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Healthcare-associated infections: think globally, act locally

J.-P. Marcel[1], M. Alfa[2], F. Baquero[3], J. Etienne[4], H. Goossens[5], S. Harbarth[6], W. Hryniewicz[7], W. Jarvis[8], M. Kaku[9], R. Leclercq[10], S. Levy[11], D. Mazel[12], P. Nercelles[13], T. Perl[14], D. Pittet[6], C. Vandenbroucke-Grauls[15], N. Woodford[16] and V. Jarlier[17]

[1]Executive Committee, Societé Française de Microbiologie, Paris, France, [2]St Boniface General Hospital, Winnipeg, Canada, [3]Ramon y Cajal University Hospital, Madrid, Spain, [4]Medical University, Lyon, France, [5]University Hospital Antwerp, Antwerp, Belgium, [6]Hopital Cantonal de Geneve, Geneva, Switzerland, [7]National Medicines Institute, Warsaw, Poland, [8]Jason and Jarvis Associates, Port Orford, OR, USA, [9]Tohoku University Graduate School of Medicine, Sendai, Japan, [10]Hopital Universitaire, Caen, France, [11]Tufts University School of Medicine, Boston, MA, USA, [12]Institut Pasteur, Paris, France, [13]Universidad de Valparaiso, Valparaiso, Chile, [14]John Hopkins School of Medicine, Baltimore, MD, USA, [15]Medical Microbiology and Infection Control, VU University Medical Centre, Amsterdam, The Netherlands, [16]Health Protection Agency, London, UK and [17]Hospital Universitaire Pitié-Salpêtrière, Paris, France

ABSTRACT

Healthcare-associated infections (HAIs) have been a hot topic for several decades. An understanding of HAIs should be based on an understanding of the organisms that cause infection and determine prevention. Although some improvements in control in hospitals have been recorded, the community setting is now implicated, and the role of microbiology in diagnosis, detection of carriers and strain typing of organisms is evident. As healthcare systems vary widely, prevention strategies must be designed accordingly. Hand hygiene, however, remains applicable in all settings, and the WHO is strongly promoting alcohol-based hand rubs to interrupt transmission. Some countries are only beginning to develop standards, whereas compliance is obligatory in others. Economics and cost factors are common to all countries, and litigation is increasingly a factor in some.

Keywords alcohol-based hand rub, *C. difficile*, consumer unions, ESBL, healthcare-associated infections (HAIs), microbiology, MRSA, prevention strategies, search and destroy, VRE

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Healthcare-associated Infections (HAIs) have been a hot topic for several decades, and constitute an issue of increasing importance now that medical care involving the risk of infectious complications (surgery, intensive care, grafts, etc.) is being delivered to populations with increasing susceptibility to infection (e.g. those who are of advanced age and those who are immunodeficient). For this reason, the healthcare community is spending increasing time and resources to address this issue, leading to progress in various aspects of HAIs.

Corresponding author and reprint requests: J.-P. Marcel, Executive Committee Societé, Française de Microbiologie, 191 rue de Veugirard, 75015 Paris, France
E-mail: jpierre.marcel@gmail.com

Like community-acquired infections (CAIs), HAIs offer a wide range of models with distinct consequences for prevention, diagnosis and treatment. Indeed, the basic features of the microorganisms involved and the risk factors determine the type of HAI. Recent developments in microbiology have provided improved understanding and better tools with which to document situations and anticipate evolutions.

Furthermore, HAIs occur within healthcare systems which are very diverse in medical scope, resources and style of management, reflecting socio-economic and cultural differences. Most countries address the issue of HAIs in their own context, and therefore with different organizations and priorities.

An International HAI Forum, held early June 2007 in Les Pensières, near Annecy, France,

provided the opportunity to exchange data and perspectives on HAIs from a multidisciplinary and global perspective. This report covers the key themes discussed during the Forum, namely, the factors driving HAI risk, multidrug resistance and HAIs, intercontinental HAI strategies, HAI and genetics, and societal aspects of HAIs.

