



# HOSPITAL INFECTION SOCIETY INDIA newsletter

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## President's Message

*Wishing all HIS-I members a very happy new year 2007!*

*At the outset, I thank everyone for their active support and for giving me the opportunity to serve the cause of HISI as its President. I look forward to your continued support and suggestions and will do my best to live up to your expectations.*

*In the last two years, the challenge of infection control and quality in health care has been taken up by health care professionals world wide. In our country state-of-the-art corporate hospitals have been developed, which are second to none. However, many health care facilities continue to remain resource strapped with poor infrastructure and man power. Evidence based information is still not available. We need to encourage research and look for low cost solutions which work in our situation. Basic standards need to be defined and made mandatory.*

*As we enter the year 2007, the national conference approaches and we eagerly await the most important event which brings members from all over the country on one platform. It provides a meeting ground for learning new things while confirming and consolidating the old. Jagdish Chander and his team at Chandigarh have been working hard to provide an excellent academic feast. Being a multi-disciplinary society, it is an opportunity to discuss various issues of infection control and means to solve various problems which we face in our professional work.*

*The new Directory of Members with updated addresses was brought out by Sunil Sawant, late last year. Despite his extensive efforts some addresses continue to be incorrect and I request that change of address should be communicated to our Secretary, Anita Arora, so that we may continue to receive information.*

*At this conference we will launch our web site, [www.HISIndia.org](http://www.HISIndia.org), which will provide an access to all members through the internet.*

*Anuj Sharma, our Web Editor, is putting all his creative efforts into developing an informative and interactive web site and will be posting this newsletter online along with a lot of other interesting material...*

*Looking forward to an exciting year ahead*

**GEETA MEHTA**  
President, HISI



## Editorial

*From a health standpoint the last two years will be remembered for 60 deaths and 441 cases of meningococcaemia reported in the May 2005 outbreak in Delhi followed by 34 deaths and 486 cases in the year 2006. These figures are a sad reminder of the fact that meningococcal disease can kill a healthy person in days if not treated in time. In fact the old adage 'Prevention is better than cure' holds true even today. Health care workers working in close contact with patients suffering from meningococcal disease are at an increased risk of acquiring this deadly disease. Sporadic cases of meningococcal meningitis, in fact, continue to trickle into hospitals.*

*We thus thought it appropriate to include in this issue of the newsletter the deliberations of the consensus group on 'Preventing Meningococcal Disease in Health Care Workers'.*

*The physical design of a health care facility is an essential component of its infection control strategy. The ventilation system requirements need to be addressed at the planning stage for better infection control. Col SKM Rao's article on 'Draft Guidelines on Ventilation Systems in Hospitals' extensively addresses the design and maintenance of a hospital ventilation system.*

*We also intend to keep our readers up to date with the latest articles on infection control. Keeping this in mind, we have included a few abstracts on various topics from the American Journal of Infection Control.*

*Finally, I request everyone to forward their achievements / activities held in their region so that they can be included in forthcoming issues of the newsletter.*

*Here's wishing you a Happy New Year*

**ANITA ARORA**  
Secretary, HISI



# Preventing Meningococcal Disease in Health Care Workers

## Deliberations of Consensus Group Meeting 18 May 2005, Delhi

### Introduction

Meningitis is a term used to define inflammation of the pia and arachnoid mater, or meninges, which are membranous tissues that surround the brain and spinal cord. The term is usually restricted to inflammation due to infective agents.

Meningococcal disease is caused by the bacterium, *Neisseria meningitidis*. These bacteria are carried naturally at the back of the throat or nose by about 10% of the population at any one time. But only some strains cause disease, and Group A is the most prevalent in India.

There are two predominant types of meningococcal illness: meningitis and septicaemia (also called meningococcaemia). Patients may present with a combination of the two. The mortality in septicaemia is considerably higher than in meningitis alone.

### Indian Scenario

#### Historical background of meningococcal disease in India

1883	Earliest record of an outbreak of meningococcal meningitis in Shikarpur Jail
1886	Recorded in Alipore Jail
1932	Outbreak in Borstal Institute in Lahore
1935	Delhi and Indore
1966-67	Delhi
1985	Delhi, Haryana, Rajasthan, Maharashtra, Bihar, West Bengal
1986-89	Delhi, Gujarat, Maharashtra, Madhya Pradesh, Orissa, Bihar, Rajasthan, Andhra Pradesh, Haryana
1989-99	Sporadic cases from different parts of the country

#### Major outbreaks of meningococcal disease in Delhi

Meningococcal disease is endemic in Delhi and sporadic cases of meningococcal meningitis have been occurring in Delhi in previous years. In addition, outbreaks of meningococcal meningitis in and around Delhi have been documented during 1966 and 1985. During 1966, 616 cases of meningitis were reported with case-fatality rate of 20.9%. The highest proportion of cases and deaths occurred in age group less than 1 year followed by those in 1-4 years. The male to female ratio was almost 3:1. Because of non-availability of reagents, grouping of *N. meningitidis* could not be performed.

The outbreak in 1985 was bigger in magnitude, both in terms of cases and the geographical area affected. 6133 cases with 799 deaths (13%) were reported. The male to female ratio of cases was 3:1. All the isolates of *N. meningitidis* belonged to subgroup A.

### Notification

Meningococcal disease is compulsorily notifiable. The local public health authority (Department of Health, MCD in Delhi) should be informed immediately, whenever the attending physician suspects a case.

### Case Definition

#### Standard case definition of Meningococcal Meningitis

1. Probable case
  - Suspected case of either acute meningitis or bacterial meningitis, With
  - Gram stain showing Gram-negative diplococci, Or
  - Ongoing epidemic, Or
  - Petechial or purpurral rash
2. Confirmed case
  - Suspected or probable case as defined above, With either
  - Positive CSF antigen detection of *N. meningitidis*, Or
  - Positive culture of CSF or blood with identification of *N. meningitidis*

#### Standard case definition of Meningococcaemia

1. Probable case
  - Sudden onset of fever (38.5°C rectal or 38°C axillary) with or without shock, and one of the following:
  - Petechial or purpurral rash
  - Gram stain showing Gram negative diplococci
2. Confirmed case
  - Probable case, with
  - Demonstration of *N. meningitidis* or antigen in blood and/or CSF

Note: All probable or confirmed cases of Meningococcal meningitis or Meningococcaemia should be reported to the local health authorities, in any part of India. The local health officials inform the state health authorities, who inform the ministry of health, government of India. For Delhi and the NCR, the following should be informed:

- DHA (MCD), Tel: 23936101; Fax: 23942056, 23832314
- Director (EMR), Tel: 23017302; Fax: 23017457
- Director, NICD, Tel: 23971272; 23971060, 23912836; Fax: 23922677

## Laboratory Diagnosis

The following microbiology specimens should be taken in cases of suspected meningococcal disease, on or soon after admission to the hospital. Take specimens before administration of antibiotics.

- Blood culture - state if, and which, antibiotic has been given
- CSF: Microscopy and culture - if not contraindicated. Request urgent processing.
- Aspirate of petechiae, purpura or ecchymoses, if present
- Throat swab (sweep of pharyngeal wall and tonsils) or pernasal swab; a nasal swab is NOT necessary.

