminal contamination, whereas the prolonged use of catheters induces intraluminal contamination.

## Training, audit, surveillance

A prevention program allows a reduction to be achieved in the avoidable proportion of infections associated with IVDs, through the implementation of technical recommendations, the training of doctors and authorized paramedics, the education and evaluation of the practices of personnel (auditing of practices), and the surveillance of infections associated with such devices. Recent studies have demonstrated the effectiveness of these measures, grouped together in a bundle strategy. Evaluation of the implementation of measures can also be carried out in the form of a checklist at the time of insertion, consisting of both a reminder of the important prevention measures, as well as their degree of observance. A CVC checklist, such as that used in surgery, is in the process of being drawn up under the auspices of the French National Authority for Health (HAS).

The regulations designate the personnel authorized to carry out IVD insertion, as well as the rules for informing patients, in particular with regard to the infectious risk associated with the insertion of IVDs.

## Insertion of intravascular devices

The regulations specify that the use of safety equipment should be favored when it comes to the protection of personnel against infectious risk, for the case of PVCs and steel cannula devices in particular.

Since the risk factors for infection associated with short term IVDs are related primarily to the density of local flora, correct preparation of the insertion site, before IVD insertion, is essential.

For a CVC or a TIVC, maximum barrier precautions similar to surgical asepsis (the wearing of a cap, mask and sterile gown, surgical disinfection of the hands, extensive draping of the insertion site) are required before insertion. Antisepsis should be carried out using an alcohol-based antiseptic following, in general, the use of a deterative cleaning phase.

For the insertion of a PVC, the following practices are required: wearing of gloves in order to prevent blood and body fluid exposure (BBFE), hand hygiene before insertion, and implementation of antisepsis with alcohol-based antiseptics, preceded by a deterative cleaning phase. Nevertheless, for PVCs with a very short placement duration, taking into account the low risk of colonization of the catheter via flora on the skin's surface, the benefits of deterative cleaning are debatable, and if the skin appears to be clean, the local preparation of the site may be achieved by two applications of an alcohol-based antiseptic.

In order to limit the risk of contamination, the insertion site should be covered by a dressing, preferably transparent and semi-permeable, in order to facilitate regular inspection of the injection port, and keep the IVC in place.

In the case of CVC, the existing literature does not justify the systematic replacement of dressings. The replacement period proposed in the literature is usually 96 hours, although it may reach as much as seven days for some. In practice, this frequency is often related to the loosening or soiling of the dressing. The use of a sponge impregnated with antiseptic has recently been proposed. Generally, in order to limit the risk of contamination, any manipulation of the dressing or the venous catheter should be preceded by an alcohol-based handrub.

Tunneling and the use of cuffed-catheters have been shown to be preventive factors for long-term catheters.

The use of CVCs impregnated with antiseptics or antibiotics has been shown to be useful only within the context of a high infection rate. It is therefore recommended only in such cases and after having verified the implementation of the recognized preventive measures. The use of antibioprophylaxis at the time of insertion, or for the duration of catheterization, exposes the patient to the risk of bacterial infections with multi-resistant germs, as well as to fungal infections, and is therefore not recommended.

## **Manipulation of the intravascular device, tubing and stopcocks**

In order to limit the risk of contamination, the manipulation of the IVD, tubing and stopcocks must be carried out antiseptically, following prior disinfection of the hands.

The stopcock ramps need to be kept away from any possible source of contamination. There is no literature justifying the use of antiseptic junctions, or protective devices for junctions and stopcocks, in order to prevent the risk of infections associated with IVDs.

Good medication preparation and administration practices must be applied while preparing and managing the administered products. Because of the risk of bacterial proliferation, the duration for the administration of labile blood products and lipid-containing products should be limited, and the tubing used for administering these products should be changed with a frequency adapted to the type of product.

The frequency proposed in the literature, for the replacement of venous catheters, is every 96 hours (PVC and CVC) or even seven days (CVC).

The usefulness of antibiotic locks for PVCs has not been demonstrated. There is no scientific basis for preferring a specific strategy to maintain catheter permeability (heparin and guiding mandrel). Nevertheless, the rules relating to asepsis should be adhered to, regardless of the technique used for the maintenance of the catheter.

Concerning CVCs and TIVCs, the use of therapeutic antibiotic locks should be discussed, in accordance with the locally recommended protocols, and the patient's venous capital.

## Removal of the intravascular device

The risk of phlebitis and colonization increases with the duration of catheterization, which constitutes the main risk of infection. The insertion site should be monitored at least daily to inspect for local signs of infection.

Because of a stable immediate risk, a CVC may be left in place as long as is necessary for the patient's treatment, provided there are no local or general signs of infection.

In adults, it is recommended to not leave a CVC in place longer than 96 hours, except in patients with a limited venous capital, provided the insertion site is carefully monitored and there are no complications.

## Recommendations

### General measures

- R99** The indications for the insertion and maintenance of an intravascular device (IVD) are restricted whenever this is possible, by systematically preferring the oral or enteral route to the venous route, for the administration of medication or nutrients. The IVD should be removed once it is no longer indispensable.

- R100** The techniques for placing, managing and monitoring IVDs are disclosed in technical specifications or protocols, and are updated once new recommendations have been published. IVD placement and surveillance are carried out by authorized personnel. Ensure traceability of IVD placement in the patient's file: placement date, removal date, catheter type, insertion site, operator. Clinical surveillance of the IVD insertion site should be done on an at least daily basis (search for local symptoms).

### Training, audit, surveillance

- R101** Healthcare workers should be trained for IVD indications, placement procedures and IVD maintenance as well as for the prevention of IVD-associated infections. The patient shall be informed about the IVD-related infectious risk and should take part, in association with his/her relatives, in the prevention and detection of IVD-associated infections through adapted educational methods.
- R102** The practice of professionals in charge of IVD placement and maintenance is reviewed on a regular basis. Practice auditing is carried out using adapted tools, including a checklist both serving as a reminder and as an appraisal tool for the adherence to recommendations. The identification of practice errors, as well as information feedback to the healthcare team, are indispensable.
- R103** Continuous surveillance of IVD associated infections (bacteremias) is established in high-risk units (critical care and intensive care units). The results are expressed as the number of IVD associated bacteremias per 1000 catheter-days.

### Intravascular devices

- R104** Catheters made of polyurethane or fluoropolymers and stainless steel cannula devices are preferred. It should be noted that stainless steel cannula devices should not be used when administering a substance which may induce cutaneous necrosis (extravasation risk). Prefer safety devices when available and train carers in the use of such equipment. Antiseptic or antibiotic-impregnated catheters should not be used on a routine basis. Avoid antibacterial filters.

### Insertion site

- R105** In adults, for PVCs, favor an insertion site which is located on the upper, rather than the lower limbs. For CVCs, favor an insertion site which is located in the superior vena cava area (especially the subclavian route), whenever the expected catheterization duration exceeds 5-7 days; the femoral route, in spite of its greater infectious risk, may be used in cases of emergency. Ultrasound guidance, under the same asepsis conditions as conventional placement, by ensuring safe placement conditions, is believed to produce fewer infections.

**R106** Replace any catheter that has been inserted in a lower extremity as soon as possible. Do not insert a catheter in the vicinity of weeping infectious skin lesions, or into a limb on which lymph node dissection or radiotherapy has been carried out, or on which a malignant tumor has been diagnosed, or with an arterial venous fistula, or next to a joint, or with an orthopedic prosthesis or into a paralyzed limb.

**R107** "Degreasing" agents, such as acetone or ether, should not be applied before IVD placement. If necessary, remove hair with clippers, scissors, or depilatory cream (no shaving). If a topical anesthetic is required, favor single-dose presentations and apply the topical anesthetic before beginning skin preparation of the insertion site.

### Insertion of a central venous catheter or a totally implanted venous catheter

**R108** Do not administer antibioprophylaxis treatments or antibiotic ointments or creams during catheter placement or during catheter use. The placement of antiseptic-impregnated sponge is to be envisaged.

**R109** The placement of a CVC requires an environment, which should be adapted to the required asepsis level, and at best, to that of the operating room or intensive care unit. The placement of a totally implanted venous catheter (TIVC) is to be carried out surgically. Restrict the attendance of staff in the patient's vicinity to the strict minimum, when catheter insertion is carried out. Use a checklist.

**R110** Insertion is to be carried out by a trained operator wearing surgical garments (cap, surgical mask, sterile gown), with the help, in the case of TIVC, of an assistant wearing a clean gown, a head cap and a surgical facemask. Before placement, the operator carries out a surgical handrub and then puts on a pair of sterile gloves.

**R111** Skin preparation of the insertion site is performed in four steps: cleaning (antiseptic soap), rinsing (with sterile water), drying (with sterile pads) and antisepsis (with an alcohol-based antiseptic). Sterile drapes that are much larger than the catheterization area, are placed after the antiseptic has naturally dried. Tunneling is seldom used and cannot be subject to a formal guideline recommendation, although it offers advantages for the jugular and femoral sites. The IVD is firmly secured to the skin with a non-resorbable suture. Replacement by guide wire exchange should be carried out under the same aseptic conditions as insertion.

### Insertion of a peripheral venous catheter

**R112** No specific measure is required concerning the operator's garments. Before insertion, the operator is to carry out a hand hygiene procedure, and then put on a pair of gloves (as per standard precautions), which may be non-sterile if the insertion site is not touched after the antisepsis phase. The preparation of the skin at the insertion site is carried out in four steps: cleaning (mild soap or antiseptic soap), rinsing (sterile water), drying (sterile pads), and antisepsis (alcohol-based antiseptic). For PVCs with a short catheterization period,



when the skin is visibly clean, skin preparation may be carried out through two consecutive applications of an alcohol-based antiseptic. Wait until the antiseptic has dried out naturally.

## Dressing

**R113** Cover the IVD insertion site by using a transparent, semipermeable, sterile dressing made of polyurethane, to allow visual inspection of the IVD. Use sterile gauze with the sterile adhesive dressing in case of bleeding or exudation. Before exposure to water, temporarily protect the dressing with an impermeable material. Before manipulating the dressing, disinfect the hands (handrub). Proceed with dressing replacement only when it becomes loosened or soiled, or when inspection of the site is necessary, under the same conditions as during dressing application. Indicate the date of dressing replacement in the patient's file.

## Manipulation of the intravascular device, tubing and stopcocks

**R114** Reduce the number of manipulations as far as possible. Decontaminate the hands using an alcohol-based handrub before manipulating the IVD or components of the infusion device. Perform manipulations in an aseptic manner, with observance of the closed system concept. Disinfect the tips and stopcocks before they are manipulated, using a sterile gauze pad dipped in an alcoholic antiseptic. The use of needleless connectors is possible as long as they are disinfected before use. Install a new sterile stopper whenever the access site or the stopcock is opened. Place a sterile stopper on any unused stopcock.

**R115** Abide by the asepsis rules when preparing the liquids to be infused. Never use solutes with visible turbidity, leaks, cracks or particles of material, or with an overdue expiry date. Favor the use of disposable ampoules. Discard the unused contents of disposable ampoules. Manipulate the multi-dose vials under strict aseptic precautions, whilst adhering to the preservation conditions and durations. Clean the multi-dose vial stoppers with 70% alcohol before adding any material into the vial. Use sterile equipment for sampling the contents of the multi-dose vials. Discard any multi-dose vial with a compromised sterility.

**R116** Terminate the infusion of labile blood products within four hours after the beginning of administration. Terminate the infusion of lipid emulsions within 24 hours of the start of the infusion. Replace the tubing used after each administration of labile blood products and within 24 hours after administration of lipid emulsions.  
Abide by the antisepsis rules when using a heparin lock, continuous heparinization, a saline lock or a stopper.

## Removal and replacement of the intravascular device

**R117** Do not systematically change a CVC at regular intervals. Change a CVC by changing the site when purulence is observed on the insertion site or in case of suspected bacteremia on the catheter. The replacement by guide wire exchange of a CVC may be considered

when an infection is weakly or moderately suspected, in the absence of any clear local signs.

Replace a PVC as soon as possible, if non-aseptic insertion is suspected. Change the PVC insertion site every 96 hours and imperatively, in the case of signs of venous intolerance, local complications, or a suspected catheter-related systemic infection.

When an infection is suspected, carry out aseptic removal of the distal end of the catheter and send it to the laboratory for microbiological examination.

Change the infusion device (tubing and auxiliary items) whenever a catheter is replaced.

## Criteria for the evaluation of practices

### For peripheral venous catheters

■ A series of criteria for the evaluation and improvement of professional practices (CEAPP) developed by the French Society for Hospital Hygiene:

- Five traceable criteria that may be used notably within the framework of care reviews: existence and accessibility of a written protocol in accordance with the latest national recommendations for the insertion and maintenance of a peripheral venous catheter; traceability of the date and site of insertion in the patient's records; traceability of the removal of the catheter in the patient's records; duration of catheterization equal to four days or less; traceability of the daily clinical surveillance details (presence or absence of localized or general symptoms) of the insertion site in the patient's records.
- Six non-traceable criteria that may be used within an observational framework: the wearing of gloves for catheter insertion, immediate elimination of the catheter's guiding mandrel in a nearby container for sharp or cutting objects, hand disinfection procedure (hand rubbing with an alcohol-based product) immediately before catheter insertion, a detergic cleaning phase (washing with soap followed by rinsing) before application of the antiseptic, use of an antiseptic in an alcoholic solution, disinfecting of the tips and stopcocks before handling, with the help of sterile dressings soaked in an alcoholic solution.
- National audit on the insertion and maintenance of PVCs, developed by the Hospital Hygiene Assessment Task Force.

### For central venous catheters

- Checklist being drafted under the auspices of HAS.

## Specificities

■ For the use of antiseptics in children aged under 30 months, refer to the SF2H guide for antisepsis with children (*cf.* "Further Reading").

■ In onco-hematology or for prolonged catheterizations (>30 days), favor the use of TIVC.

■ In units where the incidence of infections associated with IVDs remains high, despite the implementation of preventive measures, discuss the use of antiseptic or antibiotic impregnated CVCs and the use of antiseptic impregnated sponges placed under the dressing in contact with the catheter.

■ With patients who have a limited venous capital, provided there is careful monitoring of the insertion site and there are no complications, it is possible to leave the PVC in place for more than 96 hours.

■ In nursing homes for the dependent elderly, when access is necessary, favor the use of subcutaneous access in accordance with the recommendations of the Observatory for infectious risks in geriatrics (ORIG) (*cf.* "Further Reading").

## Research topics

- Usefulness of the deterative cleaning phase.
- Usefulness of sponges or other devices impregnated with antiseptics.
- Indications for impregnated (antiseptics, antibiotics) catheters.
- Usefulness of non-antibiotic or non-antiseptic (ethanol) locks.
- Choice of antiseptics (chlorhexidine, povidone iodine, combination antiseptics).

## Further reading

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# Gastrointestinal sytem infections

## Foodborne illness outbreaks

### Rationale

Foodborne illness outbreaks (FIO) are defined by the occurrence of at least two similar grouped cases of general gastro-intestinal symptoms, the cause of which can be traced to the same food origin. They may in particular have symptoms in the form of vomiting, diarrhea, or a combination of both. They occur more frequently in public catering, from which around 11% of cases arise in hospitals.

The pathology may be due to the ingestion of food contaminated by a toxin, entero-toxin-producing or entero-invasive bacteria, as well as viruses or parasites, leading to a proliferation, and the risk of a secondary contamination.

Between 2006 and 2007, the most frequently found pathogens in France were *Salmonella spp.*, *Staphylococcus aureus*, *Bacillus cereus* and *Clostridium perfringens*.

A FIO in a hospital may affect both patients and staff. Several stages of food preparation and distribution may be responsible. This highlights the particular importance of applying quality procedures in the central kitchen, and to the meal distribution circuit (of the HACCP type, or other).

The identification of a FIO in a healthcare establishment leads to: i) compulsory reporting to the ARS (French Regional Authority for Health); ii) informing the health authorities (ARS and the Regional Nosocomial Infection Control Coordination Centre; and iii) initiating an investigation in the hospital. The investigation is usually carried out by the infection control team of the hospital concerned, in association with the ARS whenever possible. It seeks to identify the food sources potentially responsible for the FIO. The occupational physician of the hospital is informed if staff members are affected.

