Considerations for a WHO European strategy on health-care-associated infection, surveillance, and control

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Health-care-associated infection (HAI) is a major issue of patient safety with a substantial impact on morbidity, mortality, and use of additional resources worldwide. In April 2004, the WHO Regional Office for Europe organised the first international consultation to address the issue of HAI in eastern and central Europe. The main objectives of the consultation were to identify the primary needs and obstacles for the prevention and control of HAI at country level, to design the essential components of an international strategy to effectively address the issue of HAI, and to identify specific priorities and recommendations for interventions by the WHO and other international institutions. An update on HAI activities and related networks throughout Europe, together with the outcome of the meeting, are presented, with special emphasis on future considerations for a European WHO strategy on HAI prevention.

A health-care-associated infection (HAI) is generally defined as "an infection occurring in a patient in a hospital or other health-care facility in whom the infection was not present or incubating on admission to that hospital/facility".[1] Some of these infections, such as surgical site infections, can occur after patient discharge, depending on the incubation period and the length of stay. The concept of HAI extends also to infections acquired by health-care workers as a result of their work within the health-care system.

HAI have a substantial impact on morbidity and mortality. They prolong the duration of hospital stay, require additional diagnostic and therapeutic interventions, and generate added costs to those already incurred by the patients' underlying diseases. Furthermore, hospitals are notorious as a source for the emergence, selection, and spread of multiresistant bacteria that can cause severe clinical syndromes that are difficult and expensive to treat and may even become virtually incurable. Health-care settings also act as a reservoir for the dissemination of resistant organisms to the community and may, in some cases, become the epicentre for the spread of emerging epidemic agents, like severe acute respiratory syndrome (SARS) or ebolavirus. Some of these conditions would certainly have led to "complete isolation" in times when quarantine hospitals and even quarantine islands were frequent (figure 1). The occurrence of HAIs is detrimental both to the patient and health-care workers and, consequently, HAI rates are considered an indicator of the quality of care. Although HAI may occur as an adverse event potentially expected from the more advanced and sophisticated care techniques of modern medicine, it is also evident that frequently they represent a failure in health-care performance and therefore are considered a patient safety issue.

Given the wide range of pathogens and different health-care settings involved, reliable, standardised figures on HAI at national and international levels are extremely difficult to obtain. National surveys undertaken in different European countries during the past 20 years have reported overall HAI prevalence rates in hospitals ranging from 3·5% to 14·8%.[2–13] About 2–3 million people are estimated to be affected by HAIs in Europe annually with a corresponding economic burden of €800 million.[14,15] Available data are insufficient to allow an estimate of HAI-related mortality for the entire European region, but HAI attributable deaths are estimated at around 5000 annually in the UK[16] and France.[17] These figures could be even higher if the burden of infections occurring in patients admitted to health-care facilities with a lower awareness of the need for HAI surveillance activities, infection prevention, and control interventions (eg, long-term care facilities, private clinics, nursing homes) is taken into consideration.
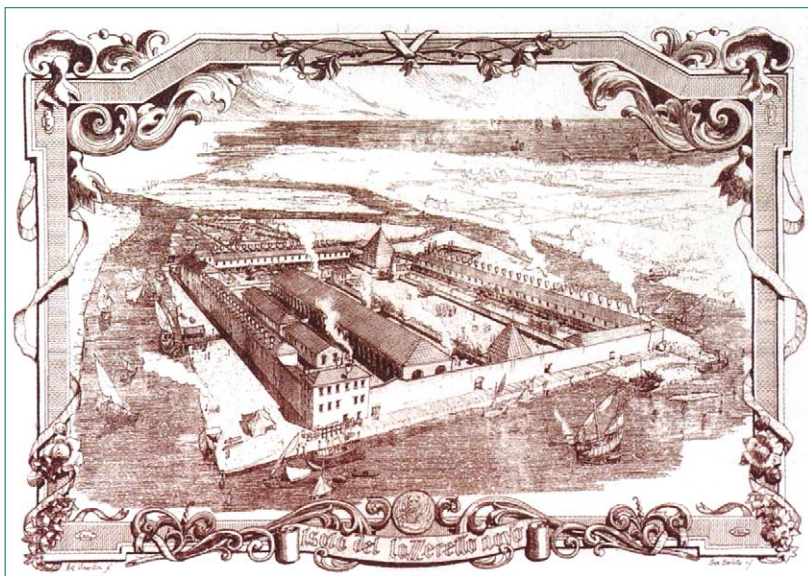