## Health Care Workers at risk

Front line staff in Accident & Emergency, ITU, anaesthesia, medicine and paediatrics, who are involved in the immediate resuscitation of the patient on admission to the hospital, are at risk.

## Transmission to Health Care Workers

*Neisseria meningitidis* is transmitted from person to person through nasopharyngeal secretions or large particle respiratory droplets that are unlikely to remain airborne beyond a distance of one metre (3 feet). The organism dies quickly outside the host. Exposure to meningococci may be followed by colonisation, and development of immunity, or, much more rarely, the development of invasive disease.

## Prevention of spread to Health Care Workers

- Wear a surgical mask while resuscitating a patient with suspected meningococcal disease, or carrying out any procedure which may result in exposure to respiratory droplets, such as cough, including procedures or tracheal suction.
- Exposure of the eyes to respiratory droplets is not considered an indication for prophylaxis. Staff should be counselled about this risk and advised to seek early treatment if conjunctivitis should develop within 10 days of exposure.
- Immunisation against this disease is possible using meningococcal vaccine but it takes 10-12 days to get adequate immunity from the disease. Hence, we should start immunising the at risk hospital staff at the earliest. The following vaccines are available:

Vaccine	Manufacturer	Type
Quadrimenigo	Biomed, India	Polysaccharide, quadrivalent (A, C, W-135 & Y)
Mencevax	GSK	Polysaccharide, polyvalent (A, C, W-135 & Y)
Meningococcal A&C	Sanofi Aventis	Conjugate, bivalent (A & C)

All the cases so far are type A and all the vaccines are equally effective. The post vaccination immunity lasts for about 1-3 years.

- Chemoprophylaxis of contacts: Close contacts of a patient of meningococcal disease should be advised to go for vaccination & also to take:
  - Ciprofloxacin 500 mg / Ofloxacin 400 mg, OD to be given and repeated every 5 days, OR
  - Rifampicin 600 mg BD for 2 days.
  - Alternatively, Ceftriaxone 250 mg I/M single dose, or Spiramycin 1gm 12 hourly orally for 5 days, can be given in adults.
  - For children (< 15 years old), any of the following can be given:
    - Rifampicin 10mg/kg (5mg/kg, under 1 year), every 12 hours for 2 days
    - Ceftriaxone 125 mg I/M single dose
    - Spiramycin 25 mg/Kg 12 hourly orally for 5 days

Close contacts are defined as household members, kissing contacts, sexual partners and friends who have stayed with the patient in the 7 days prior to onset of the illness. Healthcare workers in contact with the patient do not need prophylaxis unless they have had direct exposure (within 3 feet of the patient) to respiratory droplets from the patient at the time of admission. Chemoprophylaxis should be started as early as possible, and not later than 48 hours post exposure.

- Hand washing: Strict measures to be taken for hand-wash while examining the next patient. Hand wash devices and hand wash solutions should be made freely available.
- Staff posted in the casualty in General OPD should be provided with three layered surgical masks.
- One of the isolation rooms should be assigned for the patients of meningococcal infection so that such patients can be immediately isolated.

## References and Bibliography

- Guidance for public health management of meningococcal disease in the UK: Public Health Laboratory Services Meningococcus Forum. Communicable Disease and Public Health 2002; 5 (3): 177-264.
- Preventing secondary meningococcal disease in healthcare workers: Recommendations of a working group of the PHLS Meningococcus Forum. Communicable Disease and Public Health 2001; 4: 102-105.
- WHO (SEARO) Communicable Disease Department - Meningococcal disease in Delhi; <http://www.searo.who.int/EN/Section10/Section1973.htm> (last accessed 30 January 2007).

**NOTE:** Recently some meningococcal isolates have been reported to be resistant to Ciprofloxacin. This is particularly ominous and use of ciprofloxacin as prophylaxis for *N. meningitidis* needs to be reviewed. [Ref: Mehta G, Goyal R. Emerging fluoroquinolone resistance in *Neisseria meningitidis* in India: cause for concern. J Antimicrob Chemother 2006, Dec 21; Epub ahead of print; doi:10.1093/jac/dkl484]

# Draft Guidelines on Ventilation Systems in Hospitals

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The infectious process may be thought of as a chain with three interrelated components. In order for infection to occur all three of these elements must be present. These are infectious agent, a means of transmission, and a susceptible host.

The first link in the chain of infection is the infectious agent, which may consist of:

- (a) Viruses
- (b) Bacteria
- (c) Fungi
- (d) Protozoa
- (e) Multi cellular parasites

The second link in the chain of infection is the means of transmission. Infectious agents can be transmitted through:

- (a) Direct person-to-person contact such as health care personnel having direct contact with patients or their secretions, excretions, or other body fluids.
- (b) Indirect contact between a patient or health care worker and a contaminated intermediate object, including contaminated equipment or supplies.
- (c) Droplet contact, such as that associated with talking, sneezing or coughing.
- (d) Air borne dissemination of agents that are contained in droplet nuclei or dust particles or are suspended in the air and spread through ventilation systems.
- (e) Common vehicle transmission, through such vehicles as contaminated blood, drugs, food or water.
- (f) Vector transmission.

The third link in the chain of infection is a susceptible host. Host susceptibility is increased by presence of open wounds, invasive devices, presence of chronic underlying diseases, immunosuppressive therapy and certain population groups such as very young and very old.

In the guidelines on ventilation systems we will discuss more on means of transmission and in particular about air borne transmission.

## Air borne transmission

Infection may be transmitted over short distances by large droplets, and at longer distances by droplet nuclei generated by coughing and sneezing. Droplet nuclei remain air borne for long periods may disseminate widely in an environment such as a hospital ward or an operating room and can be acquired by patients directly, or indirectly through contaminated medical devices. It has been known and documented that the bacteria do not float in air freely but ride over the particles derived from dust, skin squama, cotton fabrics etc. "Noble" determined that

organisms associated with human disease were found on the particle size ranging from 4 micron to 20 micron. The bacteria are also found in droplet nuclei and when the water in these droplets evaporates. The size of the particle may shrivel to 1-34 micron. The survival of bacteria in the air depends on the type of bacteria and its aquatic habits, e.g. gram positive cocci and tubercle bacilli can survive in the air for a longer time, may be up to one week, but gram negative bacilli cannot survive for a long time.<sup>2</sup>

House keeping activities such as sweeping, using dry dust mops or cloths, or shaking out linen can aerosolize particles that may contain micro-organisms. Similarly, *Legionella pneumophila*, the organism responsible for Legionnaires disease can become air borne during the evaporation of water droplets from air conditioning cooling towers or with aerosolisation in patient showers.<sup>3</sup>

The number of organisms present in room air will depend on the number of people occupying the room, the amount of activity, and the rate of air exchange. A normal human being without protective covering sheds bacteria at the rate of 1 lakh to 30 lakh per minute. Normal human being with conventional clothing and during normal activity sheds 10,000 bacteria per minute.<sup>4</sup>