### Recommendations

**R118** The investigation of food-borne illness outbreak requires:

- checking the infection diagnosis and whether an epidemic has occurred;
- setting up ACPs in support of SPs, until the responsible pathogen has been identified and/or termination of the epidemic;
- considering temporary removal of the affected staff;
- defining the case, period, and concerned population;
- interviewing the affected persons in order to identify common food intake and formulate

a possible hypothesis as to the responsible pathogen. The onset of signs within several hours after ingestion would suggest a toxin-based origin (staphylococci), whereas an onset 24 hours after ingestion, or fever, or bloody diarrhea, would rather suggest enteral invasive bacteria;

- if needed, conduct a food-related interview by performing a case-control study (e.g. using the WINTIAC software developed by the InVS);
- computing the attack rate;
- constructing an epidemic curve;
- considering a microbiological analysis of the food ingested over the preceding days, samples of which must be preserved for five days in the institution's central kitchen (French Order of September 29th, 1997);
- sampling stools (or vomit) from a group of three to five patients having symptoms as well as from potentially infected staff.

## Criteria for the evaluation of practices

- Presence of an internal reporting procedure.
- Presence of a quality procedure for the central kitchen and the meal distribution circuit (HACCP or other) (cf. Chapter “environments and circuits”).

## Nosocomial gastroenteritis

### Rationale

Nosocomial gastroenteritis is defined by the occurrence of acute diarrhea (liquid stools for more than 12 hours) of infectious or unexplained origin, after 48 or 72 hours of hospitalization. Its incidence varies between 1% and 40%, depending on the patient populations studied. Nosocomial gastro-enteritis represented 2.9% of the total number of nosocomial infections in 2006.

These lead to an increase in hospitalization time of between 4 to 7 days for adults, 15 days for children and more than 30 days for elderly people.

The occurrence of nosocomial gastro-enteritis increases the risk of acquiring urinary tract or pulmonary infections. Contamination takes place via the orofecal route, from the hands of healthcare personnel, or indirectly via contaminated objects. Germ resistance promotes contamination: *Clostridium difficile* spores, rotaviruses or noroviruses can survive for several weeks on inert surfaces. The presence of *C. difficile* or rotavirus on the hands of healthcare personnel, whilst giving care to an infected patient, has been demonstrated.

Nosocomial gastroenteritis has some specific features, depending on the etiological organisms involved.

## Clostridium difficile associated gastroenteritis

In adults, there are mainly due to *C. difficile*, which leads to ordinary, non severe diarrhea and, more rarely, pseudomembranous colitis, which can lead to complications in the form of toxic megacolon, digestive perforation, septic shock and death. It occurs mostly in patients over 65 years of age, and, in more than 92% of cases, during the course of antibiotic therapy, in particular cephalosporins, amino-penicillins, clindamycin and fluoroquinolones. Numerous 'before and after' studies suggest that control of the use of antibiotics is essential to the prevention of the emergence of *C. difficile* infections (CDI). Antibiotic therapy destabilizes the flora barrier, allowing *C. difficile* to take hold and multiply. Toxin-producing species produce two toxins (A and B), leading to the destruction of enterocytes, an inflammatory reaction in the *lamina propria* and a fluid influx. Since 2003, severe *C. difficile* infection epidemics have been documented, and metronidazole therapy failure and recurrences appear to be on the increase. This evolution, and the concomitant dissemination in the Western world of a "hypervirulent" species called "NAP1" or "PCR ribotype 027", which has a higher sporulation capacity, is hyperproductive of A and B toxins *in vitro*, and secretes another toxin called binary toxin. The reference diagnosis relies on cytotoxicity tests of the stools, or the cultured production of a toxin-producing species. If an immuno-enzymatic test is used initially, the test capable of detecting both A and B toxins should be preferred. The sensitivity of immuno-enzymatic tests is 80% on average, such that a negative result should be interpreted with caution. *C. difficile* spores are resistant to alcohol. Soaps (antiseptic or not) have a limited effect. The environmental source probably plays an important role in *C. difficile* contamination: i) 20% to 59% of samples taken in the rooms of infected patients are contaminated; ii) *C. difficile* spores can survive on inert surfaces; iii) the spores are resistant to numerous disinfectants (alcohol, quaternary ammonium salt...); iv) daily disinfection with bleach significantly reduces contamination of the environment, and has been correlated with a decrease in the incidence of CDI, particularly in wards with a high endemicity. CDI epidemics have been documented following the sharing of rectal or electronic thermometers. Recent American and European recommendations specify and list these factors. Following a clinically successful treatment with metronidazole or vancomycin *per os*, approximately 30% to 40% of patients remain positive when tested for toxins, and/or in culture.

## Virus-associated gastroenteritis

Viral gastroenteritis mainly affects children and kindergartens, but also elderly, immuno-depressed patients or healthcare staff. The most frequently encountered viruses are the rotavirus, norovirus, calicivirus, astrovirus, coronavirus and adenovirus. Apart from the coronavirus, all enteric tropism viruses are nonenveloped and therefore relatively resistant to the use of antiseptic and disinfectant substances, particularly to chlorhexidine and quaternary ammonium salt. These viruses, the rotavirus in particular, are however sensitive to alcohol-based solutions. Rotaviruses are naked RNA viruses, involved in more than 75% of nosocomial diarrhea cases in children under five. Their incidence in France in children aged between one month and four years has been estimated at 9 for every 1 000 hospital days. The main risk factors are premature birth, slow growth, and the number of children sharing the same room. In France, these infections are more

prevalent during the winter months. Contamination is promoted through high viral excretion rates ( $10^{10}$  to  $10^{12}$  virus particles / ml of stools). Infections occur readily by way of epidemics in wards for children aged six months to two years, but also in long-term care, which can lead to the closure of wards. Infections due to the norovirus (old Norwalk-like viruses) are characterized by a digestive episode with a violent onset, with predominantly upper digestive signs (vomiting in more than 50% of patients), combined with diarrhea, which can affect hospitalized patients or retirement home residents. Although contamination is essentially foodborne (FIO), secondary patient-to-patient contamination has been documented. The incubation time ranges between 12 and 16 hours. Infections often cure spontaneously, but can involve rapid dehydration, particularly in elderly patients. Human-to-human contamination is facilitated by the persistence of the norovirus in the environment, and the possibility of it becoming airborne during the course of vomiting, which explains the explosive character of certain epidemics affecting healthcare staff not in direct contact with infected patients. Epidemics are often difficult to eradicate, because of the low infective dose (< 100 viral particles) and because of the virus's resistance to the disinfectants normally used in hospitals (it is resistant to a 10 ppm concentration of hypochlorite).

In June 2010, the AFSSAPS (French Agency for the Sanitary Safety of Health Products) issued its conclusions concerning the efficacy of alcohol-based products with respect to the human norovirus. Having studied the available scientific data, and following advice from an *ad hoc* group of experts, the AFSSAPS declared that it *"considers an alcohol-based product to be effective against the human norovirus, provided it complies completely with the European standard EN 14 476 (i.e. is effective against the adenovirus and the poliovirus) following the prescribed handrub duration. In case the product should respond only partially to the EN 14 476 standard (active only against the adenovirus and inactive against the poliovirus), an additional test on a sample virus (e.g.: the murine norovirus) according to the protocol for the EN 14 476 standard is then necessary, in order to demonstrate the product's efficacy on the norovirus"*.

## Other forms of gastroenteritis

Other etiological organisms (salmonella, shigella, campylobacter) are more rarely involved in nosocomial gastroenteritis infections in industrialized countries.

## Recommendations

### GENERAL MEASURES

**R119** Any patient hospitalized for infectious gastroenteritis should be maintained in an individual room until the infectious source of the diarrhea has been eliminated. SPs and ACPs should be applied. "Contact" precautions only apply to symptomatic patients and comprise:

- the geographical isolation of symptomatic patients in individual rooms with private bathrooms. If not possible, patients infected (by the same enteral pathogen) should be grouped together. During the time period of an epidemic, it is acceptable to group infected persons together in the same area of a healthcare unit and for the appropriate

care to be provided by specifically assigned medical and paramedical staff ("cohorting");

- informing persons entering the room of an infected patient (healthcare workers, outside professionals or visitors) about the precautions to be observed and the control measures to be taken. Signs displaying the precautions to be observed must be posted on the room's door and in the medical and nursing files. Visitors are warned not to use the patient's bathroom and must perform an appropriate hand hygiene procedure when leaving the room;
- the movement of infected patient outside their rooms (including transfers) should only be allowed when strictly necessary. The destination unit should imperatively be forewarned, so as to maintain the continuity of "contact" precautions;
- enhanced hand hygiene before and after any provided care, using, in order of priority, alcohol-based handrubs, except if alcohol appears to be ineffective with the responsible microorganisms (see specific measures: *C. difficile*);
- the use of disposable gloves preceded by an alcohol-based handrub before entering the room of patients suffering from nosocomial gastroenteritis (because the environment is often contaminated). Before leaving the room, the gloves should be discarded and the hands cleaned according to a procedure which is adapted to the relevant germ (see specific measures);
- the wearing of a gown:
  - of the long-sleeve, disposable type, when directly handling the patient, his/her excreta and environment,
  - which is put on when entering the room, replaced after a sequence of care, and removed before leaving the room,
  - to be supplemented with a disposable, impermeable plastic apron for care involving "splashing" or splattering;
- the use of disposable medical supplies, to be discarded with other infectious hospital waste. Potentially non-disposable supplies in direct contact with a patient (stethoscope, sphygmomanometer, thermometer, antiseptic vials, ...) should be dedicated to the concerned patient, maintained in his/her room until the measures are terminated and be disinfected at least once a day using a virucidal or sporicidal disinfectant according to the nature of the responsible germ;
- fast removal of stools, for incontinent persons, by removing the protections prevailing for infectious hospital waste, and for continent persons, using bed-pan washers, or if not possible, through disposal in the sewer system followed by disinfection of the bed-pan washer with a sporicidal or virucidal disinfectant, as appropriate. The use of hand showers to wash the bed-pans is not recommended, as it may promote spreading of

the pathogen into the environment, onto the garments and onto the carer, through splattering;

- daily biocleaning of the environment using a disinfecting detergent which is efficient on the infectious agent (whether of the virucidal or sporicidal type). This is all the more crucial when the environment of a patient suffering from infectious gastroenteritis is frequently contaminated. Isolation measures and the observance of "contact" precautions should be maintained until the end of the diarrhea episode.

## SPECIFIC MEASURES

### **C. difficile Infections (CDI)**

**R120** Washing the hands with water and soap is recommended, to mechanically eliminate *C. difficile* spores. Such washing should be followed by thorough drying, and then by an alcohol-based handrub in order to eliminate other bacteria which might have escaped the action of the soap, and to maintain the awareness of healthcare workers concerning the use of alcohol-based products.

**R121** After having been used on an infected patient, the medical equipment should be cleaned and disinfected with a sporicidal product. Alcohol should be avoided for the disinfection of stethoscopes between two patients. The sharing of thermometers is to be avoided. Biocleaning on at least a daily basis of floors and surfaces of the infected or colonized patient's room should be performed. This includes:

- thorough cleaning (detergent cleaning, rinsing) with disposable items, ending with passive drying;
- followed by disinfection using a 0.5% active chlorine sodium hypochlorite solution, that is, bleach diluted to 1/5 (1 liter of 2.6% bleach and 4 liters of water for a final volume of 5 liters, or 250 ml of the 9.6% solution in a serving carton and 4.5 liters of water), by observing a minimum contact time of 10 minutes.

**R122** In case of an epidemic or high incidence of CDI, it is recommended to update or implement a purposeful antibiotics prescription policy, specifically designed to avoid the prescription of risk-prone antibiotics (second- and third-generation cephalosporins, fluoroquinolones, clindamycin, amoxicillin/clavulanic acid), and which should include, *inter alia*, the measurement and monitoring of the intake of such antibiotics, expressed in DDD for 1000 hospital days.

**R123** In adults, the search for *C. difficile* should be performed on a routine basis for any stool culture that would have been prescribed after the third hospital day (the so-called 3-days rule). This increases the number of identified CDIs by 24%. A CDI diagnosis should also be considered when a post-antibiotic diarrhea occurs (simple diarrhea), but also in cases where an ileus is diagnosed along with fever, abdominal pain and leukocytosis (pseudomembranous colitis), in particular in elderly patients with prior antibiotic treatment

in the preceding months. The search for *C. difficile* or its toxins after treatment is to be forbidden. Routine screening of asymptomatic patients for *C. difficile* has never been proven to efficiently reduce cross-contamination.

**R124** Surveillance is an integral part of the CDI prevention program. It allows the health institution concerned to identify risk-prone units, monitor incidence rates, obtain an early warning of an epidemic, and assess the efficacy of the prevention measures. It should make use of the standardized definitions of infections described in recent European or French guidelines. Surveillance relies on microbiological laboratory data. The ratio of the number of infections to the number of hospitalizations or hospital days is computed. Attention should be focused on the difference between the community acquired and healthcare-associated case percentages, as well as on the proportion of severe cases (according to the accepted definitions), for which an increase may reveal the appearance of a new hypervirulent clone. The Infection Control Teams and Nosocomial Infection Control Committee should be notified by the microbiology laboratory or by the relevant clinical department, of an increase in the number of nosocomial diarrheas considered to be abnormal, and of each situation where the search for an A/B toxin has turned out to be positive, or when a toxinogenic strain of *C. difficile* has been isolated. It is imperative that the following information be reported to CCLIN and ARS as soon as possible, in compliance with the order of July 26<sup>th</sup>, 2001, and circular of January 22<sup>nd</sup>, 2004, by additionally specifying the potential need for external expertise:

- any severe case of nosocomial CDI,
- any clustered or epidemic CDI.

Any reported *C. difficile* infection should be accompanied with the shipping of the strain to one of the expert laboratories of the network built around the National Reference Centre for anaerobic bacteria and botulism screening, for expert analysis the aim of which is to determine whether the strain belongs to the epidemic clone 027. In the case of an epidemic, the ICT should implement a practical review of the care and hygiene procedures provided in the affected department(s), with support from the CCLIN and their regional branches, with, if necessary, specific focus being placed on the implementation of "contact" precautions, hand hygiene and biocleaning of the premises. Furthermore, a review of the antibiotic therapy practices should be carried out in collaboration with the Antibiotics Committee of the concerned institution, and with the antibiotics senior adviser(s).

## Gastroenteritis of viral origin

**R125** The measures to be imperatively implemented are as follows:

- do not use hand showers to clean bed-pans, because of the risk of producing contaminated aerosols;
- for enteric virus inactivation, use solutions that are active against naked viruses: bleach



or phenol derivatives such as triclosan. Seventy percent alcohol is effective against rotaviruses. Alcohol-based products are thus especially recommended for the control of rotavirus hand contamination;

- without delay, report the following information to the CCLIN and ARS, in accordance with the order of July 26th, 2001, and the circular of January 22nd, 2004, by additionally specifying the potential need for external expertise:
  - any clustered cases of a viral gastroenteritis epidemic,
  - any death related to acute gastroenteritis;
- send stool samples to the enteric virus National Reference Centre at the Dijon university hospital;
- in case of a norovirus gastroenteritis, the staff in charge of biocleaning should wear a mask;
- group activities should be suspended (in the pediatric or geriatric departments);
- parents must be educated in diaper handling in pediatric departments.

## Criteria for the evaluation of practices

■ Audit of “contact” precautions (individual room, the wearing of gloves, gowns, notice on the door and notes in the medical and nursing staff files).

■ Observance of hand hygiene: if hand hygiene must be practiced by washing with soap and water (*C. difficile* infections), it is important to clearly indicate the required duration.

■ Audit of biocleaning measures (frequency, products used, method and frequency of bleach preparation, check-list of surfaces to be cleaned...).

■ Audit of antibiotic prescriptions (conformity with local standards) in the case of an epidemic or a high rate of *C. difficile* infections.