Figure 1: Lazzaretto Nuovo in the 16th–18th century.
The Lazzaretto Vecchio, the first isolation institution worldwide, was established on the island of Saint Mary of Nazareth (later renamed Lazzaretto Nuovo) in Venice in 1423 to limit the spread of plague (from which the name "Lazzaretto" originated). In 1468, the Venetian Senate designated Lazzaretto Nuovo as a quarantine island and huge warehouses were erected to store merchandise arriving in Venice from suspect areas with merchants and sailors quartered alongside. Reprinted with permission from Vanzan Marchini NE. I recinti della peste. In: Rotte Mediterranee e Baluardi di Sanità. Geneva-Milan: Skira Editore SpA, 2004: 207.

Consultation background

For many years, HAI has been considered primarily to be a clinical care and hospital management issue, and has only recently been recognised as a global public-health problem. As a result, the international community and the WHO have addressed the problem only in a limited and fragmented manner. Some guidelines and documents are available but they are limited in scope, and in the extent to which they offer tools for national programme managers. They have not been widely translated from their original languages, distributed to other countries and interested parties, nor have they been implemented. A recent inventory of activities and documents related to HAI available at the WHO headquarters and the WHO Regional Office for Europe (WHO EURO) is summarised in web appendix 1 (http://image.thelancet.com/extras/ 05ID10006webappendix1.pdf). Among these initiatives, there are some successful examples of programmes related to infection prevention and control, such as the blood and injection safety programmes. However, there is currently no established group or specific programme committed to comprehensively address the problem of HAI at either global or regional levels. Recent events, particularly lessons learned from the SARS epidemic, which had a major nosocomial component, have shown that it is now urgent to bring the HAI issue to the forefront of infection control. Based on these premises, WHO EURO, in collaboration with the International Health and Social Affairs Office of the Veneto Region, Italy, the Department of Infectious Diseases of the University of Verona, Italy, and several departments in WHO headquarters, organised an international consultation to address the issue of HAI in eastern and central Europe.

Objectives and consultation framework

Representatives from several eastern European countries, including Bulgaria, Croatia, Kyrgyzstan, Lithuania, Poland, Romania, Russia, Turkey, Ukraine, and Uzbekistan, were invited to attend the consultation (see web appendix 2; http://image.thelancet.com/extras/05ID 10006webappendix2.pdf). To approach the topic from different viewpoints in an integrated manner, professionals from differing health-care backgrounds in each country were invited: a health manager (eg, local government representative, hospital administrator), a health professional involved in infection control activities, and a high-level policy-maker (health ministry delegate).

In addition, a group of internationally acknowledged HAI experts from Belgium, France, Finland, Italy, the Netherlands, Switzerland, and the UK participated in this meeting, together with members of existing European institutions and networks related to HAI, and WHO staff from different areas, including infectious diseases, health technologies, and patient safety.

The meeting consisted of expert presentations, plenary discussions, and working groups. The expected outcome was to design the essential components of an international strategy to effectively cope with the issue of HAI, and to establish an international collaboration in the field of HAI surveillance and control.

Update on activities and networks on HAIs in the European region

The first part of the consultation reviewed HAI epidemiology in Europe to identify effective and feasible models for HAI surveillance and control in daily practice at hospital level, as well as within international networks (see web appendix 3; http://image.thelancet.com/extras/ 05ID10006webappendix3.pdf). Implementation of basic prevention and infection control measures, as well as current and future challenges, were thoroughly discussed and are summarised in panel 1.