Droplets projected from the infected upper respiratory tract may contain a wide variety of micro-organisms, including viruses, many infections can be spread by this route (i.e. respiratory viruses, influenza, measles, chicken pox, tuberculosis). In most cases, these are spread by large droplets, and an infective dose will rarely move more than a few feet from the source patient. Varicella- zoster (Chicken pox), tuberculosis and a few other agents, however, may be transmitted over a long distances in droplet nuclei.<sup>5</sup>

The spores of *Aspergillus fumigatus* have a diameter of 2-3.5 micron, with a settling velocity estimated at 0.03 cm/second in still air. With this enhanced buoyancy, the spores, which resist desiccation, can remain air borne indefinitely in air currents and travel far from their source. Increased levels of atmospheric dust and fungal spores have been associated with clusters of health care-acquired infections in immuno-compromised patients.<sup>6</sup> Absorbent building materials (e.g. wall board) serve as an ideal substrate for the proliferation of this organism if they become and remain wet, thereby increasing the number of fungal spores in the area. Emerging evidence suggests that *Pneumocystis carinii* now classified as a fungus may be spread via air borne, person-to-person transmission. Some human viruses are transmitted from person to person via droplet aerosols; but very few viruses are consistently airborne in transmission, and health care associated outbreaks of air borne viral disease are limited.<sup>7</sup>

## Ventilation systems

Fresh filtered air, appropriately circulated will dilute and remove air borne bacterial contamination, as well as eliminate smell. Desirable ventilation rates, expressed in air changes per hour vary with the purpose of a particular area. High-risk hospital areas (operating rooms, nurseries, intensive care units, oncology units, bone marrow transplant units and isolation rooms) should have air with minimal bacterial contamination.<sup>8</sup> Adequate ventilation systems require proper design and maintenance to minimize microbial contamination. Heating, ventilation and air conditioning (HVAC) systems in health care facilities are designed to:

- (a) Maintain the indoor air temperature and humidity at comfortable levels for staff, patients, and visitors.
- (b) Control odours
- (c) Remove contaminated air
- (d) Facilitate air handling requirements to protect susceptible staff and patients from air borne health care associated pathogens;
- (e) Minimize the risk for transmission of air borne pathogens from infected patients.

In addition to above it serves following purposes:

- (a) Protects the sensitive equipment from dust and increases its efficiency.
- (b) Ensures the reliable operation of microprocessor-based equipment by providing an appropriate environmental temperature.
- (c) Reduces the noise level of the environment.
- (d) Supplies fresh air into enclosed spaces.
- (e) Fulfils a therapeutic role in certain diseases like thyrotoxicosis, congestive cardiac failure, head injury, and patients with tracheostomy and burn patients.

## Basic components and operations of HVAC system

An HVAC system includes an outside air inlet or intake, filters, humidity modification mechanism, heating and cooling equipment, fans, ductwork, air exhaust or out-takes and diffusers or grilles for proper distribution of the air.<sup>9</sup>

In a centralised HVAC system, outdoor air enters the system, where low efficiency or coarse filters remove large particulate matters and many micro-organisms. The air enters the distribution system for conditioning to appropriate temperature and humidity levels, passes through an additional bank of filters for further cleaning and is delivered to each zone of the building. After the conditioned air is distributed to the designated space, it is withdrawn through a return duct system and delivered back to HVAC unit. A portion of this return air is exhausted to the outside while the remainder is mixed with outdoor air for dilution and filtered for removal of contaminants. Complete fresh air system is used for ultra clean operation theatres and should be well supported by heat recovery devices. HEPA filters are third filter barriers used in HVAC

system for operation theatre, BMT units etc before the air is actually delivered to an enclosed space. Other than centralised systems, hospitals are using window air conditioners as well as split system units. Both these systems consist of the following components:

- (a) A compressor
- (b) An expansion valve
- (c) A hot coil (on the outside)
- (d) A Chilled coil (on the inside)
- (e) Two fans
- (f) A Control unit

Window air conditioner as well as split system air conditioner is 100% recirculation system. In split system only difference is hot coil and compressor is placed outside the building and the capacity of air handling load can be much higher.<sup>9</sup>

## Engineering controls in HVAC system

Centres for disease control and prevention (CDC) recommend the following engineering controls to reduce microbial contamination of the air:<sup>3</sup>

- (a) Local exhaust ventilation i.e. source control
- (b) General ventilation
- (c) Air cleaning

General ventilation encompasses

- (a) Dilution and removal of contaminants via well-mixed air distribution of filtered air.
- (b) Directing contaminants towards exhaust grilles via uniform non-mixed airflow patterns.
- (c) Pressurisation of individual spaces relative to all other spaces.

Air cleaning is achieved through various types of filters. HVAC system discussion also involves mention of following issues like:

- (a) Indoor air quality
- (b) Air distribution
- (c) Air movement
- (d) Air change rates (Ach)
- (e) Pressure relationship
- (f) Temperature and humidity

## Indoor air quality in Hospitals

Indoor air quality in hospital is a complex multifaceted issue. There are too many potentially contaminating sources and their diversity is great. Contaminants come with dust, air, and visitors as well as originate inside the hospital complex and threaten the quality of environment. Ventilation and filtration provides a means of combating contaminants by diluting their concentration. Acceptable indoor air quality can be achieved by following the fundamental principles:

- (a) Contaminant source control
- (b) Proper ventilation
- (c) Humidity management
- (d) Adequate filtration<sup>11</sup>

## Filtration

The physical removal of particulates from air is the first step in achieving acceptable indoor air quality. Five methods of filtration have been described:

- (a) Straining - results in gross removal of large particles with low filtering efficiency.
- (b) Impingement - particles collide with filter fibres coated with adhesive and remain attached (low efficiency).
- (c) Interception - particles get entrapped in filter (medium efficiency).
- (d) Diffusion - small particles moving in erratic motion collide with filter fibre and remain attached (high efficiency).
- (e) Electrostatic - particles are negatively charged and are attracted towards filter with positively charged fibres (high efficiency).

As described above low to medium efficiency filters can be placed in first bank of filters. Incoming air then gets mixed with re-circulated air and reconditioned for temperature and humidity before being filtered by second bank of filters, which consists of high efficiency filters. These remove particles of 1-5 microns in diameter effectively (90% efficiency) from air.<sup>1,5</sup>

## HEPA Filters

HEPA filters are at least 99.97% efficient for removing particles of >0.3 micron in diameter. Examples of patient care areas where these are indicated are protective environment room and those operating rooms designated for orthopaedic implant procedures. Maintenance costs associated with HEPA filters are high compared with other types of filters, but use of in-line disposable pre filters followed by 90% efficient filters will extend the life of HEPA filter. HEPA filter efficiency is monitored with the Dioctylphthalate (DOP) particle test using particles that are 0.3 micron in diameter. HEPA filter of size 2 ft x 2ft with 150 mm thickness costs approximately Rs 7,500/- and 300 mm thickness costs Rs 10,000/-. Each filter is mounted on metal frame and material is paper or fibre however, paper is the most common material used. HEPA filter in metropolitan city of Delhi, considering dust levels, lasts for approximately 1 year. Installation of manometer across the filter to measure the pressure drop will help monitor life of HEPA filters. Filters with 90% efficiency called Microvee filters (1-5 micron filter) of similar size would cost much less. HEPA filters should never get wet otherwise they will become a reservoir and source of fungi and bacteria. HEPA filters are generally attached to HVAC system but can also be used as portable unit, many of which are available in Indian market. Portable units can be used whenever main system is undergoing repairs and construction activity is taking place. It should be used as an adjunct to existing system rather than replacement. Upon removals, spent filters can be bagged and discarded with routine solid waste regardless of patient care area.<sup>(9)</sup> Excess accumulation of dust and particulates decreases filter efficiency requiring more pressure to push the air through. Filters also require regular inspection for other

potential causes of decreased performance. Gaps in an around filter banks and heavy soil and debris upstream of poorly maintained filters have been implicated in health care associated outbreaks of Aspergilliosis.<sup>5</sup>

