The health professional's role in preventing nosocomial infections

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Abstract

Despite their best intentions, health professionals sometimes act as vectors of disease, disseminating new infections among their unsuspecting clients. Attention to simple preventive strategies may significantly reduce disease transmission rates. Frequent hand washing remains the single most important intervention in infection control. However, identifying mechanisms to ensure compliance by health professionals remains a perplexing problem. Gloves, gowns, and masks have a role in preventing infections, but are often used inappropriately, increasing service costs unnecessarily. While virulent microorganisms can be cultured from stethoscopes and white coats, their role in disease transmission remains undefined. There is greater consensus about sterile insertion techniques for intravascular catheters—a common source of infections—and their care. By following a few simple rules identified in this review, health professionals may prevent much unnecessary medical and financial distress to their patients.

(Postgrad Med J 2001;77:16–19)

Keywords: infection control; cross infection; hand washing; catheterisation

Infection control programmes are cost-effective,^{1,2} but their implementation is often hindered by a lack of support from administrators and poor compliance by doctors, nurses, and other health workers. Some health professionals suffer from the “Omo syndrome”—a belief that they are always super clean and sterile. Many are visibly upset when their poor hygiene practices are exposed and are offended when it is suggested that they may be potential vectors of disease and are spreading virulent microorganisms among their patients.

There is increasing concern worldwide about the rising prevalence of multiresistant, virulent bacteria. Indeed, in one South African neonatal unit multi-antibiotic resistant *klebsiellae* are now the commonest organisms cultured.³ While this neonatal unit, like many others, has resorted to using more potent and expensive antibiotics to curb the threat these organisms pose to vulnerable infants, it is clear that the focus of any efforts has to be on the prevention of nosocomial infections.

Aetiology of nosocomial infections

Intravascular device related infections and infections acquired through the respiratory tract are among the most common nosocomial

Box 1: Risk factors for nosocomial infection

- Duration of hospital stay
- Indwelling catheters
- Mechanical ventilation
- Use of total parenteral nutrition
- Antibiotic usage
- Use of histamine (H₂) receptor blockers (owing to relative bacterial overgrowth)
- Age—more common in neonates, infants, and the elderly
- Immune deficiency

infections in critically ill patients.⁴ Among the numerous risk factors for acquiring a nosocomial infection, the length of hospital stay is the most important. (box 1). Aetiological agents vary and include antibiotic resistant bacteria, particularly *Staphylococcus aureus*, Gram negative bacilli and enterococci, viruses (which account for up to 20% of cases), and fungi.

Hand washing

The hands of staff are the commonest vehicles by which microorganisms are transmitted between patients.⁵ Hand washing is accepted as the single most important measure in infection control.^{5–7} Not surprisingly, hospital staff believe that they wash their hands more often than they actually do, and they also overestimate the duration of hand washing.⁸ In a study of nurses' practices, hands were only cleaned after 30% of patient contacts and after 50% of activities likely to result in heavy contamination. Poorer hand washing performance was related to increasing nursing workload and the reduced availability of hand decontaminating agents.⁹ At many hospitals and clinics, particularly in developing countries, handwash basins are poorly accessible and the unavailability of soap, sprays, and hand towels is a regular, annoying occurrence.

Alcoholic hand disinfection is generally used in Europe, while hand washing with medicated soap is more commonly practised in the United States.¹⁰ The superiority of one method over the other is a moot point. Voss and Widmer argue that alcoholic hand disinfection, with its rapid activity, superior efficacy, and minimal time commitment, allows easy and complete compliance without interfering with the quality of patient care.¹⁰ They estimated that given 100% compliance, soap hand washing would consume 16 hours of nursing time for a 24 hour shift, whereas alcoholic hand disinfection from a bedside dispenser requires only three hours. Hand washing using a spray can be accomplished in 20 seconds, compared with 40–80 seconds for soap.