A wide array of epidemiological studies have been undertaken in European countries at national (figure 2) and/or hospital level over the past 25 years, and report very different infection rates.[2–13,18–24] Nevertheless, the number of multicentre and international studies that could provide a reliable European overview of HAI epidemiology is still limited owing to the lack of coordinated activities,

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Panel 1: Major topics in infection prevention and control activities

Organisation

At national level

Develop a national IC programme; establish a national IC committee; allocate specific budget resources for infection prevention and control; make infection prevention and control interventions mandatory by law

At hospital level

Establish an IC committee; designate an IC team; build up an IC programme; prepare written IC guidelines; organise active surveillance and investigation; establish an alert system for sentinel pathogens/events

Application

Hand hygiene; standard precautions; transmission-based precautions; environmental cleaning; waste disposal; disinfection; updated sterilisation procedures; judicious use of antibiotics; outbreak investigation and control

Examples of interventions

Surveillance and prevention of surgical site infection; prevention of catheter-related infection; prevention of catheter-related urinary tract infection; prevention of ventilator-associated pneumonia; campaign to increase the compliance of health-care workers with hand hygiene practices; education strategies to improve application of standard and transmission-based precautions; guideline/strategies for antibiotic control; system changes to improve the efficiency of infection prevention and control

Considerations

Battle against multiresistant organisms; antimicrobial control; patient profile-based infection prevention; new materials; emerging pathogens; computerised patient record/data mining; evidence-based recommendations for IC and prevention. New challenges: transgenic therapy; massive and complete immunosuppression; xenotransplantation; prion-related issues; SARS, influenza H5N1 and H7N7; cost constraints; new health-care delivery systems; health-care worker behaviour and modification

IC=infection control

Figure 2: **European countries where national HAI surveillance studies have been done (in orange).**
Note: only data published in peer-reviewed journals have been considered to generate the figure; reports available only from websites or other sources have not been used.

standardised methods, and agreed definitions. Therefore, no meaningful comparison of nosocomial infection rates between different studies in hospitals or countries can be made if survey methods are not harmonised in advance, and if adjustment for case-mix is lacking.[25–27] Hence, there is a need for robust national or international HAI surveillance protocols to obtain comparable and unbiased data. However, substantial progress is to be expected from some European initiatives.

As part of efforts of the European Parliament and Council to establish networks for epidemiological surveillance and control for communicable diseases in the European Union (EU), three surveillance networks directly and indirectly related to HAI have been established. These are HELICS (Hospital in Europe Link for Infection Control through Surveillance), EARSS (European Antimicrobial Resistance Surveillance Scheme), and ESAC (European Surveillance on Antimicrobial Consumption).

The HELICS network, aimed at HAI surveillance, currently involves 31 European countries and is