## Research topics

■ The role of asymptomatic carriers of *C. difficile* in the transmission of certain strains has not been specifically evaluated. It is however suggested by the fact that the environment of these patients is often contaminated. Furthermore, infected patients who have been correctly treated can remain *C. difficile* carriers for several weeks. Currently, the isolation of these patients is a controversial issue.

■ It is not currently known whether antiseptic soaps are more effective than mild soaps for the elimination of *C. difficile* from the hands.

■ The usefulness of wearing gloves and gowns by visitors to prevent contamination by *C. difficile* has not been demonstrated.

■ The usefulness of an automatic alert system to report the re-admission of patients, known to have been previously infected by *C. difficile*, has not been evaluated; the answer is closely related to the role of asymptomatic carriers.

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# Maternity infections

Nosocomial infections in maternity are a reality, affecting both mothers and newborns. In France, the infection rates evaluated within the 'Mater South-West' network in 2008 were 0.8% following vaginal delivery and 2.7% following Caesarean section, the latter percentage having been halved over the past five years; in newborns the infection rate is of the order of 0.2%.

It is possible to control the infection rate in mothers and children, to improve staff safety by promoting epidemiological surveillance, and by applying best practice pre-, per- and post-delivery hygiene, and prophylactic antibiotic treatment.

## Rationale

### Main nosocomial infections and risk factors in maternity

**Endometritis:** Following vaginal delivery (0.2% to 0.7%) or Caesarean section (approximately 3%); the patient-specific risk factors associated with a good level of evidence are: premature rupture of the membranes (with the risk increasing with the duration of labor), hyperthermia during labor, dystocia requiring the use of instruments, intra-uterine monitoring, number of vaginal examinations, use of an emergency Caesarean section.

**Urinary tract infections:** in general 3% to 4% of new mothers (from 0.4% to 2% of vaginal, and as many as 6% of Caesarean deliveries, respectively); the major factor remains the use of an indwelling urinary catheter, with intermittent bladder catheterization presenting a lower risk; the presence of renal disease, diabetes, or a urinary tract infection in the mother during pregnancy are risk factors, as are induced labor and Caesarean sections.

**Surgical site infections:** concerning the Caesarean wound (1% to 11%), vaginal deliveries, or episiotomies (0.2%); the patient-specific risks with a good level of evidence are premature rupture of the membranes (the risk increases with the duration of labor), obesity, intra-uterine monitoring, pH of the scalp, emergency situations, or a significant blood loss.

**Infections in newborns:** are accounted for by eye infections, skin infections and umbilical cord infections, but also by more serious infections (meningitis, osteoarticular infections, and generalized sepsis).

**Breastfeeding:** whereas it should generally be encouraged, in some situations breastfeeding can present a risk of infection for the newborn. The transmission of viruses from mother to child via the mother's milk is high for retroviruses (HIV and HTLV), and is a contra-indicator for breastfeeding; with the hepatitis B (HBV) virus, breastfeeding is possible after serovaccination of the newborn; with the hepatitis C (HCV) virus, breastfeeding should be discussed according to the mother's virological markers. Breastfeeding requires verification of the mother's serology (HIV I and II, HVC, HVB, HTLV I and II) (compulsory). Oral herpes is not a contra-indicator for breastfeeding. The varicella zoster virus (VZV) is not a contra-indicator for breastfeeding if the mother has shingles, as long as she is immuno-competent and her breasts are free of skin lesions; other

situations involving VZV should be discussed with the pediatrician. If the mother had active tuberculosis during pregnancy, and has received appropriate treatment, she may breastfeed without being separated from her child; if this is not the case, breastfeeding is temporarily contraindicated, and the child is separated from its mother.

**Infectious risk for staff:** attention should be drawn to the high frequency of accidents through blood and body fluid exposure (BBFE), and to the amniotic fluid in obstetrics, especially in the case of emergencies, of manual delivery, hemorrhaging during delivery, and suturing of the perineum, for which the use of blunt suture needles reduces the risk of injury by 71%. In the absence of the use of a needle-holder, suturing of the perineum is the most common cause of BBFE in midwives.

## Epidemiological surveillance

This is an important element for prevention, and the evaluation of implemented actions; its usefulness has been studied in the reduction of the number of surgical site infections during Caesarean sections (associated with a 30% to 40% reduction in infection rate). Staff adherence to the national BBFE surveillance network (RAISIN-BBFE) (RAISIN = '*National program for early warning, investigation and surveillance of healthcare-associated infections*') contributes towards a clarification of the mechanisms through which accidents occur, and to the implementation of appropriate equipment and practices.

Exceptional, specific or serious incidents should be reported in accordance with the regulations.

## Prophylactic antibiotic treatment

**Prevention of surgical site infections:** the usefulness of prophylactic antibiotic treatments has been well established in the case of urgent and non-urgent Caesarean sections. In other situations, including obstetric interventions, the usefulness of prophylactic antibiotic treatments has not been proven.

**Prevention of infectious endocarditis in the mother:** this is indicated in the case of premature breaking of the waters and if labor began more than six hours before admission, for women giving birth by vaginal delivery and having a high risk cardiopathies (prosthetic valves, cyanogenic non-operated congenital cardiopathies and surgical bypass, or a history of infectious endocarditis).

**Prevention of a streptococcal B infection** (of uncertain nosocomial character): the usefulness of a prophylactic antibiotic treatment for streptococcus B during labor has been demonstrated for women who have tested positive, or who have a neo-natal infection history, or who experienced a streptococcus B bacteriuria during pregnancy. Moreover, such prophylactic antibiotic treatment also appears to be associated with a reduction in the rate of endometritis and urinary tract infections.

## Recommendations

### Epidemiologic surveillance

**R126** Organize surveillance:

- of SSIs and endometritis in women undergoing caesarean section, preferably with a post-hospital follow-up, by at least integrating the data from patients returning to the maternity units for infectious reasons;
- of UIs and endometritis for vaginal deliveries;
- of infections in neonates.

**R127** Implement a warning and reporting system to detect unusual and/or severe infectious events in parturients and newborns (e.g.: *Streptococcus pyogenes* infections).

### ANTIBIOTIC PROPHYLAXIS

**R128** Perform antibiotic prophylaxis for any caesarean section, using an intravenous route and after cord clamping. In the presence of a B streptococcus infection risk, perform antibiotic prophylaxis as soon as possible during delivery. When no search for the B streptococcus has been performed, per-partum antibiotic prophylaxis should be carried out in case of pre-term birth, rupture of membranes after 12 hours, and for mothers with fever above 38°C (100°F).

### GOOD PRACTICE FOR HYGIENE AND THE PREVENTION OF INFECTIOUS RISKS

#### General Hygiene Measures

##### Hand hygiene

**R129** Carry out hand hygiene procedures inbetween any two patients, be it mothers or infants, between two different care acts on the same patient, before putting gloves on, and immediately after removing them. Use an alcohol-based handrub for dry, powder-free and non-soiled hands.

##### Individual protection garments and equipment

**R130** Midwives or obstetricians should wear a surgical mask when membrane rupture occurs during any genital procedure carried out in front of the parturient (vaginal inspection, vaginal sampling, delivery...), wherever the delivery takes place, including at home.

Midwives or obstetricians should wear surgical garments (surgical masks and eye protections, sterile gowns, caps, dedicated shoes) for any invasive procedure during pregnancy, in the delivery room and in the operating room.

## Measures during pregnancy

### Ultrasound inspection (intravaginal, abdominal)

**R131** Use an appropriate protective disposable sheath for any intravaginal ultrasound examination. Treat ultrasound probes between two patients, whether abdominal or vaginal, even if protected. Use sterile ultrasound gel in unidose packaging for intravaginal ultrasound examinations, and ultrasound gel in daily renewed 250 ml cans, for abdominal ultrasound examinations.

### High-risk intrauterine interventions through the abdominal route (amniocentesis, trophocentesis)

**R132** Ask the patient to take a shower before the procedure. Perform a pre-operative skin preparation (detergent cleaning, rinsing, drying, antiseptics allowing the antiseptic to dry spontaneously). Perform the procedures under aseptic surgical conditions (premises, surgical disinfection of hands, surgical garments for the operators, sterile material and drapes, disposable sterile protective sheath for the ultrasound probe, sterile unidose gel).

### High risk intra-uterine interventions through the vaginal route (trophoblast biopsy)

**R133** Perform vulvoperineal and then vulvovaginal antiseptics before any procedure on the fetus during pregnancy, during labor and before expulsion. Perform these procedures under surgical asepsis conditions.

## Measures to be taken during delivery

### For all parturients

**R134** Restrict the number of vaginal manipulations, in particular after membrane rupture. Perform antiseptic vulvoperineal cleansing before the first vaginal examination. Perform vaginal examinations with a sterile, disposable finger stall after membrane rupture. When a urinary catheter is required, prefer evacuation tubing.

### Vaginal birth

#### PREPARATION AND PLACEMENT OF AN EPIDURAL CATHETER

**R135** Before placing an epidural catheter, prepare the skin (detergent cleansing, rinsing, drying, antiseptic treatment, waiting until the antiseptic has spontaneously dried). Perform the epidural or spinal anesthesia under surgical aseptic conditions (surgical disinfection of hands, surgical garments, sterile gloves, wearing of a surgical mask).



## EUTOCIC DELIVERY

- R136** Perform an antisepsis procedure on the perineal region, followed by the anal regions; if hair removal is necessary, use clippers or scissors (trimming). Wear surgical garments (with a mask and eye protection), surgically disinfect the hands by rubbing, use double sterile gloves for delivery, and long-sleeved sterile gloves in case of removal of retained placental tissue. Use a sterile delivery kit and sterile drapes. When episiotomy is required, use sterile scissors which should be discarded immediately after use. Unless a particular examination is required, discard the placenta through the IW circuit using an appropriate container.

## PARTICULAR SITUATIONS

These include: the placement of intra-uterine pressure devices, fetal oximetry, artificial delivery, removal of retained placental tissue, artificial rupture of membranes, placement of scalp electrodes, intra-uterine per-partum manipulations, assisted extraction (forceps, spatula, vacuum extractors), perineal repair.

- R137** Perform vulval, perineal, vaginal antisepsis, depending on the type of act. Carry out the procedure under surgically aseptic conditions. Use sterile medical devices (amniotome, electrodes, forceps, scissors, clamps) and sterile consumables (delivery sets, drapes, gauze, pads). Do not wet the forceps cups with an antiseptic solution. Refrain from using equipment that has been previously employed for episiotomy when performing perineal repair.

## Cesarean delivery

- R138** Have the parturient take at least one pre-operating shower for planned caesareans. Do not shave pubic hair (if hair removal is required, use clippers or trimming). Prepare, including the case of urgent caesarean sections, the skin of the lining (cleansing, rinsing, drying, antisepsis), preferably with alcohol-based antiseptics. Observe surgical antisepsis (premises, operators' garments, surgical disinfection of hands, double sterile gloves); protect the uterus with sterile drapes when it is exteriorized. Replace gloves after fetal extraction and/or removal of retained placental tissue.

## NEONATES IN THE DELIVERY ROOM

- R139** Use an alcohol-based handrub before touching the neonate. Treat the cord with an antiseptic before cutting, and use new sterile scissors to cut the cord. If a maternal-fetal infection is suspected, take several microbiological samples (gastric fluid and one or more peripheral sites, preferably the ears and the anus) to make sure that any later infection is not nosocomial.

## POSTPARTUM MEASURES

### Mother

#### VULVOPERINEAL CLEANSING AND PERINEAL CARE

- R140** Perform a daily check of the condition of the perineum, the quantity, nature and odour of lochia. Ask the parturient to carry out the vulvoperineal cleansing herself, as soon as possible.

#### BREASTFEEDING HYGIENE AND BREAST CARE

- R141** Assess the breastfeeding-associated infectious risk. Encourage breastfeeding, since only an unexplained maternal fever would be a temporary contra-indication. In case of unexplained coughing or herpes affecting the mother, ask her to wear a surgical mask when she breastfeeds and provides care to the infant. Explain why appropriate body hygiene, and especially hand and breast hygiene, are important for the parturient.

### Neonate

#### CORD CARE

- R142** Create, validate and publicize a protocol pertaining to cord care, specifying hand hygiene, substances and materials to be used, and the corresponding techniques.

#### HYGIENE OF INFANT FORMULA ROOMS IN MATERNITIES

- R143** Implement an organization and define relevant procedures.

#### USE OF ANTISEPTICS IN THE PREMATURE AND NEONATE

- R144** Do not use povidone iodine, 70% alcohol, 0.5% alcoholic chlorhexidine, substances containing camphor, in the premature and infants below the age of one month. Use low alcohol chlorhexidine as well as chlorine-based antiseptics. Prefer products in single-use sachets.

## PREVENTING BLOOD EXPOSURE ACCIDENTS

- R145** Use double pairs of gloves for delivery, long-sleeved gloves for uterine scar revision, and gloves to manipulate the infant. Protect professional clothing and the face of healthcare workers from splashing (disposable aprons, facemasks or surgical masks with protective goggles). When compatible with the chosen episiotomy technique, for suturing an episiotomy, use blunt curved needles which mounted on a needle carrier. Dispose of sharp objects in specific containers specifically designed for hazardous objects, as close as possible to the point of use.

## Criteria for the evaluation of practices

- Participation in a surveillance network (MDRO-SSI and/or Mater network).
- Prophylactic antibiotic treatment practices.
- Wearing of a surgical mask in the labor, birthing and Caesarean rooms.
- Hand hygiene (GREPHH - 'Hospital Hygiene Assessment Task Force' - national methodology).
- Mucocutaneous preparation, according to the type of act.

## Research topics

- Usefulness of prophylactic antibiotic treatment for vaginal deliveries, in the case of obstetric interventions.
- Microbial ecology in maternity wards and the impact of prophylactic antibiotic treatments.
- Prevention of streptococcus A: efficacy of recommendations, usefulness of the rapid diagnosis test for streptococcus A of the throat in maternity wards, in the case of dysphagia or a fever > 38 °C.
- Post-partum endometritis: should it always be considered as a healthcare-associated infection?

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# Skin Infections

Not all skin afflictions are infections, but they are all conducive to either colonization of the skin by exogenous microorganisms, or the growth of skin flora already present.

In fact, the skin is naturally and normally rich in microorganisms. These microorganisms constitute the skin's ecosystem or “commensal skin flora”. In general, a distinction is made between permanent endogenous flora (residential flora) and exogenous flora (transitory flora). These flora vary both qualitatively and quantitatively, depending on: their location on the body (they are more prevalent in hot and humid zones); the quality of the epidermis; the interaction of germs (destabilization of the commensal flora due to prophylactic antibiotic treatment, oestro-progestatives ...); environmental factors (humidity is conducive to negative gram bacteria); and the host (immunity deficiency, diabetes, age...).

The role of this skin ecosystem is to maintain a balanced environment, and it constitutes an effective barrier against the implantation of pathogenic microorganisms. It is supported by the epidermis (the upper layer of the skin). Skin that has been broken aggressively in any way allows for deeper penetration of endogenous or exogenous microorganisms into the second or third layer of the skin, which can lead to a generalized infection.

The superficial localization of the microorganisms leading to skin infections promotes transmission by (direct or indirect) contact, and the general prevention of their dissemination involves the implementation of standard precautions, if necessary in combination with additional 'contact' type precautions (*cf.* Chapter on cross contamination).

The purpose of this chapter is to illustrate, by way of a few examples, skin infections of parasitic, bacterial or viral origin.

## Parasitic skin infections

### The example of scabies

#### Rationale

Scabies is a common, cosmopolitan parasitic skin infection, caused by the *Sarcoptes scabiei* var. *hominis* mite. It is exclusive to human beings. The adult mite cannot survive more than one to two days outside its host at room temperature. It becomes immobile below 20°C, without dying (survival is two days at 20°C). It is able to survive for up to three weeks in a very humid environment, at a temperature between 10°C and 15°C. However, the mite is killed at temperatures over 55°C (10 minutes at 50°C).