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Submitted 12 January 2000
Accepted 9 May 2000

Theatre staff are sometimes reluctant to remove their wedding rings when scrubbing up. Higher microbial counts after washing are found in health workers who prefer not to remove rings,¹¹ and may put the patient at risk for a nosocomial infection.¹² The value of surgical scrubbing using a brush is questioned. In one study, subjects who washed with an antiseptic soap alone had a twofold greater reduction in bacterial counts than when they scrubbed with a brush.¹³

Continued monitoring and educational efforts can improve hand washing habits.^{14 15} Larson *et al* reported that by providing feedback to staff regarding the frequency of hand washing, compliance improved by 92%.¹⁴ Alas, when feedback was stopped compliance quickly returned to baseline levels. The importance of constantly reminding staff of the need for hand washing, and of senior staff setting a good example by their own hygienic practices, cannot be overemphasised.

It is difficult to provide clear guidelines on how often hands should be washed. The Handwashing Liaison Group is emphatic: "an explicit standard [should] be set, that hands should be decontaminated before each patient contact."¹⁶ We recommend the use of chlorhexidine solution before the performance of invasive procedures. The thoroughness of application is more important than the time spent on washing or the agent used.

Gloves

Gloves are a useful additional means of reducing nosocomial infection, but they supplement rather than replace hand washing. Possible microbial contamination of hands and transmission of infection has been reported despite gloves being worn.¹⁷ Not surprisingly, health care workers who wash their hands more often are also more likely to wear gloves.³ Single use gloves should never be washed, resterilised, or disinfected, and gloves must be changed after each patient encounter.

Sterile gloves are much more expensive than clean gloves and need only be used for certain procedures, such as when hands are going to make contact with normally sterile body areas or when inserting a central venous or urinary catheter. Clean gloves can be used at all other times, including during wound dressings. For gloves to be used appropriately they must be readily available. Again, this is not always the case at many clinics and hospitals in poorer settings.

Gowning

Gowns help keep infectious materials off clothing, although in some centres they are used more as reminders that the patient is isolated. Two recent studies confirm that staff gowning in the neonatal intensive care unit is an unnecessary custom.^{18 19} Wearing gowns did not reduce neonatal colonisation, infection, or mortality rates. There was no change in traffic patterns in the unit or in hand washing behaviour,¹⁸ and it was not cost-effective.¹⁹ The universal use of gloves and gowns was found to be no better than the use of gloves alone in

preventing rectal colonisation by vancomycin resistant enterococci in a medical intensive care unit.²⁰

Masks

It has never been shown that wearing surgical facemasks decreases postoperative wound infections. When originally introduced, the primary function of the surgical mask was to prevent the migration of microorganisms residing in the nose and mouth of members of the operating team to the open wound of the patient. However, it is now recognised that most bacteria dispersed by talking and sneezing are harmless to wounds.²¹ The prevailing opinion that masks are useful in preventing surgical site infection has been challenged.²²⁻²⁴ Orr reported a 50% decrease in wound infections when masks were not worn, but the study was criticised for lack of proper controls.²³ Tunevall, using better controls, confirmed the earlier findings of lack of clear benefit from wearing masks²⁴; after 1537 operations performed with face masks, 73 wound infections were recorded (4.7%), while following 1551 operations performed without face masks, 55 infections occurred (3.5%). The difference was not significant. Thus while masks may be used to protect the operating team from drops of infected blood and from airborne infections, they have not been proven to protect the patient.

Stethoscopes

Some health personnel have difficulty in accepting that the stethoscope, the symbol of their professional status, may actually be a vector of disease. In a study of 150 health care workers (50 paramedics, 50 nurses, and 50 doctors), staphylococcus species (mostly coagulase negative) were cultured from 89% of the participants' stethoscopes, the mean number of colony forming units increasing the longer stethoscopes were not cleaned.²⁵ Overall, 48% of health care providers cleaned their stethoscopes daily or weekly, 37% monthly, 7% yearly, and 7% had never cleaned them. Cleaning the stethoscope's diaphragm resulted in an immediate reduction in the bacterial count—by 94% with alcohol swabs, 90% with a non-ionic detergent, and 75% with antiseptic soap.²⁵

There are no studies on the beneficial effect of regularly cleaning stethoscopes on nosocomial infection rates. Nevertheless, we suggest that regular disinfection should be carried out (at least once daily), as the level of contamination rises from 0% to 69% after more than one day without cleaning of the stethoscope.²⁶ Isopropyl alcohol is an effective cleaning agent,²⁷ but may dry out the stethoscope's rubber seals and damage the tubing if used routinely.