increasing its coverage regularly (figure 3). The main activity of HELICS is surveillance of surgical site-acquired infections and intensive care unit-acquired infections according to standardised protocols, including agreed case definitions and risk adjustment methods; specific software for data collection and statistic tools for data analysis and reporting are freely available to participating countries and hospitals (http://helics.univ-lyon1.fr). As a network, HELICS has not yet addressed the reporting of special events such as epidemics, emerging pathogens, and environmental threats. These shortcomings are to be addressed in a follow-up project. The HELICS philosophy is based on the following essential points: the need for legislation making surveillance recommended and/or compulsory through an accreditation process; the choice of meaningful indicators of HAI adjusted for patient characteristics and level of exposure to invasive procedures, and linked to feasible prevention actions; and the identification of a minimum data set, possibly collected through a computerised data management system. A key aspect of
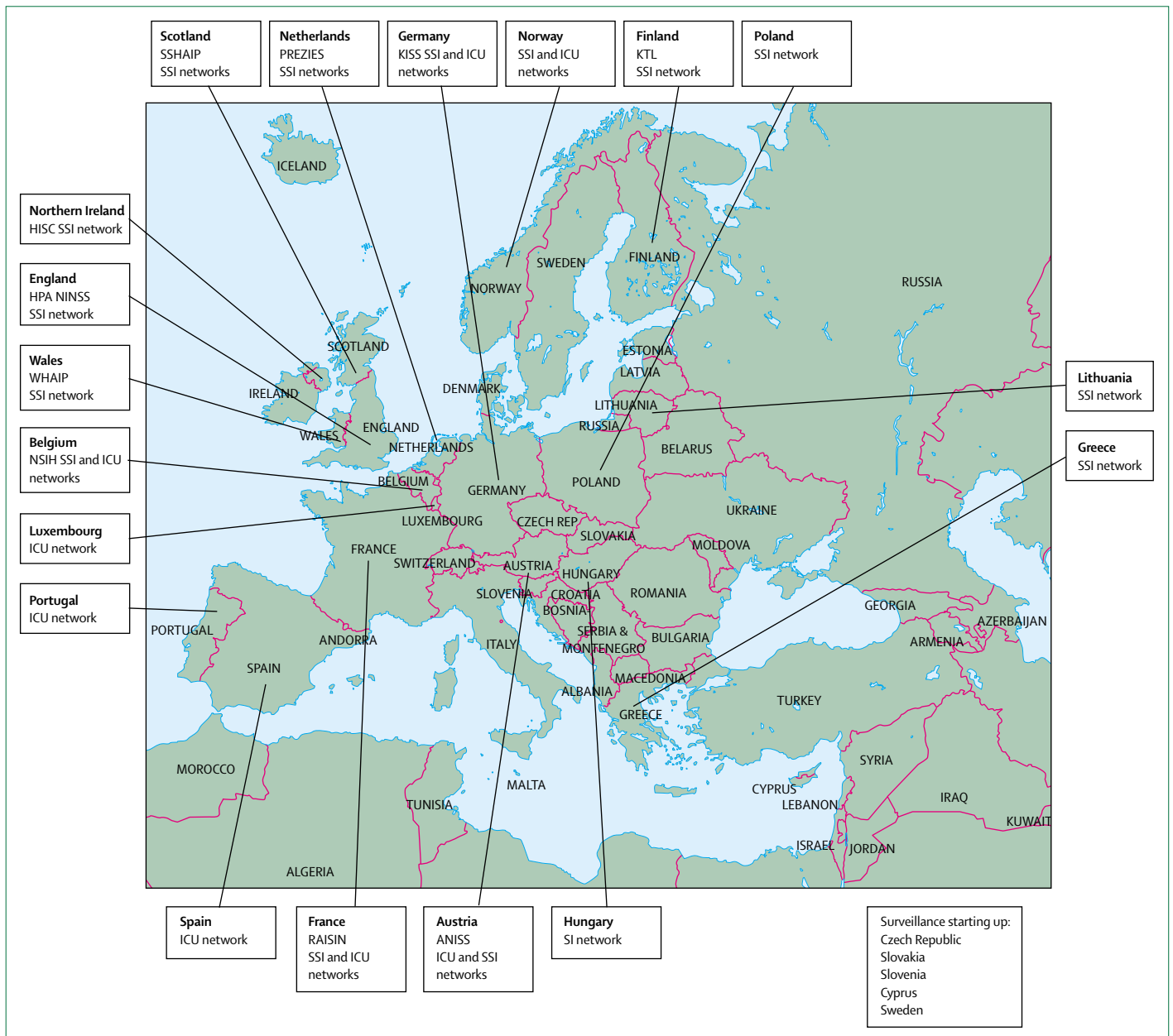
Figure 3: **Hospital in Europe Link for Infection Control through Surveillance (HELICS)-associated surveillance national networks, 2004.**
Currently ongoing surveillance programmes (as of the end of 2004), as well as surveillance activities planned to start in the near future are indicated. ANISS=Austrian Nosocomial Infection Surveillance System, Envin=Estudio Nacional de Vigilancia de Infección Nosocomial en Servicios de Medicina Intensiva, HISC=Health-care Associated Infection Surveillance Centre, HPA=Health Protection Agency, ICU=intensive care unit, KISS=Krankenhaus Infektions System, KTL=Kansanterveyslaitos Folkhälsoinstitutet, National Public Health Institute, NINSS=Nosocomial Infection National Surveillance Scheme, NSIH=National Surveillance of Infections in Hospitals, PREVINE=Programa Específico de Vigilancia de las Infecciones Nosocomiales en España, PREZIES=Prevention of Nosocomial Infections by Surveillance, RAISIN=Réseau Alerte Investigation Surveillance des Infections, SSHAIP=Scottish Surveillance of Health-care Associated Infection, SSI=surgical site infections, WHAIP=Welsh Health-care Associated Infection Programme.

the HELICS philosophy is to support the creation of national surveillance networks. Consequently, individual hospitals can only participate through their national network, except under certain circumstances (eg, for piloting if a national network is not available).