Scabies is generally transmitted by recently fertilized females. However, the destruction of skin



burrows through scratching can lead to contamination by older females. In view of their high mortality rate, the immature stages (larvae and nymphs) are responsible for contamination only when present in very high numbers. The dissemination of the parasite is promoted by collective living arrangements and promiscuity. It can occur through:

- direct transmission, responsible for contamination in 95% of cases, either by:
  - contact between one person and another: the mite can thus introduce itself into the epidermis of the new host (for healthcare staff, skin to skin contact arises essentially through nursing care);
  - sexual transmission: scabies is a sexually transmitted infection (STI);
- indirect, more difficult transmission, via the environment (essentially washing and bedding): the living mites found in the environment, weakened and malnourished, take longer to penetrate the skin and are less infectious. However, even though this type of transmission is rare, it should not be discarded, especially in collective living environments, especially since the hyperkeratotic forms of scabies (rich in parasites) facilitate transmission.

Scabies thrives in the form of epidemics in institutions (retirement homes, hospitals, prisons...). A scabies epidemic is characterized by two or more cases of scabies, as diagnosed by a medical practitioner. Two clinical forms can be observed:

- common scabies: the scabies burrows are the pathognomonic sign of scabies;
- profuse scabies: the most contagious forms such as hyperkeratotic or crusty scabies, so-called 'Norwegian scabies', or inflammatory disseminated scabies

The semiotics may be misleading, in particular in elder people who live in retirement homes or in long-term care: the back, the scalp and the face may be affected.

Although the treatment of cases during epidemics has not been the subject of comparative tests, there are numerous studies favoring the use of ivermectin to control the epidemic, with a dose of 200 µg/kg on an empty stomach, which according to the studies, should be repeated systematically after two weeks.

For profuse scabies, at least two applications of a topical scabicide should be used, together with a course of ivermectin, which may be repeated.

Nosocomial scabies can affect both patients and healthcare personnel. For nosocomial scabies, a delay of one to six weeks is retained as probable, with confirmation for investigation and research of the index case. For staff, a case is considered to be nosocomial if a definite or probable case of scabies exists in the hospital, and if contact could have occurred with this case. It should also be noted that nosocomial scabies may be diagnosed in one hospital and have been contracted in another; the absence of an index case within the hospital is therefore possible.

## Recommendations

### **R146** Managing an isolated case:

- the application of SPs is an efficient barrier against parasitic transmission;
- observe CCPs before any confirmed or probable case of scabies, to prevent spreading of the parasitosis;
- imperatively wear non-sterile disposable gloves and a short-sleeved gown for any long-lasting continuous contact with the patient or contaminated object;
- perform simple hand washing so that, on rinsing, parasites on the surface of the skin are physically removed (non-acaricidal alcohol-based products do not kill mites at certain stages of their growth cycle on the surface of the skin);
- handle potentially parasite-infested laundry with care, without placing it on the floor; treat it with antiparasitic products and transfer it to the treatment service without intermediate storage;
- in the case of a profuse form of scabies, apply supplementary disinfection measures with an acaricidal of the APAR® type, following cleaning on D1 at the beginning of treatment; treatment of the surrounding environment is not indicated for common scabies.

### **R147** Management of an epidemic (two or more cases of scabies, diagnosed by a physician):

- set up a crisis team aimed at assessing the seriousness of the epidemic, choosing a therapeutic strategy whilst taking organizational constraints into account, organizing the information of patients, relatives, staff and outside workers, setting the missions and responsibilities of all concerned, and establishing recommendations;
- select the date at which handling of the epidemic should begin (treatment of patients and surrounding environment), only when all of the required logistic resources are available;
- implement surveillance aimed at screening other cases (patients whose clinical signs would not have been noticed or would have been wrongly interpreted);
- report the epidemic.

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## Bacterial skin infections

### Examples of pyogenous/ pus-producing infections:

*Staphylococcus aureus*

and *Streptococcus pyogenes*

## Rationale

Bacterial skin infections are common, and mostly benign, but have the potential to develop into serious infections, either because of the terrain or due to the bacteria's own virulence (particularly through the production of toxins). Indeed, bacterial proliferation triggers the production of enzymes and toxins (germ virulence factors), potentially leading to the expansion of the infectious source, and even to septicemia. These numerous toxins and enzymes destroy the cells and produce pus: the germs are referred to as being pyogenous.

### *Staphylococcus aureus*

These germs are very widespread in nature. It is estimated that 20% to 75% of individuals are *S. aureus* carriers (persistent, occasional or transitory). *S. aureus* infections are very frequent and present with varied localizations and clinical aspects. The germ most often penetrates the

organism following breakage of the skin barrier (injury, catheter, surgery, burns....), or at the hair follicle. *S. aureus* has been shown to be resistant to methicillin since 1961, practically coinciding with the appearance of this antibiotic on the market. Since then, the MRSA (methicillin-resistant *staphylococcus aureus*) has been prevalent in healthcare institutions. It is even one of the indicators on the nosocomial infection checklist. MRSA are however also currently present in the community. We thus distinguish:

- MRSA in hospitals:
  - hosted by persons staying or having stayed in a hospital, or by staff in contact with these infected or colonized persons,
  - disseminated through (direct or indirect) inter-human cross contamination, triggered by mostly asymptomatic and long-term carriage.
- Community-associated CA-MRSA:
  - acquired independently of care,
  - producing a necrotizing / flesh-eating toxin (Panton Valentine leucodine),
  - essentially responsible for skin infections,
  - transmitted through skin-to-skin contact, promoted by promiscuity, or a high level of physical contact (sportspeople).

### ***Streptococcus pyogenes***

The Group A Streptococcus (GAS) is also responsible for extremely varied skin infections. This is a strictly human germ. It is found essentially in the nasopharynx and in skin lesions. Contrary to *S. aureus*, its sensitivity to antibiotics, and to penicillins in particular, has been preserved.

The GAS is transmitted through direct or indirect contact of the mucous membranes with the hands or objects that have recently been soiled by oropharyngeal secretions or by skin lesions of an infected or carrier patient.

The skin pathology can take varied invasive and non-invasive forms: erysipelas, impetigo, pyodermitis, cellulitis, necrotizing dermo-hypodermatitis (or necrotizing fasciitis). The symptomatology is acute, with fever and localized signs; the progression of serious forms can be very rapid: toxic streptococcal shock syndrome, and even death. Factors increasing the risk of invasive infection are age (over 65 years), progressive varicella, extensive skin lesions (including burns), intravenous toxicomania, progressive diseases (diabetes, cancer, diseases of the blood; HIV infection, weakness of the heart) and corticosteroid therapy.

The risk of contracting a GAS strain increases with the proximity and duration of contact with the patient: members of the family, people having been in close contact.

Since the implementation of the reporting of nosocomial infections (NI) in July 2001, up until June 2005, 59 reports (87 cases) of NI-associated Group A streptococcus were recorded by the French Institute for Public Health. Among the declared cases, 17 were surgery-related infections, and 37 were post-partum-related infections. Of the 87 cases, 12 died with the deaths being directly attributable to the NI.

## Recommendations

**R148** Bacterial skin infections are mainly transmitted through cross-transmission; as a result, it is appropriate to:

- apply SPs;
- organize a warning system for MDROs (e.g.: MRSA) or epidemic bacteria which may lead to severe infections (e.g. *Streptococcus A.*) using, when available, tools enabling rapid diagnoses, which optimize screening and early treatment;
- apply CCPs when required (see the cross-transmission section);
- define the conduct to be followed in case of an epidemic (see the section about treatment and controlling healthcare-associated infections);
- report clustered cases (see the chapter on reporting).

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# Viral skin infections

## Examples of *herpesviridae*: (varicella, herpes zoster, herpes)

### Rationale

The herpes and varicella zoster (VZV) viruses are DNA viruses, which are capable of remaining in a latent form throughout the lifetime of infected persons. This latent state is asymptomatic. Under certain conditions, the virus can reappear through activation (recurrence or resurgence). The VZV produces varicella (chicken pox) following initial contact, and herpes zoster during any following appearances.

### The varicella zoster and herpes zoster viruses

These are transmitted by close contact with an infected person, through skin lesions, and also by inhalation of projected respiratory droplets during coughing or speaking. The virus penetrates the nasopharyngeal cavity and the conjunctiva. Propagation to the skin and mucous membranes occurs through viremia. The incubation period is from two to three weeks. The aerosol is contaminating two to three days before the appearance of the exanthema, and this mode of contamination has been demonstrated for varicella as well as for herpes zoster. An even brief face-to-face contact can produce contamination. The analysis of air samples using PCR (polymerase chain reaction) in the room of patients affected by varicella or herpes zoster has revealed the presence of the virus at distances as great as five meters from the bed, and sometimes even outside the patient's room: this detection of the viral DNA does not imply that it is infectious, since only the full enveloped virion can be infectious.

Although varicella is a classical childhood illness, cases of varicella in adults are on the increase, which explains the high incidence rate of nosocomial cases, in patients as well as hospital staff. The illness often becomes severe in adults, immunosuppressed patients, pregnant women and newborns. Similarly, in immunosuppressed infants, varicella can have a malign form with generalized viral dissemination.

Herpes zoster is a manifestation of the reactivation of the latent varicella zoster virus. The vesicles are limited to the area of skin in the vicinity of a sensitive nerve (intercostal, cranial ...); a non-visible development, with radiating pain and no exanthema, is possible. The occurrence of herpes zoster in an elderly person in a nursing home is not currently an indication for his/her isolation. This could be re-visited following recent publications. In a retirement home, several cases of varicella were thus diagnosed in patients and healthcare personnel, within a short period of time following the appearance of herpes zoster in one of the patients. This study would thus favor the "air" isolation of patients affected by herpes zoster.

### The herpes virus

This is responsible for frequent infections, which are mostly benign (e.g. "cold sores"). They are due to two serotypes of the virus: the herpes simplex 1 virus (HSV-1), and the herpes simplex 2 virus (HSV-2). Classically, the first type is transmitted orally and the second through sexual



contact, although this 'geographic' differentiation is not always applicable. The reservoir is strictly human. The incubation period is from two to twelve days. Recurrences can be symptomatic or asymptomatic. In both cases, they are a potential source of contamination for other nearby persons. As for 'nosocomial' cases, genomic studies of various strains have shown that these are generally due to recurrences, rather than to a real acquisition of exogenous strains.

The HSV virus is fragile, and can survive only for a limited period of time outside the host. Its infectivity under experimental conditions has a short duration (1 to 2 hours on most inanimate surfaces, and 72 hours on a moist dressing).

The newborn is particularly sensitive to herpes infections. Neonatal herpes exposes the host to death or neurosensory impairment. The newborn can become contaminated *in utero* (hematogenously, following a maternal infection), during birth, or during the post-natal period. The most commonly encountered mode of infection is that occurring during birth (two thirds of cases), through direct contact with infected maternal cervico-vaginal secretions. Infections acquired during the post-natal period can be nosocomial, if the transmission is related to a person from the healthcare personnel, another infected newborn, or to contaminated equipment. It should be noted that cases of indirect transmission through non-disinfected medical equipment are exceptional. It is thus important to avoid any contact of the newborn with herpetic lesions. Standard precautions must be observed. Povidone-iodine, proposed by some in the form of an eyewash or a bath, is contraindicated for newborns. Breastfeeding is contraindicated in the case of herpetic lesions of the mother's breasts or nipples. More distant lesions must be covered.

## Recommendations

**R149** Since varicella is no longer only an infant illness, a preventative strategy must be established in the relevant institutions, by associating occupational healthcare in order to:

- screen seronegative staff upon hiring and propose their vaccination;
- apply SPs;
- apply ACPs (single room, closed door, or even negative pressure room if possible) and CCPs for the varicella or zoster herpes cases;
- maintain isolation until the lesions become crusty;
- limit displacements of the index case (or cases);
- identify the exposed individuals, check their immunity, isolate receptive persons and set up the therapeutic management (by resorting to an infectious diseases specialist or a physician in an occupational health service).

**R150** The herpes simplex virus is mainly transmitted by contact, and it is therefore appropriate to:

- apply SPs;
- avoid, in the neonate or pediatrics unit (hematology, oncology), any direct contact between healthcare workers having recurrent herpes and the patients;
- set up a protocol for treating mothers who deliver, with ongoing or previous herpes conditions;

- establish a close clinical surveillance in the first month of life in neonates exposed to an herpetic infectious risk;
- apply the appropriate procedures to disinfect equipment, or use disposable equipment.

## Further reading

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## Specific cases

### The example of pressure ulcers

#### Rationale

Pressure ulcers are lesions of ischemic origin, associated with the compression of soft tissue, between a hard surface and a bony protuberance. Pressure ulcers are also described as an internal "outer wound", of conical shape, with a deep base and of multifactorial origin, which differentiates them from cutaneous abrasions. There are four pressure ulcers stages, ranging from simple redness, to particularly serious forms, which can reach the bone. It is a common pathology in hospitals, which frequently affects patients with a reduced mobility. Geriatric, neurology, physiotherapy, critical care and surgery wards have a large number of patients at risk of bedsores. Their prevention can be efficient, whereas the curative treatment of a bedsore is long, costly and uncertain. Neither antiseptics, nor antibiotics can be used for their prevention.

Indeed, this type of cutaneous lesion favors bacterial colonization, even though it is not, strictly speaking, an infection. The preservation of the commensal flora colonizing the wounds is essential, since it contributes to debridement and granulation. The natural debridement of the cutaneous flora is a long process, taking approximately three weeks, which involves the formation of a putrid accumulation, which may not be a sign of infection.

An infection may nevertheless be present. This is to be suspected according to local signs, confirmed by more than  $10^5$  germs/ml (or gram of tissue) in samples (puncture or biopsy fluid) and/or hemoculture. There is a risk of propagation of the infection to the bone, or of septicemia. The usefulness of antibiotics and local antiseptics, in the absence of a pressure ulcer infection diagnosis, has not been demonstrated. Systemic antibiotic treatment, adjusted according to the antibiogram, must be applied, in the context of a global medico-surgical strategy, whenever a bedsore infection is confirmed.

There is a lack of information concerning the necessary level of evidence for the evaluation, prevention and treatment of pressure ulcers. Research into pressure ulcers is too often limited to therapeutic trials of isolated products; it would be highly beneficial if this could be extended to fundamental and clinical research.

## Recommendations

**R151** The main actions to be performed are to:

- identify patients at risk;
- identify risk factors (using clinical assessment and a validated scale);
- carry out a re-assessment whenever the patient's condition changes;
- observe the skin's condition on a regular basis;
- involve the patient, relatives and friends;
- set up preventative measures:
  - reduce pressure (mobilization)
  - use supports,
  - maintain skin hygiene,
  - prevent maceration,
  - adapt the nutritional balance;
- provide initial training to all physicians and healthcare workers in the prevention and treatment of bedsores.

## Further reading

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# PROFESSIONAL RISKS

## (BBFE, tuberculosis) and vaccination

### Blood exposure accidents

#### Rationale

#### Blood exposure accidents (BBFE) in France

Any form of contact which is percutaneous (needlestick injury, cut) or mucous (eye, mouth), or occurs on injured skin (eczema, wound), involving blood or a blood-containing body fluid, is defined as a blood or body fluid exposure accident (BBFE).

Since the 1990's, numerous preventative measures have been taken to limit the risks of BBFE during nursing acts, intravascular interventions in particular, which carry the greatest risks. In France, the incidence rate of needlestick injuries for nurses in general medicine and critical care has been reduced by a factor of four over a period of ten years, according to a study made by the French Working Group on the Risk of Blood Exposure (GERES): 7/100 nurses per year in 2000, as compared to 30/100 registered nurses per year in 1990; 4.7/100 000 acts carried out in 2000, as compared to 18.1/100 000 in 1990. This decrease is certainly due to an improved application of preventative measures (39% of needlestick injuries could have been avoided by the observance of "standard" precautions in 2000, as compared to 53% in 1990), although the use of safety equipment also has an influence. The needlestick injury rate per 100 000 intravenous acts (simple samples, hemoculture samples, or the insertion or removal of an intravenous catheter) is 4.4/100 000 in wards with safety equipment (more than 66% of orders requiring safety equipment) for each of the latter four acts, whereas it is 17.8/100 000 in wards without such equipment (less than 33% of orders requiring safety equipment). The relative risk is 0.24; 95% CI [0.11-0.55]. These results are similar in other countries, thus confirming the advantage of using safety equipment.