White coats

Like the stethoscope, the white coat has long been a symbol of the medical professional. Many institutions insist that junior doctors, in particular, wear a white coat as part of a mandatory dress code. About half of all patients still prefer their doctor to wear one.²⁸ However, they

may be less enthusiastic about this if they realised that white coats harbour potential pathogens and are thereby a source of cross infection, particularly in surgical areas.²⁹ The cuffs and pockets of the coats are the most highly contaminated areas. The recommendation that the coat is removed and a plastic apron is donned before wound examination is rarely followed in practice. While few would challenge the sartorial elegance of the white coat, clearly its value needs to be critically assessed. There is little microbiological evidence for recommending changing white coats more often than once a week, or for excluding the wearing of white coats in non-clinical areas.²⁹

Intravenous catheters

In critically ill patients, intravenous lines are responsible for at least one quarter of all nosocomial blood stream infections, with a 25% reported mortality.³⁰ Most causative organisms originate from the skin: staphylococci cause two thirds of the infections, with *S aureus* accounting for 5–15% of these. The insertion of an intravenous needle or cannula results in a break in the body's natural defences. Organisms can enter the circulation from contaminated fluid or a giving set, or can grow along the outer surface of the cannula.

Prevention of complications requires careful insertion practice and optimal catheter care. Inserting a peripheral catheter demands the same precautions as for any surgical procedure. The hands should be disinfected with alcohol and gloves should be worn. The skin of the insertion site must be thoroughly disinfected with alcoholic chlorhexidine or 70% isopropyl alcohol for at least 30 seconds and allowed to dry before inserting the cannula. The insertion site should not be touched after disinfection. When 2% chlorhexidine, 10% povidone-iodine, and 70% alcohol were compared as skin disinfectants, the rate of catheter associated bacteraemia was almost fourfold lower in the patients who received chlorhexidine than in the two other groups.³¹

The use of a clear, adhesive, bacteria impermeable dressing to secure the cannula has become popular. These dressings may be contraindicated as they allow accumulation of blood, sweat, and exudate, which may promote growth on and in the underlying skin. Indeed, a meta-analysis showed a significantly increased risk of catheter tip infection when transparent rather than gauze dressings were used with either central or peripheral catheters.³² Recently, polyurethane dressings, such as Tegaderm®, have been produced which are several times more permeable than standard dressings.³³ These should minimise the risk of moisture accumulation and reduce sepsis rates.³³

Routine replacement of the intravenous line every three to five days is common practice in the USA but not in Europe. Guidelines developed by the Centers for Disease Control and Prevention recommend that peripheral intravenous catheters be changed every three days. However, routine replacement of central ve-

nous catheters was no longer supported in their latest update.³⁴ A recent Swiss study was unable to show an increased risk of catheter related complications—phlebitis, infections, and mechanical complications—during prolonged peripheral catheterisation.³⁵ Peripheral catheters can be safely maintained with adequate monitoring for up to 144 hours (six days) in critically ill children.³⁶

Containers of intravenous fluids are usually changed before significant growth occurs, but the giving set does not need to be replaced more often than every 72 hours.³⁷ “Flagging” each set with a sticker displaying the time it had to be replaced resulted in a significant reduction in the incidence of klebsiellae in a busy neonatal unit.³⁸ There is no difference in the incidence of septicaemia in children who have in-line bacterial filters fitted compared with those who do not.³⁹

Conclusions

Methods for preventing nosocomial infections are summarised in box 2. Nosocomial infections are worth preventing in terms of benefits in morbidity, mortality, duration of hospital stay, and cost. Educational interventions promoting good hygiene and aseptic techniques have generally proved to be successful, but these practices are often not sustainable. Greater efforts are being made in some countries to ensure the application of the infection control evidence base into practice.⁴⁰ In the end, constant vigilance and attention by