EARSS includes surveillance systems in 31 countries (http://www.earss.rivm.nl). By linking national networks,

it aims to maintain a comprehensive surveillance and information system providing comparable and validated data on the prevalence and spread of major invasive bacteria with clinically and epidemiologically relevant antimicrobial resistance. The goal of EARSS is neither to produce crude data, nor to classify countries in a league table, but rather to provide a partnership and a forum for
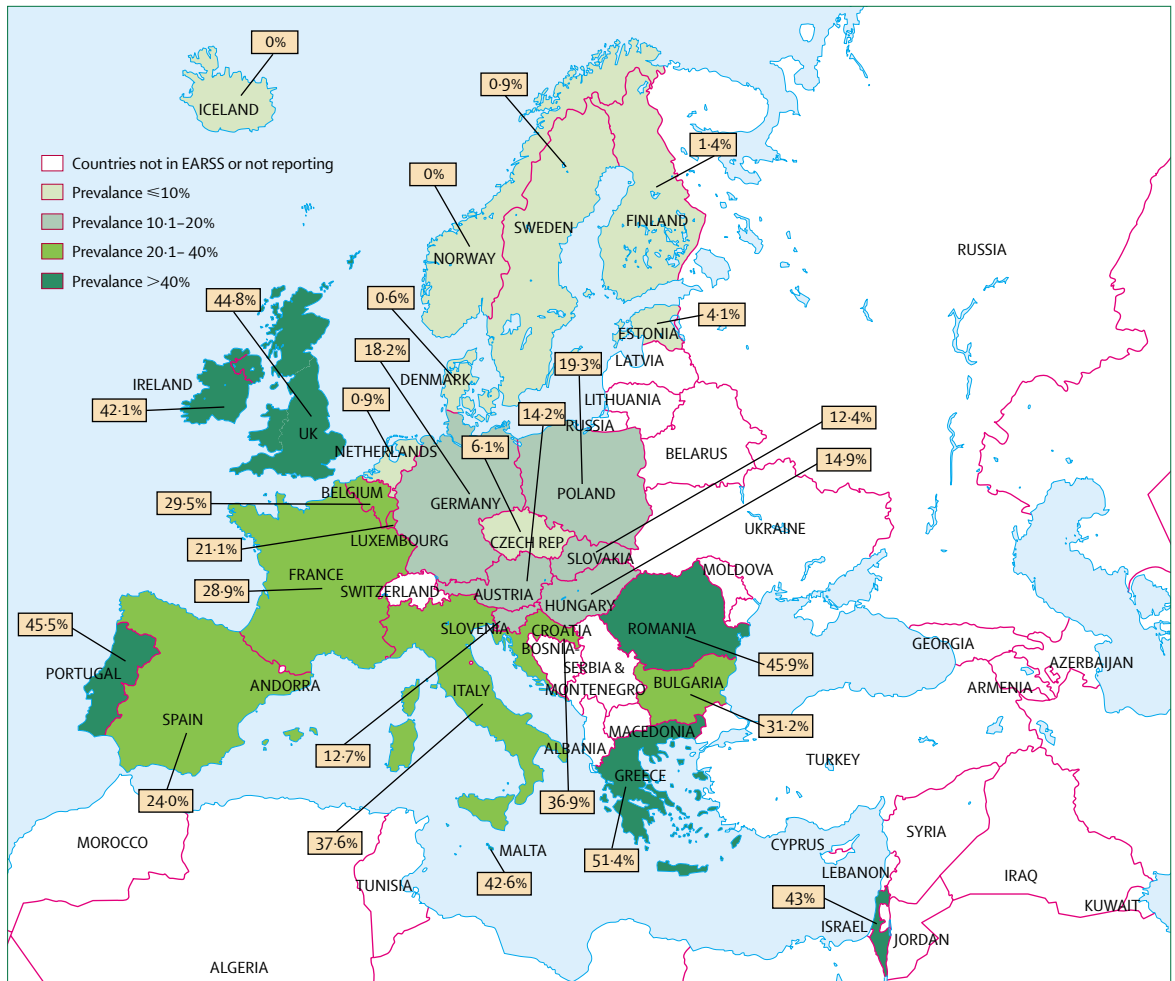
Figure 4: Prevalence of meticillin-resistance among *Staphylococcus aureus* bloodstream isolates in 2003.
Data from 28 countries reporting to the European Antimicrobial Resistance Surveillance Scheme (EARSS) in 2003 (http://www.earss.rivm.nl, accessed Feb 16, 2005).

exchange of experiences to stimulate the implementation of national networks. Samples are collected at community and hospital level and the resistance patterns of five major pathogens—*Streptococcus pneumoniae, Escherichia coli, Staphylococcus aureus, Enterococcus faecium,* and *Enterococcus faecalis*—are detected according to international standardised methods and summarised in widely available datasets and figures. Variations in antimicrobial resistance in clinical specimens over time and location are monitored, and used for policy decisions and the assessment of effectiveness of intervention. Figure 4 illustrates a possible use of the tools of this network to map the prevalence of meticillin resistance among *S aureus* across European countries.