## UVGI

Two systems of UVGI have been used in health care settings - duct irradiation and upper room air irradiation. UVGI is effective in reducing transmission of bacteria and virus but has minimal effect on fungal spores. UV lamps are either suspended from the ceiling or mounted on the wall. Germicidal effect is dependent on air mixing via convection between the room's irradiated upper zone and lower patient care zone. UVGI systems cannot replace HEPA filters, but they can be used as adjuncts. Regular maintenance of UVGI systems is crucial like keeping bulbs free of dust and replacing bulbs wherever required.<sup>9</sup>

## Air quality indicators<sup>12</sup>

Air indicators for infection control should include viable and non-viable airborne particles analysis. In the case of non-viable particles measurements can indicate control of air borne particles, especially if methods such as filtration are used to remove these particles from incoming outside air. Non-viable airborne particles can be detected with the use of a particle counter that allows for real time air quality analysis. There are both optical and laser particle counters available. The particles at >0.5 micron are used for assessing a clean room and as a standard utilise a Military Standard 209 (e), which classifies clean rooms with particles per cubic foot that are less than a number. The classification is based on increments of 10. In a HEPA filtered (99.97% efficient at 0.3 micron diameter particles) operating room or bone marrow transplant environment with no people, air particles counts should be capable of class 1000 clean room status or better. As a definition for a class 1000 clean room, "there are less than 1000 particles per cubic foot greater than 0.5 micron in diameter" to achieve a clean room status.

Viable airborne particle analysis is more complex because laboratory expertise is necessary. Microbiological air sampling should be limited to assays for air borne fungi; of those, the thermotolerant fungi are of particular concern because of their pathogenicity in immuno-compromised hosts. Sedimentation methods using settle plates and volumetric sampling methods using solid impactors are commonly employed when sampling air for bacteria and fungi. Settle plates because they rely on gravity during sampling, tend to select for larger particles and lack sensitivity for respirable particles. Therefore they are considered impractical for general use. Unresolved issues associated with microbiologic air sampling are as follows:

- (a) Lack of standards linking fungal spore levels with infection rates.
- (b) Lack of standard protocols for testing (sampling intervals, number of samples, sampling locations).
- (c) Culture issues like false negative, insensitivity, lag time.

Particulate sampling can be used as part of a battery of tests to determine if a new HVAC system is performing to

specifications for filtration. Microbiological sampling is useful only when you are comparing outside air with indoor air for fungal spore densities and fungal spore bursts.

## Outdoor intakes

These intakes should be located as far as practical at not less than 9 m, from combustion equipment stack exhaust, ventilation exhaust outlet from the hospital, medical-surgical vacuum system, cooling towers and plumbing vent stacks. The bottom of outdoor air intakes serving central systems should be located as high as practical (3.6 m recommended) but not less than 1.8 m above ground level or if installed above the roof, 0.9 m above the roof level. Air intakes should be kept free of bird droppings, dust etc to prevent contamination.<sup>4</sup>

## Exhaust outlets

These exhausts should be located a minimum of 3 m above ground level and away from doors, occupied areas and operable windows. Preferred location for exhaust outlets is at roof level projecting upward or horizontally away from outdoor intakes. Care must be taken in locating highly contaminated exhausts (fume hoods, safety cabinets).<sup>4</sup>

## Types of ventilation

The flow of clear air through an enclosed space must carry away bacteria liberated inside it but there are still uncertainties on the best methods of distributing air for doing this. One of the methods is to arrange for incoming air to rapidly mix up with the existing air in the room to give turbulent ventilation. Another method is to bring it at ceiling level with minimum turbulence so that the descending piston of air displaces bodily the air already present in the room thereby providing displacement ventilation.

Putsep describes four categories of ventilation as under:<sup>13</sup>

- (a) Turbulent ventilation - The turbulent or mixing type air distribution system promotes uniform mixing of air throughout the room and thereby causing uniform dispersion of air borne contamination throughout the room.
- (b) Laminar flow ventilation - The laminar flow is also called the unidirectional airflow ventilation system. Most common laminar flow system used is the vertical laminar flow or the horizontal laminar flow.
- (c) Zonal ventilation - In air curtaining or zonal system air flows downwards through a perforated ceiling and forms an inner zone over and around the operating table, where a stable rate of air exchange is higher than that in the rest of the room. Any one or anything passing through this air curtain will deflect this high velocity air along with the contaminated peripheral entrainment towards the much lower velocity of the down flow zone. Thus this zone may become contaminated immediately.
- (d) Exponential Flow Verification - The exponential flow gives a trumpet shaped airflow pattern, which is an exponential horn. This ex-flow sterile air pattern

has higher velocity and pressure in the centre of the clean zone than at the periphery, therefore peripheral entrainment cannot occur.

## Ventilation Rate

The ventilation rate affects both components of ventilation viz. pressurisation and removal of bacteria. These two requirements determine the ventilation rate needed in an enclosed space. Ventilation rate is expressed as volume of air supplied per minute or number of air changes per hour. These are expressed as under:

$$\text{Volume of air} = \text{Velocity} \times \text{Area}$$
$$\text{Air changes per hour} = \frac{\text{Volume of air Supplied per hr.}}{\text{Volume of room}}$$

The calculated number of air changes per hour does not necessarily indicate that all the air in the room is completely changed; that number of times each hour. This can be true in only a perfect displacement ventilation system. With 12 changes per hour in an average sized theatre only two third of the room is pressurised, whereas the full pressurisation can be achieved with 15 air changes per hour. To achieve 15 air changes per hour, the plant should be designed to deliver 20 air changes per hour, because the rate of flow will fall consequently as filters become blocked.<sup>8</sup>

## Measurement of Ventilation rate

The ventilation of a room can be measured in two ways; firstly the volume of air brought into or extracted from the room is measured with the help of anemometer. The simplest method for detecting the direction of air movements through and around the doors and windows is by observations of the drift of smoke. A convenient source of dense smoke which; needs no generating equipment is titanium tetra chloride. This smoke is non toxic and irritant only in large quantities.

## Direction of Air Flow

Direction of air flow should be from clean to less clean areas. Airflow rate of 0.28-0.47m/sec is desirable across an open door to prevent back flow into cleaner area. In ultra clean air enclosure the airflow should not be less than 0.2 m/sec at one meter above the door is desired.