FACTORS DRIVING HAI RISK

HAIs arise from the interaction of several factors: pathogenicity of microorganisms, general and local patient immunity, iatrogenic procedures, cross-contamination and antibiotic pressure.

HAIs and pathogenicity of microorganisms

The microorganisms involved in HAIs can be schematically classified into three groups according to their ecological features and pathogenicity.

Commensal bacteria, which constitute normal patient flora, are the most frequent agents of HAIs. The main reasons for this are: (i) the huge number of these bacteria (10^{13}, of which 10^9 are on the skin, 10^{10} in the nasopharynx and 10^{13} in faeces, exceeding the number of eukaryotic cells in the human body); (ii) their permanent presence, ensuring that they are always 'on hand', particularly in the case of invasive procedures; and (iii) the fact that, although commensal, several species have marked potential pathogenicity, allowing them to easily create infections when introduced into sterile body sites. *Staphylococcus aureus*, *Escherichia coli* and *Enterococcus* spp. are the three main commensal species involved in HAIs, accounting, respectively, for *c*. 15–20%, 20–25% and 0–5% of the cases. Altogether, commensal species account for 70–80% of HAIs.

Saprophytic bacteria (e.g. *Pseudomonas aeruginosa*, *Enterobacter* spp., *Serratia* spp. and *Acinetobacter baumannii*) present in the environment (e.g. water, air and soil) can colonize patients, particularly those receiving antibiotic therapy, and can cause infections in the case of invasive procedures. Other saprophytic organisms (e.g. *Legionella* and *Aspergillus*) can be disseminated among patients via air or water systems. The incidence of HAIs due to *Legionella* and *Aspergillus* depends on the types of patient in the hospital and on efforts to control water and air supply systems. Altogether, saprophytic species account for *c*. 20–25% of HAIs, and *P. aeruginosa* is the third most frequently involved species in HAIs (*c*. 10%). The most frequently involved saprophytic *Enterobacteriaceae* are *Enterobacter* spp. (*c*. 5% of HAIs). *A. baumannii* is responsible globally for less than 2% of HAIs, but can be involved in epidemics, mostly in intensive care units (ICUs). Finally, highly pathogenic organisms that are major agents of CAIs (e.g. *Mycobacterium tuberculosis*, influenza virus, rotavirus, hepatitis B virus and hepatitis C virus) are less common causes of HAIs (less than 5%), but can cause severe infections or epidemics in certain settings (e.g. among geriatric and paediatric populations).These three groups of organisms cause HAIs that differ widely in their nature and epidemiology, and this affects the preventive measures needed to control them.

Risk factors

Invasive procedures are major risk factors for HAIs. On the one hand, these procedures are used with increasing frequency (e.g. surgery and intravascular devices), but on the other hand, the risk of infection is progressively controlled by revising and reinforcing preventive measures. It should be noted that nowadays iatrogenic risks and 'nosocomial' infections can also occur outside the hospital setting (e.g. in ambulatory care), justifying the use of the term HAI in place of 'nosocomial'.

Many hospitalized patients are immunocompromised and therefore at high risk of infection, even by microorganisms with low pathogenicity. For these reasons, uncommon types of HAI should now be recognized by laboratories, physicians and epidemiologists (e.g. bone and joint infections due to *Propionibacterium acnes*, urinary tract infections (UTIs) due to *Corynebacterium urealyticum*, and surgical wound infections (SWIs) due to fast-growing mycobacteria such as *M. chelonae*).

Cross-contamination

Exchange of commensal flora is natural among humans, and cross-contamination is the key route of transmission for many pathogenic microorganisms. In the hospital setting, cross-contamination is amplified by the density of patients and the number of direct contacts between healthcare workers (HCWs) and patients. Cross-contamination can be reduced by standard precautions, especially hand hygiene. Significant improve-