The third international surveillance network funded by the EU is the European Surveillance of Antimicrobial Consumption (ESAC), which includes 33 participating countries (http://www.ua.ac.be/main.asp?c=*ESAC). This project aims to develop a data collection system to produce standardised, comprehensive national data on the volume of antibiotic consumption in ambulatory and hospital

care. The goal is to highlight variations in antibiotic consumption and make possible the comparison of regional antibiotic use in relation to antibiotic-resistance patterns.[28] One of the main merits of ESAC is that countries actually make antimicrobial consumption data available; these data are used to monitor interventions designed to contain antimicrobial resistance and, consequently, to reduce the frequency of infections due to resistant pathogens.

In addition, the European Society of Clinical Microbiology and Infectious Diseases (ESCMID; http://www.escmid.org/sites/index.asp) has created several study groups with activities directly or indirectly associated with HAI. The European Study Group on Nosocomial Infections (ESGNI; http://www.escmid.org/sites/index_f.asp?par=2.5.0&Ref=372) has the mandate to study the various aspects of HAI and to involve ESCMID members in networks, educational activities, and epidemiological and intervention studies. Another important working group is the ESCMID Study Group for Antimicrobial Resistance Surveillance (ESGARS;

http://www.escmid.org/sites/index_f.asp?par=2.5.0&Ref=366), which recently produced a comprehensive and very useful document containing the European recommendations for antimicrobial-resistance surveillance.[29] An interesting, EU-funded research project of ESCMID, Antibiotic Resistance Prevention And Control (ARPAC; http://www.abdn.ac.uk/arpac/main-escmid.htm), investigated the state of infection control programmes in 167 European hospitals in 2001 using a questionnaire.[30] The results showed important differences and inequalities between EU countries in infection control practices (eg, use of alcohol-based handrubs for hand hygiene) and infrastructure (eg, availability of single rooms), and a general lack of auditing and feedback activities to monitor the impact of surveillance and interventions. Finally, the EU has launched a research project, HARMONY (Harmonisation of Antibiotic Resistance measurement, Methods of typing Organisms and ways of using these and other tools to increase the effectiveness of Nosocomial infection control), with the major objective to promote a closer and more productive collaboration with ESCMID. Through this initiative, the efforts of all participating institutions are united to produce harmonised and validated tools that will assist field professionals in dealing with three major issues: antimicrobial susceptibility monitoring, microbial typing, and infection prevention and control.

Outcome of working groups

Following the introductory and briefing sessions, presentations highlighted the different realities and status of implementation of HAI activities in some participating countries. Delegates were then actively involved in two working groups with the objectives of sharing experiences, identifying the main obstacles to adequately dealing with HAI encountered in their countries, and suggesting affordable solutions. Working group 1 focused on organisational approaches and advocacy for HAI

surveillance and control, and addressed policy-makers; working group 2 was centred around practical aspects of HAI prevention and control, and involved mainly the infection prevention and control specialists. For both groups, the expected outcome was the identification of specific priorities and recommendations to the WHO, other international institutions, and the member states for an effective and practical strategy on HAI.

Working group 1 dealt specifically with the following issues: how to generate interest in HAIs among decision-makers and governments to achieve support and funding for HAI surveillance and control, how to identify reliable organisational models for HAI surveillance, and how to strengthen and expand the existing international networks.

On the first point, the participants agreed that while the problem of HAI is well known and acknowledged by politicians and policy-makers in theory, practical solutions are not easily found. They suggested capitalising on new international opportunities and competing for funding in a united way. The principal

points to persuade hospital administrators included the links between HAI, quality assurance, accreditation of health-care facilities, patient safety, the morbidity and mortality burden of HAI, and the associated economic costs. Health insurance leverage is another factor emerging as a force on which to capitalise.