## Demolition, Construction, Renovation activities<sup>8</sup>

Demolition, construction and renovation activities generate considerable dust and debris that can contain airborne micro-organism. Following issues should be assessed:

- (a) Proximity of the air intake system to the work site.
- (b) Adequacy of window seals and door seals.
- (c) Proximity of areas frequented by immuno-compromised patients.
- (d) Location of under ground utilities.

Physical barriers capable of containing smoke and dust will confine dispersed fungal spores to the construction zone. Designated entry and exit procedures must be defined.

Signage should direct pedestrian traffic away from the construction area. Exterior windows should be sealed to minimise the construction zone must be negative with respect to surrounding area. Exhaust should be directed away.

All immuno-compromised patients are at risk of nosocomial fungal infections during construction / renovation activities in hospitals. Special barriers are required during such activities to isolate the HSCT recipients from undue exposure to fungal spores. False ceilings should be avoided and if necessary they must be vacuumed routinely to minimize dust and exposure to fungal spores. If HSCT recipients need to be transported near construction areas they need to wear N-95 respirators, which are fit-tested. Newly constructed areas must be cleaned before allowing patients to enter. Copper 8 - quinolate is an effective agent for decontamination of fungal contaminated areas.<sup>11</sup>

## Environmental Infection Control Measures For Special Health Care Settings

### Protective Environment (PE)

Designed for immuno-compromised patients

- Filtration of incoming air by using central or point of use HEPA filters
- Directed room air flow (from supply on one side of the room, across the patient, and out through the exhaust on the opposite side of the room)
- Positive room air pressure of 2.5 pa (0.01" water gauge) relative to the corridor
- Well sealed rooms
- More than 12 air changes per hour.
- To provide 12 air changes in a typical room with 0.5 sq ft air leakage, the air flow rate will be minimally 125 cubic feet / min.<sup>12</sup>
- Allogenic transplant patients should be placed in rooms with HEPA filters capable of removing particles more 3 microns.
- Air intake dust for HVAC must be inaccessible to birds. Air flow direction at the entrances should be maintained and verified daily by visual methods like smoke tubes and flutter strips or manometers.

### Air-borne Infection Isolation (All)

Acute care in patient facility needs at least one room equipped to house patients with air borne infectious disease. Salient features of engineering controls for All areas include:

- Use of negative pressure room with close monitoring of airflow direction using manometers placed in the room with door closed.
- Minimum 12 Air changes per hour.
- Air from negative pressure room and treatment room exhausted directly to the outside if possible.
- All room should be constructed with ante room.<sup>1</sup>

### Operation Theatre<sup>2,15</sup>

Ultra sterile zone operation room for super specialty surgery needs the following:

- Temperature: 23°C + 3°C
- Relative humidity: 40% to 60% with variation of 5%
- Fresh air allowance: 100% fresh air with no recirculation of air
- Minimum air changes 15 to 20 per hour
- Air Flow pattern: Vertical laminar airflow over the operating table
- Air filtration: Through HEPA filters with filtration level up to 0.3 m and 99.97% efficiency

### Other Operating rooms

- Temperature: 23±3°C
- Humidity : 40% to 60% RH
- Fresh air allowance: 5 to 10 per hour; total air changes not to exceed 25 per hour
- Air filtration with pre filters and Microvee filters
- Turbulent / displacement type of ventilation system

### All other Areas

Temperature and RH remains same, however, fresh allowance may be reduced to 5/hr with total air changes/hr = 15. Air filtration is through HDPE washable filters with filtration level up to 5 microns.

Other norms for HVAC system of operation theatre.

- One separate dedicated air-handling unit (AHU) each with two-speed motor, for an ultra sterile operating room and other operating room may be provided.
- During non-functional hours, blower will be operated round the clock.
- Air conditioning system will be designed to maintain positive pressure gradient to ensure flow of air from sterile to clean to protective zone.
- Anodized aluminium ducts will be provided for air ducts.
- If any pitting is observed on the inner surface of the ducts then complete replacement of ducts will be carried out.
- Quality of air and biological load is different in different operating room thus separate AHU may be provided for operating rooms and other areas of operating departments.
- Differential pressure gauge / manometer should be provided across HEPA filters, so as to detect clogging or reduced flow of air.
- Ultra violet irradiation should be installed in operating rooms as well as in corridors to irradiate upper room air.
- Provision of sets of sliding doors inside OT.
- Air curtain at the entry should be made with air lock system.

The microbiologic standards for OT have been described by few authors:<sup>9,14</sup>

- (a) Less than 35 colony forming units (CFU) of bacteria / m<sup>3</sup> of air.
- (b) Less than one CFU of *Clostridium perfringens* or *Staphylococcus aureus* in 30 m<sup>3</sup>.
- (c) During operation less than 180 CFU/m<sup>3</sup> of air using ultra clean laminar flow.

Air locks should be installed in special areas like OT, ICU, PE & All rooms. They serve following purpose:<sup>16</sup>

- (a) They provide a barrier against loss of pressurization and against entry / exit of contaminated air into / out of the isolation room.
- (b) They provide a controlled environment in which protective garments can be donned without contamination.
- (c) They also provide physical and psychological barrier to control behaviour of staff in adopting infection control practices.

## Humidity Control

One of the aspects of humidity is that bacteriological micro organisms ride on dust particles whose attract ability to one another is favoured by low relative humidity. High humidity in the hospital enhances the danger of growth of micro-organisms. Relative humidity measures the percentage of saturation. For most areas within health care facilities the designated comfort range is 30% to 60% relative humidity. Relative humidity levels more than 60% in addition to being perceived as uncomfortable promote fungal growth. Engineering controls required into the HVAC system are as follows:

- (a) Locate duct humidifiers up stream from the final filters.
- (b) Incorporate a water removal mechanism into the system.
- (c) Locate all duct take offs sufficiently down stream from the humidifier so that moisture is completely absorbed.
- (d) Incorporate steam humidifiers if possible to reduce potential for microbial proliferation within the system.

## Maintenance of HVAC System

HVAC systems should never be shut down except when maintenance is required, filter change is done and construction activities in nearby area are going on. Airflow can be reduced; however, sufficient supply, return and exhaust must be provided to maintain required pressure relationships when the space is not occupied. Maintaining these relationships can be accomplished with special drives on the air-handling units. (VAV systems). Performance monitoring of the system includes determining pressure differentials across filters, regular inspection of system filters, DOP testing of HEPA filters, testing of low-or medium efficiency filter by weight arrestment test and manometer tests for positive and negative pressure areas in accordance with pressure

differentials mentioned. Health care facilities must have contingency plan in case of disruption of HVAC. These plans include back up power supply to maintain ventilation in high-risk areas. Duct cleaning in hospitals has benefits in terms of system performance but usefulness for infection control has not been conclusively determined. Costlier methods like robot cleaning of ducts, biocide applications etc. must be utilised only when there is a clear co-relationship between epidemic and fungal spores from ducts in critical areas.<sup>1,7</sup>

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*Your comments are invited to help in developing consensus guidelines on ventilation systems in hospitals*

# Interesting Abstracts from American Journal of Infection Control

Volume 34, Issue 10 (December 2006)

## The influence of nurse cohorting on hand hygiene effectiveness

Clive B. Beggs, PhDa, Catherine J. Noakes, PhDb, Simon J. Shepherd, PhDa, Kevin G. Kerr, MDcd, P. Andrew Sleigh, PhDb, Katherine Banfield, MSc, Bradford, United Kingdom; Leeds, United Kingdom; and Harrogate, United Kingdom

### Background

Direct contact between health care staff and patients is generally considered to be the primary route by which most exogenously-acquired infections spread within and between wards. Hand washing is therefore perceived to be the single most important infection control measure that can be adopted, with the continuing high infection rates generally attributed to poor hand hygiene compliance.