Since 2003 in France, BBFE have been monitored by the National program for early warning, investigation and surveillance of healthcare-associated infections (RAISIN). In 2007, 15 605 cases were reported to the occupational physician in 626 participating hospitals, corresponding to 208 383 beds (22% of all hospitals, and 46% of all beds). In 2007 the BBFE incidence rate was 7.5 per 100 hospital beds (as opposed to 14 in university hospitals, as a result of the higher number of invasive acts carried out per bed). On the basis of data supplied by the DREES, corresponding to 448 505 hospital beds in France, the number of BBFE reported in 2007 was 33 638 (95% CI: 33 293 - 33 983).

Approximately one out of two reported BBFEs involves a nurse, for whom the annual incidence rate is 7 per 100 full-time equivalent (FTE) personnel. The next highest rate concerns doctors, with approximately 2.5 BBFE / 100 FTE, which probably does not reflect the real situation, as a

consequence of a particularly high rate of undeclared incidents with surgeons, as revealed by the strong differences between the declared incidents and those calculated from prospective surveys made by investigators: operating surgeons are the most highly exposed, with an incidence rate of two injuries and six mucocutaneous contacts per 100 person-acts.

Most injuries occur after the procedure, when the sharp object is discarded,: 48% of percutaneous accidents in this national survey of BBFE could have been avoided simply through the observance of "standard" precautions.

In the cohort of participating hospitals, the rate of BBFE remained stable between 2003 and 2005; there was no further decrease in the incidence rate, and it was noted that safety equipment was not used in all hospitals; considerable progress thus remains to be made.

### **Risk of transmission to the caregiver**

Whatever the virus under consideration, the risk of transmission to the caregiver following a BBFE is strongly related to the source patient's level of plasmatic viral load at the time of the accident.

#### **HIV**

The risk of HIV seroconversion, following percutaneous exposure, is estimated at 0.32% (95% CI: 0.18 - 0.45); the risk is ten times lower following a mucocutaneous exposure. Fourteen documented seroconversions and 34 presumed infections had been reported by the InVS (French Institute for Public Health) in France, by December 31<sup>st</sup>, 2007. Almost all documented seroconversions occurred following a needlestick injury with a large caliber hollow needle containing blood. One seroconversion, which occurred in an emergency care worker in 2004, was nevertheless the result of massive splashing and prolonged contact with blood on his/her face.

#### **HBV**

Professional contaminations with HBV are currently exceptional in France, as a result of the compulsory vaccination of healthcare personnel. To date, and since the widening of the surveillance of professional contaminations with this virus in 2005, no professional seroconversion with HBV has been reported. For an unprotected person who is exposed, the transmission rate following a needlestick injury varies between 6% and 45%, depending on the source patient's plasmatic viral load.

#### **HCV**

Considered for a long period of time to be 3%, the risk of seroconversion has more recently been estimated at 0.5%. Fifty-nine documented seroconversions had been reported by the InVS in France by December 31<sup>st</sup>, 2007, corresponding to one to five professional contaminations per year. The same risk factors are found as for HIV, although a small number of HCV seroconversions occurred with blunt or small caliber needles.

## Other potential viral transmission exposure risk situations

No HIV transmission has been published following a needlestick incident with an abandoned needle. The risk of contamination is much lower than that resulting from professional exposure, as a consequence of the generally small caliber of the needle and the fact that the often coagulated blood blocks the hollow-bore of the needle.

Contact or blood projections on lesioned skin, or a mucous membrane, often observed in non-professional situations during fights, represent a very low HIV contamination risk. Although no published data is available, in such situations there is nevertheless a risk of the more resistant HBV or HCV viruses being transmitted.

## Risk of caregiver to patient transmission

Cases of HIV, HBV or HCV transmission, from infected healthcare personnel to a patient, have been reported in the literature. Most of these transmissions occurred during surgical, obstetric or dental interventions. The oldest and most common cases are related to HBV. Only five cases of HIV transmission from caregiver to patient, of which four were published in the literature, have been reported.

Although the Centers for Disease Control (CDC) estimate the probability of an HIV infected surgeon transmitting the virus to one of his patients to lie between 0.12% and 1.2% during a period of one year (500 surgical acts per year), these estimations do not take the plasmatic viral load or the possible impact of anti-retroviral treatments into account.

## Specific care procedure

The procedure allowing an infected person to have access to post-exposure treatment involves many different actors, infection control specialists, emergency care doctors, occupational physicians, pharmacists, ... with competencies and interventions occurring at different times which, as an absolute necessity, requires an organization based on pre-established procedures, in order to guarantee the quality and safety of the resulting care.

This procedure is based, during working hours, on the hospitals' external consultation services (including some free, anonymous hospital consultation and diagnostic services), which are normally in charge of the care of persons infected with HIV, and outside normal working hours, on the emergency department; it is foreseen that the emergency care workers can, in case of difficult decisions (risk evaluation or choice of the molecule to be used when the source person is already being treated), request advice from an advisory doctor over the telephone.

Various elements are essential to the correct functioning of this procedure:

- the preparation of written procedures, distributed to all personnel, is essential. These procedures must describe the means by which the procedure can be accessed, the criteria or indicative factors to be used in therapeutic decisions, and the means to be used to orient the clinical and biological follow-up;
- the conditions to be observed during consultations, the observance of confidentiality, and



- the need for empathy on the part of the caregivers, must be emphasized;
- the availability of rapid serological tests in the laboratories of hospitals having an emergency service appears to be an unavoidable requirement for a quality service.

## Procedure assessment

Nowadays, medical practice assessment (MPA) appears to be an essential quality assessment tool, for the optimization of the procedures used to deal with the care of HIV exposure accidents. The French society for the fight against AIDS (SFLS), with the financial support of the ANRS, has promoted the use of an assessment reference system for professional practices. This reference system was established, taking into consideration the methodology recommended by the French National Authority for Health (HAS). It contains references and criteria adapted to the main clinical and organizational situations, and to the various successive steps in the care of HIV exposure accidents. The complete care structure and all of the involved actors are taken into account, with particular emphasis being placed on the quality of reception, the respect of confidentiality, the quality of information, and the optimization of the organization between the different medical and non medical actors, to ensure that suitable pluridisciplinary care is provided. The proposed indicators insist on the quality of care, the safety of all treatments, the training and awareness of all of the personnel, and the traceability of information related to the monitoring of patients having benefited from the care procedure.

## Care

### Assessment of the risk of transmission according to the type of exposure

The time of injury, its depth and the type of material involved should be determined. The risk is high in the case of an accident with a venous or arterial sampling needle containing blood. The risk is lower if it involves a needle previously used for a subcutaneous or intra-muscular injection, or a blunt (suturing) needle .... Similarly, the risk is lower in the case of a needlestick injury through gloves. Finally, it is even lower in the case of mucocutaneous splattering.

### Assessment of the risk of transmission according to the source patient's serological HIV status

It is essential to try to obtain information concerning the serological HIV status of the source patient, and should he/she be seropositive, to determine the clinical stage, previous and current treatments, the CD4 lymphocyte concentration and above all the HIV viral load.

If the serological status is not known, an HIV serology of the source patient must be urgently requested. This screening must be carried out by means of a rapid test (the results of which are known within one hour), and with his/her consent (except for cases where such consent cannot be expressed). It is important to emphasize the advantages of obtaining a confirmation of the rapid test, by means of a fourth generation mixed test (antigen and antibody screening), in order to reduce the risks of failing to recognize a primo infection.

## **Decision to implement a post-exposure prophylaxis (PEP)**

The indications for a PEP are assessed by weighing up the benefits resulting from the possibility of reducing the risk of HIV transmission, and the risk of serious undesirable effects associated with the treatment. The PEP must be reserved for situations having an identifiable risk of HIV transmission.

### **Post-exposure prophylaxis**

Whenever a PEP is indicated, the prescription of antiretroviral tri-therapy (nucleoside reverse transcriptase inhibitor [NRTI] and protease inhibitor [PI]) is desirable. In the case of a known, HIV-infected source patient, the choice of antiviral treatment is to be made on a case-by-case basis. In all other cases, the recommended NRTI are: zidovudine, lamivudine, emtricitabine and tenofovir; the tenofovir + emtricitabine combination (TRUVADA®) is of particular interest because of its simplicity (one tablet per day). Among various PI/r compounds, lopinavir/ritonavir (KALETRA®) has several advantages, including a good level of past experience (evaluated under capsule form, three in the morning and three in the evening) and the simplicity of the dosages, which have been further improved by the new galenic form: two tablets in the morning and two in the evening. Other more recent PIs (fosamprenavir, atazanavir, darunavir), boosted by the administration of ritonavir, may have a better digestive tolerance.

PET failures have been recorded, and the exposed person must be warned that the PET, even when administered immediately following an exposure, is likely to reduce the risk of seroconversion, without however completely removing it.

In addition to the possible use of a PET, mechanical contraception (condoms) must be prescribed and explained to the patient, and those persons having presented with a BBFE must be advised not to donate any blood for the same duration: three months (or four months if receiving any treatment).

### **Follow-up after exposure**

If a treatment is being administered, the follow-up is carried out by a medical expert. A clinical examination and a biological analysis of treatment tolerance are made before the initial prescription, and then repeated two and four weeks later.

In the case of a confirmed negative serology in the source patient, with the exception of the case of a risk of primo-infection in this person, there is no need to implement any monitoring (the risk is virtually eliminated if a mixed combined test, or in the case of any doubt a viral load test, is used).

If the source-patient is seropositive, or has an unknown status, serological surveillance until the third month (or fourth month in case of the prescription of a PEP), is required to be considered for a compensation procedure in case of seroconversion.

As far as HCV is concerned, monitoring is to be implemented if the source-patient is infected by HCV (PCR positive) or his/her HCV serological status is unknown. There is no known efficient post-exposure treatment for HCV. The important aspect of such an infection is to rapidly detect any possible seroconversion, which could provide an indication for anti-HCV treatment, and thus to ensure that the follow-up includes HCV serology and transaminase analysis, until the sixth month following the BBFE.

As far as HBV is concerned, in most cases no monitoring is necessary, irrespective of the source patient status, since most healthcare personnel are vaccinated and have responded to the vaccination (anti-HB antibodies > 10 mUI / ml). However, a sero-vaccination with anti-HB immunoglobulins and the injection of one dose of vaccine must be proposed to non-vaccinated and to vaccinated, non-responding persons, within 72 hours (immunoglobulin only for known, proven, non-responding persons).

## Primary prevention of blood exposure accidents

Accidents having occurred in hospitals must be analyzed, and used as a basis for the implementation of a prevention, training and information policy.

The supply of safety equipment is a key element for the primary prevention of BBFE. The users must be involved in the choice of the equipment and trained in its use.

The application of measures aimed at protecting the caregiver from the risks of contamination, should a blood or body fluid exposure accident occur, must also ensure the safety of patients with respect to this same risk.

The prevention of BBFE is integrated into the framework of the improvement of care to patients and the improvement of the personnel's working conditions. The hospital management is required to supply its personnel with collective protective means (exposure prevention) and, whenever exposure cannot be avoided by such means, to supply individual protective means.

## Recommendations

**R152** Any BBFE (Blood and Body Fluid Exposure) must be taken care of:

- IMMEDIATELY: wash and disinfect the wound (in case of pricking) or the contaminated area (in case of splattering);
- IMMEDIATELY: contact the source patient's physician to know whether he/she is infected by, or is at risk of being infected by HIV;
- WITHIN AN HOUR: contact a referring physician (or, if not available, the emergency physician) to assess the risk of transmission; if the source patient's HIV serology is unknown, propose serology screening (with the patient's agreement), in particular, by means of a quick test;
- WITHIN AN HOUR: if the source patient is known to be infected by HIV and is treated, ask his/her physician to indicate the source patient's treatment, and his/her previous medical conditions, so as to be able to adapt the PEP, if required,

- **WITHIN AN HOUR:** decide whether to start a PEP:
  - inform the professional about the administered medications (intake modalities, duration, side effects...) and ensure that this information is well understood,
  - inquire about the exposed professional's immune status with respect to HBV,
  - if the source patient has been identified, document his/her CHV serology at the same time as HIV, as well as his/her HBV serology, if the exposed professional has not been vaccinated or is not immunized,
  - recommend protection (protected intercourse) and prohibit blood donation until the three-month serology check-up (or four months in case a PET has been prescribed);
- **WITHIN 24 HOURS:**
  - report the occupational accident,
  - suggest contacting the occupational physician for the follow-up,
- **ALSO:** report to the InVS (the French Institute for Public Health Surveillance) any HIV, HCV and HBV contaminations that have occurred after a viral exposure accident in a healthcare institution.

**R153** The staff must be aware of the procedures to be avoided, the hygiene rules to be observed (SPs), the practical details applicable in the concerned institution for reporting and treating BBFEs. Educational actions are organized for the entire staff (medical, paramedical, medical-technical), with particular being paid to newly hired staff and students.

**R154** The use of safety equipment should be preferred:

- equipment with built-in rather than added security;
- equipment provided with the earliest possible automatic safety action (with respect to the intended act);
- among those systems which require operator-triggered safety, those with an irreversible single-handed actuation, and with a safety action indicator will be retained;
- the selection of this equipment should be performed in collaboration with the pharmacist, the occupational physician, the ICT, the nursing care unit, the administrative department, and after it has been evaluated by the users;
- containers for needles and sharps should be in accordance with the prevailing standards and the staff should know how to safely assemble, use and discard such containers;
- users should be trained for the appropriate use of the safety equipment and collector containers.

**R155** Any person who may be exposed to a BBFE risk should be immunized against hepatitis B. Proof of such immunity should be available for any exposed healthcare worker.

**R156** A BBFE surveillance system should be established by the occupational healthcare unit. Resorting to the tools proposed within the frame of the RAISIN BBFE national surveillance system should be encouraged. The circumstances under which BBFEs occur should be analyzed in collaboration with the CLIN and the Health and Safety at Work Committee, to determine the priority actions to be implemented in terms of staff training and the selection of equipment. The results of such analyses should be communicated to the relevant departments (feedback).

## Further reading

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■ ARTICLE dated March 15<sup>th</sup> 1991, establishing the list of hospitals or public or private organisms for prevention or care, in which the exposed personnel must be vaccinated.

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# Tuberculosis

## Rationale

Tuberculosis is an infectious illness, which is caused by the contamination of an individual by a tuberculosis bacillus of the mycobacterium tuberculosis complex (Koch's bacillus or KB).

## Airborne transmission

The experimental work of William Wells, Richard Realy and Crital Mill, carried out in the 1950s on hundreds of guinea pigs, showed that the conventional route of contamination was the inhalation of infectious particles.

Although transmission of TB through the proximity of individuals also reflects the contagiousness of respiratory secretions in humans, little experimental data is available. The presence of the viable Koch's bacillus (KB), in droplets produced by the coughing of infected patients, has recently been demonstrated in humans.

The grain size analysis of the aerosols released by infected or healthy individuals has long relied on Well's work, dating to the 1930s. However, recent studies challenge the droplet/aerosol dogma, because of the large number of parameters involved in the expulsion and drying of particles emitted by individuals. Moreover, there is a large variability between individuals, irrespective of any disease of the airways, in terms of the number of particles emitted during the expiration phase.

In FENNELLY's study, the mean aerodynamic diameter of infectious particles emitted by infected patients was generally smaller than 5  $\mu\text{m}$ . Such particles permit remote aerial transmission of the index case; such particles are likely to reach the alveoli.

Data on aerosol aerobiology are still very patchy, in particular concerning the survival of bacilli, their resistance to drying, and the influence of climatic parameters. A 6-hour survival time of bacilli in an aerosol has been reported. The minimum infective dose is not known with accuracy. Contaminating patients are those with respiratory forms (pulmonary parenchymal, bronchial or pleural) or ENT.