With regards to surveillance, it was highlighted that it is often difficult to expand from mandatory reporting systems to more comprehensive surveillance pro-grammes needed for monitoring and evaluation of HAI. As a result, very few consistent data on HAI are obtained and used to generate interventions. To build reliable and efficient HAI surveillance models, the following needs were identified: international standardised case defi-nitions—in particular, the heterogeneity of underlying diagnostic procedures; guidelines to correctly perform surveillance studies and to analyse and translate results into practice; and reference laboratories for antimicrobial susceptibility testing and typing accredited by a quality assurance system. Specific educational activities on surveillance methods and use of surveillance data are urgently required; multistep internet modules have been suggested as an innovative, widely accessible, potentially time-sparing option. To ensure that surveillance activities have an impact on infection prevention and control strategies, it is crucial to develop valid processes and outcome indicators and to use them to interact with quality management and patient safety groups. Appropriate ways of ensuring that data collected by surveillance activities are correctly interpreted and made regularly available to the public, patients (and their

advocates), national health insurance schemes, and hospital managers, should also be sought.

International collaboration through existing networks should be encouraged to support educational activities with exchange of core competencies and technical materials, to organise multicentre studies on the different aspects of HAI, especially on the cost-benefits of infection prevention and control interventions, and to reach a consensus on the minimum national standard of infection prevention and control that must be achieved. Additional partners should be encouraged to join in the existing international networking—eg, the World Alliance

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Panel 4: Infection prevention and control issues ranked by order of priority*

General importance
- Surveillance
- Outbreak investigation
- Interventions
- Education
- Guidelines on infection control structures and procedures

Needs (at country/hospital level)
- Interventions
- Outbreak investigation at country level
- Surveillance
- Education
- Guidelines on infection control structures and procedures

*Results of working group 2, see text for further explanation

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Obstacles	Actions	WHO collaboration
Issue 1: Infection prevention and control intervention		
Lack of understanding of IC issues and low priority given to interventions from hospital administrators. Difficulties in designing interventions and analysing and summarising the results. Lack of resources and personnel. Absence of a link between surveillance and intervention.	Implement training to obtain skills in performing interventions. Include IC issues in national laws and regulations to obligate hospital administrations to actively support interventions. Position IC teams adequately within the hospital hierarchy. Make IC and patient safety a priority in hospitals. Apply existing data to argue for resources.	Organise training courses in intervention techniques. Provide practical guidance on intervention strategies. Promote platforms for exchange of experience and knowledge at national and international level. Make information about successful strategies easily accessible to all. Promote expert consensus on this issue. Stimulate IC prioritisation in regulations, hospital accreditation, and national policies. Make WHOnet an important tool to support interventions at national and hospital level. Promote patient safety as a priority in health care.
Issue 2: Outbreak investigation		
Difficulties in recognising outbreaks. Lack of coordination between microbiological (typing) and epidemiological analysis. Lack of communication between laboratory and clinical team. Lack of collaboration between surveillance systems and hospital-based IC teams. Punitive attitude shown for outbreak investigations. Lack of tools, know-how, resources. Unpreparedness to crisis management and interaction with media.	Organise training courses at regional level. Establish a straightforward communication between laboratory and clinical investigators. Establish a straightforward communication between surveillance systems and hospital-based IC teams. Establish a national network as platform for timely communication about ongoing outbreaks.	Organise training courses in outbreak investigation. Establish rules for communication between laboratory and IC clinical team in regulations. Foster early warning systems and a communication platform to alert for emerging and multiresistant pathogens. Prepare practical guidelines to react to outbreaks with emerging pathogens. Establish a 24 h hotline for rapid access to information and knowledge on pathogens involved in outbreaks. Offer training in media appearance.