### Methods

Through the use of simple mathematical models, this paper demonstrates that under conditions of high patient occupancy or understaffing, handwashing alone is unlikely to prevent the transmission of infection.

### Conclusions

The study demonstrates that applying strict nurse cohorting in combination with good hygiene practice is likely to be a more effective method of reducing transmission of infection in hospitals.

## Skin reactions related to hand hygiene and selection of hand hygiene products

Elaine Larson, PhD, RN, FAAN, CICab, Raphaëlle Girard, MDc, Carmem Lucia Pessoa-Silva, MDd, John Boyce, MDe, Liam Donaldson, MDf, Didier Pittet, MD, MSg New York, New York; Lyon, France; Geneva, Switzerland; and New Haven, Connecticut

### Background

In October 2004, The World Health Organization (WHO) launched the World Alliance for Patient Safety. Within the

alliance, the first priority of the Global Patient Safety Challenge is to reduce health care-associated infection. A key action within the challenge is to promote hand hygiene in health care globally as well as at the country level through the campaign "Clean Care is Safer Care." As a result, the WHO is developing Guidelines on Hand Hygiene in Health Care, designed to be applicable throughout the world.

### Methods

This paper summarizes one component of the global WHO guidelines related to the impact of hand hygiene on the skin of health care personnel, including a discussion of types of skin reactions associated with hand hygiene, methods to reduce adverse reactions, and factors to consider when selecting hand hygiene products.

### Results

Health care professionals have a higher prevalence of skin irritation than seen in the general population because of the necessity for frequent hand hygiene during patient care.

### Conclusion

Ways to minimize adverse effects of hand hygiene include selecting less irritating products, using skin moisturizers, and modifying certain hand hygiene practices such as unnecessary washing. Institutions need to consider several factors when selecting hand hygiene products: dermal tolerance and aesthetic preferences of users as well as practical considerations such as convenience, storage, and costs.

## Prospective cohort study of central venous catheters among internal medicine ward patients

William E. Trick, MD, Julio Miranda, MD, Arthur T. Evans, MD, MPH, Marjorie Charles-Damte, RN, Brendan M. Reilly, MD, Peter Clarke, MD, Chicago, IllinoisBottom of Form

### Background

Central venous catheter (CVC) use is less well described for patients outside the intensive care unit. We evaluated CVCs and the associated bloodstream infection rate among patients admitted to the general medical service.

## Methods

We performed a prospective cohort study of patients who had a CVC on admission or inserted during their stay on the general medical service in a public teaching hospital, November 15, 2004, to March 31, 2005.

## Results

We identified 106 CVCs, 52 were present on admission and 54 were inserted; there were 682 catheter-days. The primary bloodstream infection rate was 4.4 per 1000 catheter-days (95% CI: 0.9-13): highest for catheters inserted in the emergency department compared with those inserted on other units (24 vs 1.7 per 1000 catheter-days),  $P = .045$ . By multivariable analysis, inadequate dressings were more likely among patients with a body mass index  $\geq 30$  kg/m<sup>2</sup>, adjusted odds ratio, 3.4 (95% CI: 1.4-8.0).

## Conclusions

Many CVCs had previously been inserted in the emergency department or intensive care unit; therefore, strategies to reduce bloodstream infections that focus on ward insertion practices may not dramatically reduce bloodstream infection rates. Intervention strategies should target improved dressing care and consideration of early removal or replacement of catheters inserted in the emergency department.

## Formulation technology as a key component in improving hand hygiene practices

Nancy E. Kaiser, BS, Jerry L. Newman, PhD, St. Louis, Missouri

Proper hand hygiene has long been recognized as a primary tool in reducing transmission of health care-acquired infections. Compliance with recommended practices and an increase in the frequency of hand hygiene can have a negative impact on skin condition. Poor skin condition can result in reduced compliance with hand hygiene guidelines. In addition to reduced compliance with proper hand hygiene, deterioration in skin condition leads to reduced barrier function of the skin, changes in skin microflora, and increased shedding of skin squames. Thus, poor skin condition can increase the risk of infection, increase costs to the facility, and reduce the quality of life for the health care worker. To address the problem of skin irritation and its link to low compliance to hand hygiene practices, the Centers for Disease Control and Prevention (CDC) Guideline for Hand Hygiene for Health Care Settings recommends that hand hygiene agents should be well accepted, well tolerated, and formulated to minimize irritancy. Sophisticated formulation technologies and the proper selection of ingredients can provide products that encourage hand hygiene compliance through pleasing aesthetic properties and by overcoming the damaging effects of hand hygiene practices.

Volume 34, Issue 8 (October 2006)

## Poor hospital infection control practice in hand hygiene, glove utilization, and usage of tourniquets

Suzan Sacar, MDa, Huseyin Turgut, MDa, Ilknur Kaleli, MDb, Nural Cevahir, MDc, Ali Asan, MDa, Mustafa Sacar, MDc, Koray Tekin, MD, Denizli, Turkey

### Background

Hospital-acquired infection often occurs because of lapses in accepted standards of practice on the part of health care personnel. The aim of this study is to attract attention on poor hospital infection control practice in venepuncture and use of tourniquets and emphasize the importance of hand hygiene.

### Methods

Overall compliance with hygiene during usage of tourniquets and routine patient care before and after implementation of a hospital infection control measures was evaluated.

### Results

According to the questionnaire, only 26.9% of respondents always washed their hands both before and after venepuncture. In the second step of the study, based on direct observation, hands were washed both before and after venepuncture on only 41 (45.1%) occasions. Failure to remove gloves after patient contact was observed on 23.1% occasions.

### Conclusion

Our survey reveals poor infection control practice in hand hygiene, glove utilization, and usage of tourniquets and the implementation of infection control measures produced a moderate improvement in compliance with them.

Volume 34, Issue 10 (December 2006)

## Clinical and molecular epidemiology of nursing home-associated *Staphylococcus aureus* bacteremia

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### Background and Objectives

Although nursing home residents who have *Staphylococcus aureus* bacteremia (SAB) have been included in large

studies of this infection, there are no published descriptions of SAB solely in nursing home residents. The objectives were to describe the clinical and molecular epidemiology of SAB in nursing home residents admitted to one hospital.

## Methods

This was a retrospective review of hospital medical records of nursing home residents from 22 separate facilities who had SAB and were admitted to a specialty unit at one hospital from 1997 to 2003.