## Contagiousness factors

### Patient-related factors

## COUGHING, CAVITATIONS, LARYNGEAL LOCATION

The positivity of direct examinations of bronchial secretions is a sign of the patient's contagiousness. However, although such an examination's specificity is appropriate for mycobacteria of the tuberculosis complex, its sensitivity is poor, ranging between 20% and 80%, and the positivity in itself is a sign of the presence of at least  $10^4$  to  $10^5$  bacilli per milliliter. The inoculums in sputum estimated from the number of acid-fast bacilli (AFB) per field are an important



parameter of contagiousness. The risk of contamination of the family circle thus significantly increases through contact with patients whose number of AFB per field is in excess of 100. Patients with a negative direct microscopic examination, but with a positive culture, may also be contaminating, but with a lesser risk. A recent study of all bacteriologically proven cases of tuberculosis in the Netherlands, over a period of nine years, shows that 12.6% of cases of transmission to the close family circle originated from tuberculosis cases, shown to be negative under direct microscopy. However, this study did not deal with healthcare settings.

Contagiousness also depends on the location of lesions, their extent, coughing strength, the presence of excavated lesions, and the implementation of an effective treatment and its duration.

The administration of an associated, effective antibiotic treatment quickly reduces coughing, sputum volume, and the number of microorganisms in the sputum.

The duration of the contagious period, after an effective treatment has been initiated, varies according to the size of the initial inoculums, and is of the order of 2 to 3 weeks.

## **CO-INFECTIONS BY HIV**

A meta-analysis based on 6 studies relating to 1240 caregivers showed that patients co-infected with BK and HIV did not present a higher contamination risk for caregivers than patients not infected with HIV.

### **Contagiousness factors related to the nature of contacts or the proximity between caregiver and patient**

The performance of certain manipulations, which directly expose the caregiver to the patient when no facemask is worn (intubation, bronchial fiberoptic endoscopy, induced sputum, respiratory rehabilitation, autopsy, handling of biological fluids or contaminated anatomic parts, when aerosolization is possible) increases the risk of contamination. These factors increase with promiscuity. Furthermore, confinement associated with a small, shared volume of air significantly increases the risk. The duration of exposure is a major contamination risk factor, which has been demonstrated in a case study in which subjects working for at least 40 hours in a hospital unit where a contagious patient was hospitalized were more likely to be infected than others.

Another study shows that the secondary tuberculosis risk increases by 1.6 cases per 1000 person-months of contact.

However, even though the infection rate globally increases, beyond ten hours of contact, a single contact is at risk in the case of a medical manipulation. One study showed that a smear-positive patient under assisted ventilation could infect 21 others in less than three days. In the case of close contact with the patient, such as intubation or bronchial fiberoptic endoscopy, it is no longer valid to retain a minimum contact duration for the risk to be taken into consideration.

Once the treatment has been initiated, duration is an important factor.

## Quantifying the professional risk

The transmission of the bacillus from patients to professionals has been reported in a number of publications. The professional risk for caregivers has been the subject of multiple studies of varying quality.

The degree of risk depends on many factors, such as the socio-economic development of the country, the incidence of the disease in the community, the type of hospital sector, the professional group of the caregivers, the implementation of complementary health precautions (airborne precautions).

The incidence of the latent TB infection (LTBI) in caregivers during routine surveillance varies in studies, in particular those performed in America, from 0.1% to 10%. Nevertheless, the quality of these studies is often questionable and many confusing factors are not taken into account.

A prospective cohort study among caregivers, conducted in the Atlanta area, revealed an annual positivity rate of tuberculin tests (IDR) of 1.2%, which was independent of professional exposure, but related to socio-economic and extra-professional exposures.

Finally, in those hospitals where TB patients are treated, laboratory personnel are at a significantly higher risk of infection than the administrative staff.

Since the introduction of tests which detect the production of the gamma interferon (*Interferon Gamma Release Assay* or IGRA), several studies have shown a higher prevalence of positive tests than in the general population.

The risk of infection is estimated by repeated tuberculin tests and IGRAs. The risk of tuberculosis disease depends on the risk of infection, but can be expressed a long time after infection, making it difficult to demonstrate the causality between exposure and disease.

## Preventative measures

The prevention of professional tuberculosis relies on individual and collective actions.

Although the BCG vaccination was still compulsory for healthcare workers when the present document was first published, this obligation has been removed, as recommended by the HCSP in its conclusions of March 5<sup>th</sup>, 2010; however, the use of this vaccine should still be discussed with the occupational physician, on a case-by-case basis, according to each caregiver's degree of exposure.

Many countries recommend wearing facemasks with a documented level of filtration and controlled air leakage percentage around the facemask. The efficiency threshold chosen is 90% in the USA (N95 masks), and 78% or 92% (% mainly relative to face leakage) in France, according to the circumstances of exposure (FFP1 or FFP2 masks).

In France, in 2003, the CSHPF recommended the use of respiratory protection masks for healthcare workers with a minimum level of FFP1 and FFP2 under certain circumstances, i.e. drug-

resistant TB, intubation, and bronchial fiberoptic endoscopy.

Nevertheless, since 2004, most French healthcare institutions have adopted FFP2 masks for all cases of TB, for simplification purposes. The actual effectiveness of such measures has not yet been quantified, and a comparison between the various masks remains to be made. A recently published GERES study shows that the choice of masks and the wearing of facemasks are quite heterogeneous.

The transmission of tuberculosis to caregivers can also be reduced by implementing a TB monitoring program, relying on geographical and technical measures: isolation and wearing of an anti-splash mask by the patients, technical measures (ventilation, negative pressure rooms), individual protection equipment (wearing of a protective mask by healthcare workers) and organizational measures (restricting the number of health caregivers in contact with the patient, restricting the procedures that may induce coughing).

The implementation of these measures can reduce the incidence of staff infection. However, the respective share of each is often difficult to assess, because of their joint use in most published studies.

A comparative study of 17 Canadian hospitals nevertheless showed that, in hospitals hosting at least six TB patients per year, the risk of latent TB infection was significantly lower in those hospitals having a room ventilation rate of more than six room volumes per hour.

Despite the measures put into place, exposures can occur in healthcare settings, most often because of a delayed TB diagnosis.

In France, tuberculosis is listed among the officially recognized occupational diseases (Table 40 of occupational diseases recognized by the public health insurance).

## Recommendations

**R157** The HCSP recommends that the BCG vaccination of professionals and students in the mentioned healthcare and social sectors (listed in the appendix of the notice) should no longer be compulsory, but that the tuberculosis test should be maintained as the reference test on hiring. The HSCP recommends, although it is not compulsory:

- BCG vaccination on a case by case basis, after the risk has been evaluated by an occupational physician, only for tuberculin-negative, highly exposed healthcare workers (healthcare staff with repeated contact with contagious tuberculosis patients, in particular those with a high risk of multiresistant tuberculosis; laboratory staff working on microbacteria cultures),
- the above should be implemented, whilst reminding those concerned that barrier measures should be strictly observed, and that adherence to medical screening and follow-ups is of the utmost importance.

**R158** Any case of potentially contagious tuberculosis (pulmonary and otorhinolaryngology tuberculosis with a positive culture) should be reported by the clinical department and/or laboratory, to the staff's occupational healthcare department and to the ICT, in order to check whether the isolation measures have been applied and, if necessary, to carry out a survey.

**R159** Routine surveillance of the healthcare practitioners working in high-risk departments (which receive at least five tuberculosis cases per year) and of the laboratory staff manipulating samples with a high risk of aerosolization (bacteriology, anatomopathology) should be implemented: periodic IDR every two years for staff with prior IDR < 10 mm, and every 5 years for others (IDR > 10 mm). The practice of interferon testing during the follow-up period is recommended by the HAS (2006), whether alone or combined with the IDR. This aspect is expected to be specified in the recommendations of the national tuberculosis program at the end of 2010.

**R160** Indication and duration of the geographical isolation and setting up of ACPs:

- any patient with suspected tuberculosis of the respiratory system should be geographically isolated (in a single room) and his/her treatment should be carried out with adherence to the ACPs (FFP1 mask or FFP2 mask if multiresistant tuberculosis is suspected) until this diagnosis has been eliminated. These measures should be applied at the time of hospitalization. The notion of a suspected infection should be reported at the time of hospitalization, so that these measures can be foreseen in the admission service, before the patient arrives at his/her destination unit;
- during certain procedures in which there is a risk of triggering coughing and the release of aerosols, such as intubation, induced expectoration, bronchial fiberoptic endoscopy, aerosol therapy, it is recommended to use FFP2 masks;
- when the patient must move out of his/her room, he/she should first put on a surgical mask;
- recommendations which are applicable to healthcare workers also apply to visitors: FFP1 masks or FFP2 masks if a multiresistant tuberculosis is suspected;
- in the case of suspected pulmonary tuberculosis, when the direct examination is negative and the diagnosis appears to be highly probable, and requires the initiation of an anti-tuberculosis treatment, in particular in the presence of excavated lesions, the above described measures are to be maintained for the first 15 anti-tuberculosis treatment days;
- in the case of a contagious active tuberculosis, when the direct examination of smears is positive, the above-mentioned measures are to be maintained until such time as the direct microscopic examinations of three consecutive samples are negative.

**R161** Healthcare workers should be trained in the wearing of a mask. Each professional should know how to perform a "fit-check": obdurate the filtering surface, inhale and make sure the mask is drawn to the face (because of the suction effect); this should be performed when putting on the mask.

## Specificities

### Survey focusing on a patient for whom complementary AIR measures have not been implemented immediately

■ A survey focusing on a contagious TB case should be carried out when isolation measures have not been efficient during the entire hospital stay, either because of a late diagnosis or because the measures have not been applied in a hospital ward unaccustomed to this type of risk. Exposure criteria take into account contacts between staff and patients, frequent confinement and risky manipulations, as well as a cumulative minimum contact time of one hour, with the exception of very short distance exposures (intubation, fiberoptic endoscopy, physiotherapy ...), for which a minimum delay is not required for the risk to be considered. Survey management should be multidisciplinary, as part of a team composed of the IC team, occupational physician, clinical units and, if required, the TB Control Committee (CLAT). Appropriately, there should be a list of exposed staff, so that they can be contacted for the purposes of conducting an interview and infection diagnosis tests at defined dates (J0, M3), with a follow-up until 18 months. In this context, the HAS recommends the use of gamma interferon assay tests.

■ The CCLIN may be consulted by investigators, for methodological purposes.

■ The follow-up of exposed staff is coordinated by the occupational physician.

■ Staff affected by TB may return to work, after cultures of bronchial substances have been found to be negative, or following a period of time corresponding to the usual duration of such negativity.

## Research topics

The main unresolved issues relate to the physical and biological description of aerosols projected by patients suffering from TB, and new tests for screening latent tuberculosis infections.

Concerning the latter aspect, the topics requiring further investigation are listed as follows:

- correlation between the two techniques presently used for gamma interferon assays;
- impact of an IDR on gamma-INF secretion (strength, duration);
- possible predictive character of IGRA tests, with respect to the evolution of a latent TB infection towards an active disease, and the relationship between the quantitative value of the IGRA test and the risk of evolution towards the TB disease;
- factors associated with the negation or the persistence of the IGRA test's positivity over time;
- risk factors in the evolution towards tuberculosis, in particular the impact of re-infections by *M. tuberculosis*, and other respiratory pathogens;
- efficacy of protective measures, masks in particular;
- sensitivity of IGRA tests to the TB infection;

- compared efficiency of ITL treatments on the risk of subsequent TM;
- medico-economical impact of the use of IGRA tests versus IDR in LTI screening;
- therapeutical impact of latent tuberculosis infection screening through IGRA versus IDR tests.

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# Vaccination of healthcare professionals

## Rationale

The management of infectious risk in healthcare settings cannot be based solely on hygienic measures taken on a case-by-case basis, depending on the risks identified in each patient, but must also involve systematic procedures, both in terms of hygiene, whilst observing the "standard" precaution principles, and in terms of preventative vaccinations.

These are governed by a specific regulatory body. The general principle is laid down in Article L. 3111-4 of the Public Health Code, which states that: "any person who, in a public or private prevention or healthcare institution or organization, exercises a professional occupation, which exposes him/her to contamination risks, should be immunized against hepatitis B, diphtheria, tetanus and poliomyelitis". This also applies to students in institutions who are training as medical professionals, and to other healthcare professions.

Furthermore, Article L. 3111-8 specifies that in case of war, public disaster, epidemic or epidemic threat, vaccination or revaccination against smallpox may be made compulsory by decree or by prefectural orders for all persons, regardless of their age.

The vaccination of healthcare workers against infectious agents is part of a global nosocomial infection prevention methodology, and involves the prevention of both caregiver-to-patient, and patient-to-caregiver infections.

In a healthcare setting, the evaluation of the risk of caregiver exposure to biological agents is carried out under the employer's supervision (decree n° 94-352 of May 4th, 1994), in collaboration with the occupational physician. This assessment relies on an analysis of the working environment, but also on information related to diseases liable to be caused by the professional occupations of workers, in particular information derived from the scientific literature.

If the results of such an assessment show that the occupation may result in the exposure of workers to biological agents, vaccinations intended to reduce these workers' sensitivity to such agents should be proposed. Such vaccinations should be funded by the employer, and can be carried out by any physician chosen by the employee.

The proposed measures must comply with the HCSP's recommendations, provided in particular in the immunization schedule, and with the occasional conclusions published in the Official Gazette of the Ministry of Health.

## Hepatitis B

In France, 280,000 people are carriers of a chronic hepatitis B virus (HBV) infection and therefore present a risk of transmission.

The routes of HBV transmission are vertical (infection of the child by the mother) and horizontal (sexual, blood contamination), with a clear predominance of the latter route in low endemic countries such as France.

Historically, the HBV infection has been recognized since the 1950s as an occupational risk for healthcare personnel, following the occurrence of clustered hepatitis cases after a blood and body fluid exposure (BBFE) from a source patient carrying the virus. Sero-epidemiological studies later confirmed the high risk of infection in healthcare professionals (physicians and dentists) with HBV, estimated to be three to five times higher than in the general population. In the 1970s, cases of caregiver-to-patient infections with HBV were also reported. The vaccine appeared in the 1970s (plasma vaccine), and was introduced to the market in 1981, in both France and the United States. The vaccines currently marketed are produced by genetic engineering of yeasts (*Saccharomyces cerevisiae*) or mammalian cells (CHO), and are made up from an HBV surface antigen.

In 1982, a circular of the Directorate General for Health recommended vaccination of healthcare personnel. This recommendation was transformed into a mandatory vaccination for healthcare professionals in public or private prevention or healthcare institutions or organizations, "who exercise a professional occupation which exposes them to the risk of contamination " by Law No. 91-73 of January 18, 1991.

After three injections, 97% of those vaccinated develop antibody titers above the 10 IU/l threshold. This titer was considered as a protective response, according to many studies carried out in the early 1980s. HBV contamination remains possible in patients immunized naturally or by vaccine, but does not lead to symptomatic hepatitis (McMahon, 2005) and does not pose a risk of fulminant hepatitis or chronic carriage.

There are poor responders or even non-responders to the vaccine (who are defined as having an antibody level below 10 IU/l four to eight weeks after the third injection). Active smoking, male gender, more than 40 years of age and obesity appear to be independent factors of poor response to the vaccine. Non-responders appear to have the same risk of contracting hepatitis B, whether acute or chronic, as non-vaccinated subjects. In case of non-response after the first three doses, vaccination should be continued by administering a maximum of three to four additional doses. If the anti-HBs antibody titer remains below 10 IU/l, the question of the caregiver's professional aptitude then arises, and annual surveillance of hepatitis B serology is recommended.

Although vaccination and immunization are required for caregivers, the order of March 6, 2007 states that "are exempt from vaccination those who can prove, by presenting a medical certificate, a contraindication for one or more vaccinations. The occupational physician assesses whether the contraindication is temporary or not, and determines whether those involved should be reassigned to a different position."

Here, as in the case of non-responders, the fundamental point then lies in the assessment of the risk to which the caregiver is exposed. An assignment to a position with a lower exposure to the risk of blood contamination may be considered. Informing the caregiver about the risks he/she is exposed to, and of the immediate behavior to adopt in case of an accident, is crucial.