IC=infection control

Table: **Prevention and control of HAIs: priorities, obstacles, and possible considerations for WHO collaboration.**

Panel 5: 12 priority actions for a WHO strategy for HAI surveillance prevention and control in Europe

- Collaborate with existing networks and other European health agencies and scientific institutions
- Consider infection control in a "patient safety" perspective
- Prioritise HAI surveillance and control within international health regulations
- Establish a minimum standard of infection control to be achieved in each country
- Launch practical activities (eg, hand hygiene campaign, infection control pocket book)
- Monitor HAI surveillance and control through valid and simple processes and outcome indicators
- Increase national and international preparedness to unexpected outbreaks
- Unite with other international partners to organise training on HAI surveillance and control
- Create an interactive page about HAI on WHO website
- Promote research on adjustment tools and standardised surveillance methods, cost-benefit investigations, computerised data mining
- Create a permanent expert advisory committee on HAI
- Seek new and consistent funding for HAI

for Patient Safety, the European Science Foundation, the Health Technology Assessment and National Audit Offices, the European Programme for Intervention Epidemiology Training, the International Federation of Infection Control, the Baltic Network, the South Eastern European Network, and the International Network for the Study and Prevention of Emerging Antimicrobial Resistance, accreditation bodies, professional associations, health-system financing bodies, and insurance organisations. These discussion topics were finally summarised in a list of key recommendations to the WHO (panel 2).

Working group 2 objectives were to establish the minimum standard of infection prevention and control to be achieved at national level, to identify the obstacles and the needs at country level, and to suggest the priority areas for WHO support to countries.

The facilitators identified a list of main infection prevention and control issues (panel 3) and asked participants to rank these according to: (1) a general concept of priority in their opinion, (2) the actual needs at the country level, and (3) actual needs in a global WHO perspective. As a result, intervention management for infection prevention and control and outbreak investigation were identified as top priorities, both of general importance and also according to needs (panel 4). Interestingly, issues considered a top priority of general importance—eg, surveillance—were ranked in a much lower position when evaluated from a needs perspective at country or hospital level. Furthermore, in both classifications, guidelines were considered the least

important action to be undertaken, highlighting the fact that guidelines already exist but are difficult to implement and their impact somewhat hard to measure.

After discussion of the content of these topics, participants were asked to identify the obstacles to implementation of these activities in practice, the actions required to overcome the obstacles, and to propose feasible and affordable activities through which the WHO could help the process of implementing infection prevention and control (table).

Considerations for a European WHO strategy on health-care-associated infection prevention

The Venice consultation represented a unique occasion to bring together policy-makers, politicians, and health-care professionals from different backgrounds and in very senior positions with the capacity to help in the process of promoting HAI surveillance and control. The discussion, brought about by the experts and the individual commitment of the participants, resulted in a heightened awareness of the importance of HAI as a public-health problem, together with an appreciation of its burden and associated costs.

The discussion also highlighted the urgent need for a major effort to tackle the problem of HAI in Europe with the support of the WHO, and the active involvement of all other relevant partners and networks. The Venice consultation served as an important initial step to foster collaboration among international partners and institutions involved in HAI surveillance and control. A successful strategy must be based on a synergistic integration among WHO activities and the existing international networks. As a result of the consultation, the main actions proposed to consolidate this strategy are summarised in panel 5.

Infection prevention and control is an essential element for patient safety and is a major component of the new World Alliance for Patient Safety launched by the WHO in Sept 2004. The foundation of this alliance is the direct consequence of a resolution passed in 2002 at the World Health Assembly (WHA55.18, http://www.who.int/patientsafety/en), which urges countries to pay the greatest possible attention to patient safety. The fundamental purpose of the alliance is to bring about the development of patient safety policy and practice in all WHO member states. Each year, the alliance will deliver a number of work programmes covering systemic and technical aspects of patient safety. A key programme will be the delivery of a "global patient safety challenge". The topic chosen for the first challenge is HAIs, entitled "clean care is safer care".

The constitution of the European Centre for Disease Prevention and Control (ECDC; http://europa.eu.int) will provide an important opportunity for increased collaboration in the field of communicable diseases in Europe. As the identification, assessment, and communication of current and emerging threats to

human health from communicable diseases and training are among the essential tasks of the centre, a WHO strategy on HAI, such as that proposed by the consultation, could integrate well into the ECDC's future activities.

From its supranational and influential position, the WHO should also consider infection prevention and control as a priority within International Health Regulations, and should recommend that countries react with legislative actions.

An unacceptably large number of patients continue to be exposed to HAI while seeking care for very different ailments, leading to avoidable excess morbidity, longer duration of hospitalisation, excessive health-care costs, and sometimes death. Taken together, an appropriate advocacy, good coordination mechanisms, sufficient resources, and sound technical support may well represent an important turning point in the challenge to diminish the burden of HAI and improve patient safety.

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