## Results

For the seven-year study period, 39 episodes of SAB were identified; 15 were due to methicillin-susceptible *S. aureus* (MSSA) and 24 were due to methicillin-resistant *S. aureus* (MRSA). The incidence of SAB among all residents admitted to the specialty unit increased by more than eightfold primarily because of an increased incidence of bacteremia due to MRSA. The most common identified source was the urinary tract (18% of all episodes) but for 17 (44%) episodes, no focus was identified. Hospital mortality was 28% with all deaths occurring within 15 days of admission. Analysis of the MRSA strains by pulsed-field gel electrophoresis revealed that two pulsed-field types predominated when compared with the CDC national database: USA100- (N = 13) and USA 800-like strains (N = 7).

## Conclusions

In the study population there was a substantial increase in incidence of SAB over a 7-year period due almost exclusively to an increased occurrence of MRSA. Hospital strains of MRSA predominated, as one would expect. Mortality was high but complications were low among survivors. These findings have important implications for choosing empiric antibiotic therapy in nursing home residents who have suspected *S. aureus* infection.

*Volume 34, Issue 9 (November 2006)*

## Outbreak of pertussis in a neonatal intensive care unit—Louisiana, 2004

Peter Vranken, RN, DPH&TM, MBAab, Michelle Pogue, BS, MT (ASCP)c, Christine Romalewski, MPH, BAb, Raoult Ratard, MD, MPH&Tmb Alexandria and New Orleans, Louisiana; and Atlanta, Georgia

## Background

On November 12, 2004, a 5-month-old infant, admitted in the neonatal intensive care unit (NICU) of a Louisiana

regional hospital since birth, was diagnosed with pertussis. Measures to prevent further transmission, in the NICU and beyond, were immediately put into place.

## Methods

Exposed contacts were identified among other patients of the NICU, health care workers, and family members. All were offered pertussis testing and prophylactic treatment.

## Results

The source of the outbreak was not identified. Despite the immediate implementation of control measures, a total of 37 additional NICU patients, 198 health care workers, and 15 family members were identified as potentially exposed contacts. Three more infants were diagnosed with pertussis, one of them after having been transferred to the NICU of another hospital in the state.

## Conclusion

The source of this outbreak was believed to be an adult, either a hospital worker or an outside visitor. The incident clearly illustrates the infection control challenges for hospital units serving newborns and young infants in an era of changing epidemiology of pertussis.

*Volume 34, Issue 8 (October 2006)*

## Novel ways of preventing antibiotic-resistant infections: What might the future hold?

Mary-Claire Roghmann, MD, MSab, Linda McGrail, RN, MS, CICa Baltimore, Maryland

Most antibiotic-resistant bacteria are opportunistic pathogens; they colonize the skin and mucosal surfaces and only cause infection when the opportunity arises. Thus, the processes that lead to an infection attributable to antibiotic-resistant bacteria can be broadly divided into those processes that lead to acquisition of antibiotic-resistant bacteria and those that lead to the development of an infection with that organism. We review the processes that lead to the development of infections attributable to antibiotic-resistant bacteria. We then discuss options that may become available to interrupt these processes and, thus, may reduce the rate of infections attributable to antibiotic-resistant bacteria in the future.

# Effectiveness of barrier precautions and surveillance cultures to control transmission of multidrug-resistant organisms: A systematic review of the literature

Sally W. Aboelela, PhD, Lisa Saiman, MD, Patricia Stone, RN, PhD, Franklin D. Lowy, MD, Dave Quiros, Elaine Larson, RN, PhD New York, New York

## Background

Despite the priority placed on preventing transmission of multidrug-resistant organisms (MDROs) in health care facilities, there is a lack of consensus among recommended infection control guidelines. We focused on control measures that have a great potential to affect patient care, patient services, and hospital cost/resources: barrier precautions/patient isolation and surveillance cultures.

## Methods

We conducted a systematic review of the literature and published English-language guidelines pertaining to the use of barrier precautions/patient isolation and surveillance cultures to prevent the transmission of MDROs. The recommendations made by the published guidelines were summarized and compared. The primary research studies identified through our literature search were evaluated for study quality. We then summarized the outcomes of the studies with the highest quality scores and made recommendations for future work.

## Results

A total of 29 studies were included in our assessment of study quality; of those, 7 studies were of high quality.

## Conclusion

This systematic review identified key gaps in the literature including a need for greater monitoring of implementation of the interventions, more cost analyses of interventions, determining the independent contribution of specific interventions, and identifying the minimum interventions needed to reduce transmission.

## Translating evidence into practice to prevent central venous catheter-associated bloodstream infections: A systems-based intervention

Erika M. Young, DO, Marie L. Commiskey, BS, CCRN, Stephen J. Wilson, MD, MPH Indianapolis, Indiana

## Background

The central venous catheter (CVC) is a necessary, yet inherently risky, modern medical device. We aimed to carry out a systems-based intervention designed to facilitate the use of maximal sterile barrier precautions and the use of chlorhexidine for skin antisepsis during insertion of CVC.

## Methods

All patients in whom a CVC was inserted at a medical-surgical intensive care unit at a university-affiliated public hospital were included in a before-after trial. The standard CVC kit in routine use before the intervention included a small sterile drape (24" by 36") and 10% povidone-iodine for skin antisepsis. We special ordered a customized kit that, instead, included a large sterile drape (41" by 55") and 2% chlorhexidine gluconate in 70% isopropyl alcohol. Both the standard kit in use before the intervention and the customized kit included identical CVCs. Baseline data included the quarterly CVC-associated bloodstream infection (BSI) rates during the 15 months before the intervention. Comparison data included the quarterly CVC-associated BSI rates during the 15 months after we instituted exclusive use of the customized kit.

## Results

The mean quarterly CVC-associated BSI rate decreased from a baseline of 11.3 per 1000 CVC-days before the intervention to 3.7 per 1000 CVC-days after the intervention ( $P < .01$ ). Assuming direct costs of at least \$10,000 per CVC-associated BSI, we calculated resultant annualized savings to the hospital of approximately \$350,000.

## Conclusion

Infection control interventions that rely on voluntary changes in human behavior, despite the best intentions of us all, are often unsuccessful. We have demonstrated that a systems-based intervention led to a sustained decrease in the CVC-associated BSI rate, thereby resulting in improved patient safety and decreased cost of care.

## Translating infection prevention evidence into practice using quantitative and qualitative research

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Infection control professionals and hospital epidemiologists, using the valid methods of applied epidemiology-surveillance, benchmarking, intervention, evaluation-have largely been responsible for dramatically

reducing the incidence of health care-associated infections over the past several decades. However, we believe that the field of infection control can and should also be a leader in understanding how research findings can be efficiently and effectively translated into clinical practice. Unfortunately, there is no current reliable information about which preventive practices are being used in US hospitals to prevent common device-related infections. If we are to understand how best to translate research into practice, the reasons hospitals are using some preventive practices or are not must be explored more fully. This article provides a framework for one proposed research endeavor to promote the successful translation of proven infection prevention practices and a subsequent decrease in health care-associated infections. In addition, we hope that this article will stimulate increased interest and research in identifying strategies that will successfully move evidence from the peer-reviewed literature to the patient's bedside.