In order to take the caregiver-to-patient risk into account, the order of March 6, 2007 considers the age of vaccination, with different approaches to be adopted depending on whether professionals or students were vaccinated before the age of 13 or 25. This is expected to be changed in the near future, with the requirement for any caregiver, whether as an employee or a

student, to provide evidence of either an anti-HBs antibody level greater than 100 IU/l, or a combination of an anti-HBs antibody level greater than 10 IU/l and the absence of an anti-HBc antibody.

In France, the side effects of hepatitis B vaccination have been the subject of heated debate, concerning the risk of developing demyelinating diseases of the central nervous system. Echoing this controversy, several French or foreign case-control studies have focused on vaccination history over the 2, 6 or 24 months preceding the discovery of the demyelinating disease, or on the effects of hepatitis B vaccination in patients already affected by multiple sclerosis (MS). The body of published results does not support a causal relationship between HBV vaccination and the development of MS, or the occurrence of an acute exacerbation of the disease. A consensus conference held in June 2001 under the auspices of the ANAES and the French Society of Neurology concluded that MS patients could be vaccinated with the same indications as the general population. The only contraindications being retained with respect to anti-HBV vaccination are severe febrile infections and the existence of a known hypersensitivity to any component of the vaccine or its occurrence after vaccine injection.

## Diphtheria - Tetanus - Poliomyelitis

Diphtheria, tetanus and poliomyelitis vaccinations are also mandatory for healthcare workers.

Thanks to the widespread vaccination of children, diphtheria disappeared from France in 1989. It should however be noted that a diphtheria patient was hospitalized in a Parisian hospital ward in October 2002, and that the worrying epidemic situation in Eastern Europe and North Africa still raises concerns as to the possibility of imported cases. Vaccination pressure must be maintained, using the recent vaccines containing reduced doses of diphtheria toxoid for the ten-yearly boosters.

## Rubella

Many cases of rubella transmission to nurses have been reported, as have cases of caregiver-patient transmission to pregnant women.

Rubella vaccination is not mandatory for caregivers. However, Article D4152-3 of the Labor Code states that when there is a risk of exposure to the rubella virus, *"it is forbidden to expose a pregnant woman unless there is evidence that she is sufficiently protected by her immunization status against such agents."*

The incubation period for rubella is of the order of 14 days, whereas contagiousness begins on the seventh day, and between 20% and 50% of cases are hardly or not at all symptomatic. Exposure to the virus can therefore be evaluated only on a case-by-case basis, and healthcare personnel should be considered as exposed in sectors likely to host affected patients. Since the vaccination of pregnant women is impossible, it therefore appears necessary to ensure the immunity of female healthcare personnel of childbearing age. Several studies carried out in this field, particularly in France, showed that 8% to 10% of caregivers were not immunized. In the absence of a proven and documented vaccination or former rubella history, re-vaccination, whilst

maintaining the subject under effective contraception, is therefore indicated.

## Influenza

Numerous studies have shown that caregivers are a professional group at risk of contracting influenza. However, there is no ground to state that the incidence of influenza in this population is higher than in the general population. Vaccination of caregivers is advocated because it may reduce mortality in elderly patients in institutions. This is based mainly on two Scottish studies, which have been criticized, however, especially because they do not rely on virological data. A literature review by the Cochrane center indeed recently claimed that there was no good quality evidence that vaccinating caregivers reduces the incidence of influenza in elderly persons living in institutions. The vaccine's efficacy in healthcare workers has been estimated at 88% for the prevention of influenza outbreaks, and this vaccine also appears to reduce the number of days of sick leave for caregivers, although this effect is inconsistently found in studies.

The vaccination of caregivers against influenza is currently recommended by the immunization schedule in France. It was made compulsory by the 2006 social security funding act (OJ of 20 December 2005), although this requirement was suspended by the decree of October 16, 2006.

## Pertussis

The development of cell pertussis vaccines in the 1940s led to a sharp decrease in the incidence of this disease, at least in countries applying a voluntary vaccination policy, such as France and the United States.

Vaccination has changed the age of the disease; children vaccinated at only two months are no longer affected by the disease; some newborns are affected at the pre-vaccination age and are therefore at risk of developing a severe form which can lead to death. The immunity conferred by the vaccine is short-lived (less than 5 to 10 years; and that caused by the disease is also labile, from 10 to 15 years); as a result, young adults whose last immunization dates back to the age of 13 are exposed to the disease. Thus, the rate of infection in adults in contact with infected children at home can reach 83%. Pertussis is now considered as a disease of the adult. However, because of their vaccination history, adults more often suffer from unsophisticated forms (7% to 32% of chronic cough in adults, according to the diagnosis criteria used) but are then a vector of contamination for children of pre-vaccination age.

Contamination occurs through Pflügge droplets produced during coughing by a sick person, and contagiousness reaches a maximum during the catarrhal stage, but continues at the beginning of the hacking phase.

Many isolated cases of contamination of healthcare personnel, or whooping cough epidemics have been reported in healthcare settings, over the past 30 years.

One of the studies reporting such contamination ran comparative strain typing of the patient and caregiver, unambiguously confirming the reality of the patient-to-caregiver transmission. However, it is difficult to measure the real incidence of pertussis of occupational origin in healthcare

personnel, particularly because of uncertainties related to the source, whether or not professional, of the contamination. A comparative study carried out in Germany thus showed that the incidence of pertussis was not significantly higher in healthcare professionals than in the general population. Caregivers can also contaminate patients and, since the princeps description by KURT in 1972, many cases of contamination have been reported. It may however be noted that in most epidemics that have occurred in healthcare settings, the number of infected healthcare workers was higher than that of patients.

The main features of prevention are the wearing of masks by caregivers, immunization, treatment of contact subjects, and isolation of ill subjects.

Acellular pertussis vaccines have shown their efficacy in children, and more recently, in adolescents and adults. In the latter two groups, a recent, randomized double blind study with a 22 month follow-up period, showed a vaccine efficacy of 92% (95% CI: [32-99]) against the occurrence of documented pertussis. Vaccines are recommended for all caregivers, for the prevention of occupational risk, since previously described epidemics show that pertussis outbreaks can occur in any care unit. As this disease is not limited to pediatric wards, all caregivers should be vaccinated. Current acellular vaccines exist only in a combined form, in particular in combination with diphtheria-tetanus-polio (DTP) vaccines. They are thus recommended at the time of the ten-yearly booster vaccination, although their administration within a time period of 24 months from the last DTP vaccination is permitted. In the case of an epidemic (community clustered cases), this period may be reduced to one month. Currently, the recommendation is to immunize adults only once.

Once a pertussis case has been identified in a healthcare sector, it is appropriate, in addition to the aforementioned immunization guidelines, to prescribe an antibiotic to caregivers who have been in close contact with the patient during the previous 21 days, provided their last vaccination dates back to more than 5 years and that they present a risk: pregnant women, staff with chronic respiratory diseases (asthma, ...), parents of infants not yet vaccinated. If a caregiver develops whooping cough, antibiotics (macrolides) should be initiated, and a 5-day withdrawal from the ward is recommended (such withdrawal can be reduced to 3 days in the case of a treatment with azithromycin).

## Varicella

Vaccination against varicella is now recommended for all healthcare personnel in contact with young children, who have not had this disease, and have had a blood test showing the absence of a serological scar. Vaccination is also recommended for all health professionals under training, being hired or else already employed in a position involving work in specialized units for patients at risk of severe varicella (immuno-suppressed patients, gynecology and obstetrics, neonatology, pediatrics, infectious diseases and nephrology wards); here again, this recommendation is intended for caregivers who have not previously had the disease, and after a blood test proving that there is no serological scar. In women of childbearing age, each vaccination should be assessed following completion of a negative pregnancy test, and whilst under effective contraception for the previous three months. Post-exposure vaccination may be recommended within three days of exposure, to a patient with rash in immunocompetent adults (from age 18) with no history of varicella (or with an unclear history); testing for negative serology is optional.

## Measles

Unvaccinated persons born before 1980 with no prior measles history (or with an unclear history) and with a negative serology, exercising health professions as trainees, in a hiring process, or employed, primarily in medical departments hosting individuals at risk of severe measles, should receive at least one dose of trivalent MMR vaccine. Those born after 1992 and not yet vaccinated should receive two doses of trivalent MMR vaccine, with an interval of one month between the two doses.

Post-exposure vaccination may be offered to nursing staff within 72 hours after contact with a case (one dose of trivalent MMR vaccine), if the staff member is not vaccinated, has no measles history, and is not pregnant.

## Hepatitis A

During the course of their work, caregivers may be exposed to hepatitis A, with outbreaks having already been reported in healthcare settings. However, healthcare personnel are not an occupational group at a greater risk of contracting hepatitis A, than the general population or hospital administrative staff. In addition, standard precautions should prevent caregiver contamination by this virus in healthcare settings. Vaccination against hepatitis A is therefore not specifically indicated in healthcare settings. However, it is recommended for staff working with non toilet-trained children (e.g. nursery personnel), and for those involved in food preparation in public catering.

## Typhoid

Vaccination against typhoid fever is mandatory for the staff of medical biology laboratories. The Higher Council for Public Health has pointed out (2010 immunization schedule) that it must nevertheless be reserved for exposed personnel only.

## Recommendations

- R162** A person who, in a public or private institution or organization providing care or accommodating elderly people, practices a professional occupation, which exposes him/her to contamination risks, should be immunized against hepatitis B. Proof of this immunity should be provided for any exposed healthcare worker.
- R163** A person who, in a public or private institution or organization providing care or accommodating elderly people, exercises a professional occupation, which exposes him/her to contamination risks, should be immunized against diphtheria, tetanus, poliomyelitis (article L3111-4 of the French Public Health Code).
- R164** Vaccination against typhoid is compulsory, with a recall every three years, for all laboratory staff who manipulate stool samples.



- R165** Female healthcare workers in the childbearing age who are not immunized against rubella should be injected with an anti-rubella vaccine. It is necessary to make sure that no early pregnancy occurs within two months after vaccination, because of a theoretical teratogenic risk.
- R166** Healthcare professionals who are being trained, are in a hiring process, or working, who are not vaccinated against measles, with no prior measles condition (or with an unclear history) and with a negative serology, should receive an injection of a single dose of trivalent MMR vaccine.
- R167** Healthcare workers who are being trained, are in a hiring process or working, should be vaccinated against whooping cough at the time of the ten-year DPT vaccine recall, with an acellular vaccine.
- R168** There is no indication for a routine anti-meningococcal vaccination of healthcare workers. It may however be proposed to the staff of bacteriology laboratories who constantly manipulate samples suspected to be contaminated by meningococci when aerosolization is possible.
- R169** In all healthcare institutions, flu vaccination should be proposed annually to healthcare workers.
- R170** Healthcare professionals being trained, in a hiring process or working, without any prior varicella condition (or with an unclear history) and having a negative serology, should receive two doses of anti-varicella vaccination at four to eight week intervals. In the case of a post-vaccinal rash, the healthcare professional should be removed from the hospital until such time as the skin lesions have dried out.

## Criteria for the evaluation of practices

- The rate of vaccination (and immunization in the case of the hepatitis B vaccine) of healthcare workers must be known.

## Specificities

- The risk of caregiver-to-patient transmission must be taken into account in the policy for the vaccination of healthcare professionals.

## Research topics

- The main current issue with pertussis is the duration of protection afforded to adults by an acellular vaccine. A recent review of the literature shows that the duration of protection following the disease varies from 7 to 20 years, and that the protection provided by vaccination is effective for 4 to 12 years. The appropriateness of any vaccination booster for healthcare workers therefore requires further study.

**Table summarizing vaccinations for healthcare professionals**

<b>Vaccination</b>	<b>Status</b>	<b>Target/Indication</b>	<b>Immunization conditions</b>	<b>Booster vaccination</b>
Hepatitis B	Compulsory Full vaccination = 3 injections (0-1-6 plan). Maximum of 6 injections if no response	All professionals in contact with patients or biological samples	Anti-HbS Ab > 10	None
DT Polio	Compulsory	All	None	Every 10 years with a reduced dose of diphtheria toxoid
Typhoid	Compulsory	Exposed laboratory staff	None	Every 3 years
BCG/ Tuberculosis		Refer to recommendation 157		
Pertussis	Recommended	All	One injection at the time of a DTP booster	None
Influenza	Recommended	Anyone in contact with patients at risk		Every year
Varicella	Recommended	Non-immunized personnel working in a risk-prone sector (mater., neonat., infect. diseases, immuno./hemato., immunosuppressed)	No immunity check	
Rubella	Recommended	Not immunized for more than 25 years and with no rubella history	None MMR vaccination = 1 injection	No booster

## Further reading

■ ARTICLE L. 3111-4 OF THE PUBLIC HEALTH CODE. Available at: [http://www.legifrance.gouv.fr/affichCodeArticle.do;jsessionid=F9A9C05B64C2CD8A2B98871EA44A4FA2.tpdjo02v\\_2?idArticle=LEGIARTI000020628105&cidTexte=LEGITEXT000006072665](http://www.legifrance.gouv.fr/affichCodeArticle.do;jsessionid=F9A9C05B64C2CD8A2B98871EA44A4FA2.tpdjo02v_2?idArticle=LEGIARTI000020628105&cidTexte=LEGITEXT000006072665) (consulted on May 13<sup>th</sup>, 2010).

■ CONCLUSIONS OF THE FRENCH HIGHER COUNCIL FOR PUBLIC HEALTH (HCSP), Transmissible disease section, May 19, 2006. Available at: <http://www.hcsp.fr/explore.cgi/avisrapports3?ae=avisrapports3&clef=33&menu=09> (consulted on May 13<sup>th</sup>, 2010).

■ VACCINATION SCHEDULE 2010. BEH of April 22, 2010. Available at: [http://www.invs.sante.fr/beh/2010/14\\_15/beh\\_14\\_15.pdf](http://www.invs.sante.fr/beh/2010/14_15/beh_14_15.pdf) (consulted on July 11<sup>th</sup>, 2010).

■ CIRCULAR N° DGS/SD5C/2002/400 OF JULY 15, 2002 relating to the prophylaxis of invasive meningococcal infections. Available at: [http://www.esculape.com/infectio/meningo\\_prophylaxie2001.pdf](http://www.esculape.com/infectio/meningo_prophylaxie2001.pdf) (consulted on May 13<sup>th</sup>, 2010).

■ CIRCULAR NO DGS /5C/2006/458 OF OCTOBER 23, 2006 relating to the prophylaxis of invasive meningococcal infections. Available at: [http://www.infectiologie.com/site/medias/documents/officiels/meningo\\_circ\\_2006.pdf](http://www.infectiologie.com/site/medias/documents/officiels/meningo_circ_2006.pdf) (consulted on May 13<sup>th</sup>, 2010).

■ DECREE 96-364 (OJ OF MAY 2<sup>ND</sup>, 1996): In case of exposure to rubella: the exposure of women who have declared themselves to be pregnant is prohibited, unless there is evidence that the employee is adequately protected by her conditions of immunization.

■ FRENCH HIGHER COUNCIL FOR PUBLIC HEALTH (HCSP). Specialized commission for sanitary safety. Technical committee on vaccination. Report on the conduct to be followed in the presence of one or more cases of whooping cough. French Higher Council for Public Health, September 5, 2008. Available at: [http://nosobase.chu-lyon.fr/recommandations/hcsp/2008\\_infections\\_respiratoires\\_HCSP.pdf](http://nosobase.chu-lyon.fr/recommandations/hcsp/2008_infections_respiratoires_HCSP.pdf) (consulted on May 13<sup>th</sup>, 2010).

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**Directorate-General for Health  
Directorate for Hospitalization and the Organization of Healthcare**

**Technical committee for nosocomial infections and healthcare-associated infections**

## **Definition of healthcare-associated infections**

**May 2007**

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## Introduction

Until now, infectious diseases have been classified according to two types: community-acquired and nosocomial infections (infections acquired in healthcare institutions). Today, however, the multiplication of care pathways and intervening parties involved in the provision of care, as well as the diversification of institutions and healthcare systems, the onset, sometimes delayed, of infections following surgery, especially with implanted prostheses, leads to the need for these classifications to be reconsidered.