## Colonization and infection with vancomycin-resistant enterococcus among patients with cancer

TMadonna J. Matar, MDa, Jeffrey Tarrand, MD<sup>b</sup>, Issam Raad, MDa, Kenneth V.I. Rolston, MDa Houston, Texas

Vancomycin-resistant enterococci (VRE) cause substantial morbidity and mortality in immune-suppressed patients. In a retrospective review, VRE fecal colonization was documented in 4.7% (99 of 2115) of patients screened, with 5.4% of patients with leukemia, 4.9% of hematopoietic stem cell transplantation recipients, and 2.2% of patients with lymphoma being colonized. Among the 99 patients with VRE colonization, 29 (29.29%) developed bacteremia, and there were 32 episodes of VRE infection at other sites. The rate of VRE bacteremia in solid tumor patients (0.12%) was significantly lower ( $P < .0001$ ). VRE colonization had a negative predictive value of 99.9% and a positive predictive value of 29.3% for the development of VRE bacteremia and might help identify a high-risk subset of patients that might benefit from preemptive VRE therapy during episodes of neutropenic fever.

## Measurement and feedback of infection control process measures in the intensive care unit: Impact on compliance

Mezgebe Berhe, MDa, Michael B. Edmond, MD, MPH, MPAab, Gonzalo Bearman, MD, MPH, Richmond, Virginia

## Background

Infection control process measures provide actionable and measurable indicators for performance improvement.

## Objective

To determine the relationship between the measurement and feedback of selected infection control process measures and compliance with infection control practices.

## Methods

We measured selected infection control process measures (hand hygiene, femoral catheter use as a proportion of all central venous catheter (CVC) days and proportion of head of bed elevations) in the medical respiratory intensive care unit (ICU) (MRICU) and the surgical trauma ICU (STICU). All data were collected by trained infection control practitioners. Baseline data were obtained April through June 2004. Baseline hand hygiene data were obtained from May to June. Follow-up observations were obtained from July 2004 through March 2005. Both baseline and follow-up observations were reported to the units' leadership. The data were reviewed for improvement in compliance with process measures. Differences in proportions were analyzed for statistical significance by the  $\chi^2$  test.

## Results

There was a statistically significant improvement in the head of bed elevation rates: 54.9% versus 98.4% ( $P < .001$ ) for the MRICU and 46.5% versus 77.2% ( $P < .001$ ) for the STICU, respectively. There was also a statistically significant decline in femoral catheter rates in both ICUs: 17.8% versus 10% ( $P = .001$ ) in the MRICU and 8.4% versus 3% ( $P < .001$ ) in the STICU, respectively. There was no significant improvement in hand hygiene rates in either ICU: 31.8% versus 39.3% ( $P = .1$ ) in the MRICU and 50% versus 50.3% ( $P = .9$ ) in the STICU, respectively.

## Conclusion

Feedback of process measures lowered the use of femoral catheters and improved the proportion of elevated head of beds in 2 ICUs, but there was no significant improvement in hand hygiene.

## Risk factors for nosocomial urinary tract-related bacteremia: A case-control study

Sanjay Saint, MD, MPH<sup>abc</sup>, Samuel R. Kaufman, MA<sup>bc</sup>, Mary A.M. Rogers, PhD<sup>bc</sup>, Paul D. Baker, ARNP<sup>d</sup>, Edward J. Boyko, MD, MPH<sup>de</sup>, Benjamin A. Lipsky, MD, Ann Arbor, Michigan, and Seattle, Washington

## Background

Risk factors for bacteremia in patients with hospital-acquired bacteriuria are largely unknown. Given the morbidity and costs associated with nosocomial bacteremia, determining risk factors could enhance the safety of hospitalized patients.

## Methods

We conducted a case-control study within the Veterans Affairs Puget Sound Health Care System. A patient hospitalized between 1984 and 1999 from whom a urine culture and a blood culture grew the same organism e" 48 hours after admission was considered a case. Control patients were those with significant bacteriuria detected e" 48 hours after admission who did not have a positive blood culture. We used logistic regression to determine independent risk factors for bacteremia.

## Results

There were 95 cases and 142 controls. Independent, statistically significant predictors of bacteremia included immunosuppressant therapy within 14 days of bacteriuria (odds ratio [OR], 8.13); history of malignancy (OR, 1.94); male sex (OR, 1.88); cigarette use in the past 5 years (OR, 1.26); number of hospital days before bacteriuria (OR, 1.03); and antibiotic use within 3 days of bacteriuria (OR, 0.76). Corticosteroid use within 7 days of bacteriuria predicted bacteremia in patients <70 years old (OR, 14.24). Similarly, patients <70 years old were more likely to develop bacteremia if they had diabetes mellitus (OR, 6.19).

## Conclusion

Delineating risk factors for nosocomial urinary tract-related bacteremia can help target appropriate preventive practices at the highest risk patients.

## Pseudooutbreak of *Pantoea* species bacteremia associated with contaminated cotton pledgets

Hyun-Sook Koo, RNA, Jae-Seok Kim, MD, Joong-Sik Eom, MD, Ji-Young You, MD, Ji-Young Park, MD, Han-Sung Kim, MD, Wonkeun Song, MD, Hyoun Chan Cho, MD, Kyu Man Lee, MD, Seoul, Korea

A total of 22 isolates of *Pantoea* strains, unusual causative agents of clinical infection, was isolated from blood cultures from 9 patients and 1 ear swab from 1 of the patients within a period of 1 month in a tertiary-care hospital. Pseudooutbreak was suspected because specimens were collected from a limited number of places and the patients did not show consistent signs or symptoms of bacterial sepsis. Enterobacterial repetitive intergenic consensus (ERIC) polymerase chain reaction (PCR) and partial 16S ribosomal DNA sequencing were performed to determine the clonal relationship among the isolates. Screening environmental cultures revealed that cotton pledgets were contaminated with *Pantoea* species. Molecular typing suggested that 2 different clones of *Pantoea* strains were responsible for the pseudooutbreak. Cotton materials may be a possible source of *Pantoea* pseudooutbreak. Molecular typing is useful for investigating epidemics and identifying unusual clinical isolates

## Profile

### Dr Brahm Prakash (1937-2004)

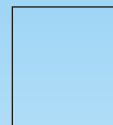


*An excellent neurosurgeon, Dr Brahm Prakash, was the president of the Hospital Infection Society India from 1997 to 2001.*

*He did his MBBS and MS from King George Medical College, Lucknow, and then worked for a couple of years in Mission hospital, Barielly followed by the army, in which he was posted at Leh, Laddakh. He trained in MCh Neurosurgery from AIIMS in 1969, followed by special training in Oslo (1969-71) and then in Zurich. On his return to India, he first joined AIIMS, and then shifted to GB Pant hospital in 1981, as the head of the department of neurosurgery. He started MCh there and trained a number of neurosurgeons.*

*His main area of interest was vascular micro-neurosurgery (pioneering the use of LASER and CUSA in India) and hospital associated infections. He was a strong advocate for the rational use of antibiotics and taught by example. He is remembered by all his colleagues and patients, for his compassion, kind hearted nature and being an exceptional human being.*

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