The epidemiological definitions developed in 1999 by the CTIN are accurate for each site. They are used in national surveys of prevalence and in the voluntary monitoring networks coordinated by the National program for early warning, investigation and surveillance of healthcare-associated infections (RAISIN) network.

However, some community-acquired, early hospital infections are classified as nosocomial, and some colonizations are classified as nosocomial infections with no clinical signs, which may encourage the often unnecessary decision to prescribe antibiotics. Conversely, some late postoperative infections, although probably related to healthcare, are not classified as nosocomial.

Nosocomial infections were initially defined with an epidemiological objective, for the monitoring of infections. However, these definitions are also used with other objectives: personal medicine, as an aid in the decision to use an antibiotic treatment, or for forensic or compensation-oriented medicine. In the latter case, the strict framework of the 1999 definitions did not always provide experts with sufficient margin to appreciate the reality of nosocomial infections, or of their being the consequence of healthcare interventions. Finally, the 1999 definitions do not allow infections acquired through a healthcare process conducted outside healthcare institutions, and for which very similar preventative measures should be implemented, to be taken into account.

This document is intended to define the scope of all healthcare-associated infections and to present an update of the definitions of nosocomial infections, in order to attain the operational goals of epidemiological surveillance, prevention and the management of infectious risk by health professionals.



## Definition of a healthcare-associated infection (HCAI)

An infection is said to be healthcare-associated if it occurs **during hospitalization or after patient discharge** (for diagnosis, therapeutic, palliative, preventative or educational purposes), and if it was neither present nor incubating at the beginning of hospitalization.

When the infectious state at the start of treatment is not accurately known, a period of at least 48 hours, or a period longer than the incubation period, is commonly accepted for the definition of a HCAI. **However, for each individual case, it is recommended to assess the plausibility of an association between the treatment and the infection.**

In the case of surgical site infections, these are commonly considered to be healthcare-associated when they occur within 30 days after surgery or, if an implant, a prosthesis or prosthetic material has been introduced during the year following the intervention. However, and whatever the time of occurrence, it is recommended to assess the plausibility of an association between surgery and infection, on a case-by-case basis, in particular by taking into account the type of pathogen involved.

A healthcare-associated infection (HCAI) is any infectious event, which is related in any particular way with a process, institution, or care procedure, in a very broad sense. The HCAI includes nosocomial infections contracted in a healthcare institution, and also covers care provided outside healthcare institutions. The main criterion defining a HCAI consists in the issuance of a **procedure or healthcare treatment in a broad sense** (for diagnostic, therapeutic, screening or primary prevention purposes) **by a health professional or the patient or his relatives and friends, supervised by a health professional**. No distinction is made as to where the treatment or care is provided.

HCAIs involve patients, whether they are sick or not, but also healthcare professionals and visitors.

It is possible to suspect the healthcare-associated character of an infection affecting a healthcare professional in the following situations:

- a documented infection affecting the healthcare professional, whose development occurs within a period consistent with the incubation time of the disease;
- associated with:
  - a documented contact with a known source patient infected by the same germ;
  - **OR** the notion of care provided by a healthcare professional to patients with the same germ as that affecting him/her;

- **OR** the fact that the healthcare professional has worked in a hospital department that usually provides care to such patients, even if they are not directly taken care of in this department, provided that the mode of transmission of the considered germ is compatible with the contamination of the healthcare professional.

Three major risk factors can be identified for the acquisition of a HCAI: the environment, the healthcare procedure involved, and the patient's condition.

1. Physical presence in institutions or premises in which care is delivered (healthcare environment) as part of a treatment. Such infections will affect the residents of these institutions, whether they are sick or not, but also caregivers and visitors,
2. The implementation of healthcare procedures, whether they be performed inside or outside a healthcare institution. This refers to procedures having a diagnostic, therapeutic (initial or follow-up), screening or primary prevention purpose,
3. The presence of certain underlying medical conditions.

Similarly to the case of healthcare institutions, a coordinated healthcare system in the home of patients who are particularly vulnerable, because of their underlying disease (home hospitalization in particular), should ensure the prevention of transmission of healthcare setting-associated infections (in this case the patient's home) and of infections associated with healthcare procedures.

Excluded from the definition of HCAs are asymptomatic colonizations (urinary, catheter-associated, cutaneous, pressure or non-inflammatory ulcers, bronchial), infections present or incubating at the time of contact with the healthcare system, maternal-fetal infections, except in certain cases (infections by hospital germs, or resulting from an untreated maternal colonization, or newborn necrotizing enterocolitis of an epidemic form).

## Definitions according to anatomical site

### Surgical site infection

#### Superficial infection of the incision

An infection occurring within 30 days after surgery, and affecting the skin (or mucosa), the subcutaneous tissues or tissues located above the covering fascia, diagnosed by:

##### CASE 1

Purulent drainage from the incision.

##### CASE 2

Microorganisms associated with neutrophils on direct examination, isolated from an aseptically obtained culture of the fluid produced by a superficial incision, or from a tissue sample.

##### CASE 3

Opening of the incision by the surgeon

**AND** presence of one of the following signs: pain or tenderness, localized swelling, redness, heat

**AND** microorganism isolated by culture OR culture not made. (A negative culture, in the absence of antibiotic treatment, excludes the case).

*Note: minimal inflammation confined to the points of suture penetration should not be considered to be an infection.*

## Deep infection

### (of the incision or organ space)

An Infection occurring within 30 days after surgery, or within one year if an implant, a prosthesis or a prosthetic material has been installed, affecting the tissues or organs or spaces in or below the covering fascia, or opened or manipulated during surgery, diagnosed by:

#### CASE 1

Purulent drainage from a subfascial drain or a drain placed within the organ or site or space.

#### CASE 2

Spontaneous dehiscence of the incision, or opening carried out by the surgeon, and at least one of the following signs: fever  $> 38^{\circ}\text{C}$ , localized pain or tenderness

**AND** a microorganism isolated by culture, obtained aseptically from a sample of the organ or site or space, or culture not made (a negative culture, in the absence of antibiotic treatment, excludes the case).

#### CASE 3

Abscesses or other signs of infection seen during reoperation, histopathological examination, imaging examination, or an act involving interventional radiology.

*Note: It is important to systematically record whether there is a need for surgical revision.*

## Bacteriuria

Simple urinary colonizations (or asymptomatic bacteriuria) are not healthcare-associated infections.

### Urinary infection<sup>10</sup>

At least one of the following signs: fever ( $> 38^{\circ}\text{C}$ ), urinary urgency, urinary frequency, dysuria, or suprapubic tenderness, in the absence of other causes, infectious or not.

#### And:

- No urinary catheterization or other installation in the urinary tract: leucocyturia ( $\geq 10^4$  leucocytes/ml) and positive urine culture ( $\geq 10^3$  microorganisms/ml) and at most two different microorganisms,
- urinary catheterization or other installations in the urinary tract, currently or within the last 7 days: positive urine culture ( $\geq 10^5$  microorganisms/ml) and at most two different microorganisms.

### Geriatric specificities

Additional clinical signs: possible worsening of mental status or dependency, appearance and/or worsening of incontinence, all in the absence of any other known cause.

It is imperative to perform a urine culture whenever possible. In very rare cases in which urine collection is impossible in a patient who cannot be catheterized, the diagnosis of UTI is based on the presence of at least three of the following signs (or two in catheterized patients):

- fever ( $> 38^{\circ}\text{C}$ ) or chills
- suprapubic tension or flank pain
- burning urination
- recent or increased incontinence
- dysuria or urinary frequency
- worsening of dependency or mental state
- purulent urine and/or presence of nitrites in the strip.

The patient's health context cannot be explained in any other way.

<sup>10</sup> Bacteriuria following urological surgery through the natural channels is not discussed here.

## Bacteremia - Fungemia

At least one positive blood culture (substantiated by clinical signs), with the exception of the following microorganisms:

- coagulase-negative staphylococci
- *Bacillus* spp. (except for *B. anthracis*)
- *Corynebacterium* spp.
- *Propionibacterium* spp.
- *Micrococcus* spp.
- or other saprophyte or commensal microorganisms with a comparable pathogenic potential, for which two blood cultures, positive to the same microorganism, taken from different punctures at different times and within a short time interval (a maximum of 48 hours is usually used), are required.

*Note: Blood cultures should not be taken in the absence of clinical signs (fever or hypothermia, chills, or low blood pressure), except in special cases where they may be absent.*

### SPECIFICITY OF BACTEREMIA WITH MICROORGANISMS OF THE COMMENSAL SKIN FLORA IN NEONATOLOGY

The microorganism is isolated on a single blood culture while the patient is equipped with an intravascular catheter, and appropriate antibiotic therapy has been initiated by the physician; if the patient is already on antibiotics and the antibiotic therapy is not modified as a result of the blood culture, contamination will be retained unless the antibiotic has already been adapted.

Bacteremia and fungemia (grouped under the generic term of bacteremia) were identified independently of the infections which caused them. The entrance site for bacteremia is consistently recorded (secondary bacteremia, including catheter-related infections). If no entrance site has been identified, it is referred to as a primary bacteremia.

## Catheter-related infections (CRI)

The mere presence of positive blood cultures in a catheterized patient with no obvious entrance site is to be identified as a primary bacteremia, and is not be linked to the presence of the catheter.

### Central venous catheters

CVC-associated bacteremia/fungemia are defined as:

- the association of bacteremia/fungemia occurring within the 48 hour interval during which the VC was removed (or suspected diagnosis of infection if the catheter is not removed immediately)

**And:**

- EITHER a positive culture with the same microorganism, on one of the following samples: culture of the insertion site or CVC culture  $\geq 10^3$  CFU/ml
- OR positive peripheral and central blood cultures for the same microorganism, with a quantitative central blood culture to peripheral blood culture ratio  $> 5$ , or a time difference between positive central/peripheral blood cultures  $> 2$  hours, with a faster positive result for the central blood culture.

In the absence of bacteremia, the CRI diagnosis is based on:

- Local CRI:
  - CVC culture  $\geq 10^3$  CFU/ml
  - and purulence of the inlet of the catheter or skin tunnel induration,
- General CRI:
  - CVC culture  $\geq 10^3$  CFU/ml
  - and a total or partial decline of general signs of infection within 48 hours of catheter removal.

*Notes:*

- *The quantitative central blood culture to peripheral blood culture ratio and the time difference between positive central/peripheral blood cultures may be obtained with the sample used to establish the diagnosis of bacteremia.*
- *It is not advisable to apply the technique of semi-quantitative catheter culture using Maki's method.*



## Peripheral venous catheters

### PVC-ASSOCIATED BACTEREMIA/FUNGEMIA:

- the association of bacteremia/fungemia occurring within the 48 hour interval during which the PVC was removed,
- and one of the following elements:
  - PVC culture  $\geq 10^3$  CFU/ml with the same microorganism,
  - or the presence of pus at the PVC insertion site, if no other entrance site has been identified.

### IN THE ABSENCE OF BACTEREMIA, CRI-ON-PVC DIAGNOSIS IS BASED ON:

- Local CRI:
  - CVC culture  $\geq 10^3$  CFU/ml if the PVC is sent for culture because of a suspected infection
  - or presence of pus at the catheter insertion site with positive culture of the insertion site, or lack of culture of the insertion site (a negative culture, in the absence of antibiotic treatment, excludes the case).
- General CRI:
  - PVC culture  $\geq 10^3$  CFU/ml
  - and a total or partial regression of general signs of infection within 48 hours of catheter removal.

## Arterial catheters

The frequency of infection is typically lower than for central venous pathways. The definition is the same as for CVCs.

## Dialysis catheters and pulmonary artery catheters

The frequency of infection is high due to frequent handling, which should be subject to specific recommendations. The definition is the same as for CVCs.

## **Long-term catheters**

### **(tunneled catheters and implantable catheters)**

As the catheter is not always removed, the diagnosis of a CRI is often made with the equipment in place. In this case, all of the diagnostic methods used with the catheter in place are important: differential blood cultures, local samples in the case of a cutaneous emergence.

Moreover, the appearance of clinical signs when using the venous catheter (connection of an administration set) is highly predictive of a catheter infection. The time difference between positive central/peripheral blood cultures then allows the diagnosis to be made.

The definition is the same as for CVCs, with the infection date being taken as the date of suspected diagnosis and not the date of catheter removal.

## **Cases of catheter colonization**

The epidemiological surveillance of catheter colonization imposes the systematic culture of catheters following their removal, and the use of the same culture technique by all healthcare institutions participating in the surveillance network. Under these conditions, colonization is defined as a positive catheter culture (quantitative method  $\geq 10^3$  CFU/ml), regardless of the presence of any associated clinical signs or microbiological data, as defined above, leading to the diagnosis of a CRI.

## Pulmonary infections

These are divided into two categories:

- mechanical ventilator-acquired pneumonia (VAP), i.e. any pneumonia occurring in a patient whose breathing is assisted by a machine, or invasively through an endotracheal tube or tracheostomy, or non-invasively by means of a facemask or other processes, within the 48 hours preceding the onset of infection,
- pneumonia occurring in the absence of mechanical ventilation, for which the microbiological, or even radiological diagnosis can be difficult and sometimes impossible to establish.

*Inhalation pneumonia promoted by consciousness or swallowing problems prior to admission and not related to initial care are excluded from the definition.*

### Definition of pneumonia

#### Radiological signs:

- two or more radiographs with an image suggesting the presence of pneumonia,
- in the absence of a history of heart disease or an underlying lung disease, a single X-ray or single CT scan examination is sufficient.

#### And at least one of the following signs:

- hyperthermia  $> 38^{\circ}\text{C}$  without any other cause,
- leucopenia ( $< 4000 \text{ GB/mm}^3$ ) or hyperleucocytosis ( $> 12\,000 \text{ GB/MM}^3$ )

And at least one of the following signs (or at least two of the following signs for the diagnosis of probable or clinical-only pneumonia - see the definition of probable pneumonia below):

- appearance of purulent secretions or changes in their characteristics (color, odor, quantity, consistency),
- coughing or dyspnea or tachypnea,
- suggestive auscultation,
- worsening blood gas (desaturation) or increased oxygen or respiratory assistance requirements.

## And according to the diagnostic method used:

A microbiological documentation is highly recommended (cases 1, 2 or 3).

### CASE 1

Bacteriological diagnosis performed through protected bacteriological examination in association with microorganism counts:

- bronchoalveolar lavage (BAL) with a threshold of  $> 10^4$  CFU/ml, or
- $\geq 2\%$  of cells obtained by BAL with inclusions in the bacterial Gram for direct examination classified in the BAL diagnostic category), or
- Wimberley brush with a threshold of  $> 10^3$  CFU/ml or protected distal sampling (PDS) with a threshold of  $> 10^3$  CFU/ml.

### CASE 2

Bacteriological diagnosis performed through unprotected bacteriological examination in association with microorganism counts:

- quantitative bacteriology of bronchial secretions with a threshold of  $> 10^6$  CFU/ml (these thresholds have been validated in the absence of a prior antibiotic therapy).

### CASE 3

Alternative microbiological methods:

- positive blood cultures (in the absence of another source of infection),
- positive culture of pleural fluid
- pleural or lung abscess with positive culture
- lung histology suggestive of pneumonia
- modern alternative microbiological diagnosis methods (antigenemia, antigenuria, serology, molecular biology techniques), validated by studies with a high level of evidence.

### CASE 4

Bacteriological examination of sputum or non-quantitative examination of bronchial secretions.

### CASE 5

No microbiological criterion.

*Cases 1, 2 and 3 correspond to certain or probable pneumonia. Cases 4 and 5 correspond to possible or even clinical pneumonia, in the absence of a chest X-ray.*

### **Possible or clinical pneumonia**

When it is not possible to perform a chest X-ray, the presence of at least three clinical signs in the respiratory sphere:

- new or worsening cough
- onset or worsening of sputum
- onset or worsening of dyspnea
- new or worsening bronchial congestion
- new or worsening auscultation signs (unilateral crackles, wheezing, rhonchus)
- appearance of chest pain
- increased respiratory rate (rest tachypnea > 25).

Associated with at least one systemic sign:

- fever > 38 ° C
- worsening dependency or mental status, which cannot be otherwise explained.

*Note: It is imperative to perform a chest X-ray whenever possible.*