Box 2: Practical methods for preventing nosocomial infection

What's in

- Hand washing:
 - as often as possible
 - use of alcoholic hand spray
 - removing jewellery before washing
- Stethoscope: cleaning with an alcohol swab at least daily
- Gloves: supplement rather than replace hand washing
- Intravenous catheter:
 - thorough disinfection of skin before insertion
 - changing administration sets every 72 hours

What's out

- Hand washing: using a brush
- Mask:
 - routine use in theatre
 - during wound dressing
- Gowning: routine use in neonatal units
- White coats: enforced use in clinical units
- Intravenous catheter:
 - routine removal of peripheral catheters after 72 hours
 - use of impermeable, transparent dressings
 - in-line bacterial filters

the individual to what are rather simple measures is demanded.

- 1 Mehtar S. *Hospital infection control: setting up with minimal resources*. Oxford: Oxford University Press, 1992.
- 2 Wenzel RP. The economics of nosocomial infections. *J Hosp Infect* 1995;31:79–87.
- 3 Saloojee H, van Wersmeskerken A. Neonatal bacteraemia and pseudobacteraemia at Chris Hani Baragwanath Hospital. Proceedings of the Eighteenth Conference on Priorities in Perinatal Care in Southern Africa, University of Pretoria, Pretoria, 1999.
- 4 Singh-Naz N, Sprague BM, Patel KM, *et al*. Risk factors for nosocomial infection in critically ill children: a prospective cohort study. *Crit Care Med* 1996;24:875–8.
- 5 Reybrouck G. Role of the hands in the spread of nosocomial infection. *J Hosp Infect* 1983;4:103–10.
- 6 Jarvis WR. Hand washing the Semmelweis lesson forgotten. *Lancet* 1994;344:1311–12.
- 7 Larson EL. APIC guideline for handwashing and hand antisepsis in health care settings. *Am J Infect Control* 1995;23:251–69.
- 8 Gould D. Nurses' hand decontamination practice; results of a local study. *J Hosp Infect* 1995;28:15–20.
- 9 Gould D, Wilson Barnett J, Ream E. Nurses' infection-control practice: hand decontamination, the use of gloves and sharp instruments. *Int J Nurs Stud* 1996;33:143–60.
- 10 Voss A, Widmer AF. No time for handwashing! Handwashing versus alcoholic rub: can we afford 100% compliance? *Infect Control Hosp Epidemiol* 1997;18:205–8.
- 11 Salisbury DM, Hutflitz P, Treen LM, *et al*. The effect of rings on microbial load of health care workers' hands. *Am J Infect Control* 1997;25:24–7.
- 12 Bernthal E. Wedding rings and hospital-acquired infection. *Nurs Stand* 1997;11:44–6.
- 13 Loeb MB, Wilcox L, Smaill F, *et al*. A randomized trial of surgical scrubbing with a brush compared to antiseptic soap alone. *Am J Infect Control* 1997;25:11–15.
- 14 Larson EL, Bryan JL, Adler LM, *et al*. A multifaceted approach to changing handwashing behaviour. *Am J Infect Control* 1997;25:3–10.
- 15 Dorsey ST, Cydulka RK, Emerman CL. Is handwashing teachable? Failure to improve handwashing behavior in an urban emergency department. *Acad Emerg Med* 1996;3:360–5.
- 16 Handwashing Liaison Group. Hand washing (editorial). *BMJ* 1999;318:686.
- 17 Olsen RJ, Lynch P, Coyle MB, *et al*. Examination gloves as barriers to hand contamination in clinical practice. *JAMA* 1993;270:350–3.
- 18 Pelke S, Ching D, Easa D, *et al*. Gowning does not affect colonization or infection rates in a neonatal intensive care unit. *Arch Pediatr Adolesc Med* 1994;148:1016–20.
- 19 Tan SG, Lim SH, Malathi I. Does routine gowning reduce nosocomial infection and mortality rates in a neonatal nursery? A Singapore experience. *Int J Nurs Pract* 1995;1:52–8.
- 20 Slaughter S, Hayden MK, Nathan C, *et al*. A comparison of the effect of universal use of gloves and gowns with that of glove use alone on acquisition of vancomycin-resistant enterococci in a medical intensive care unit. *Ann Intern Med* 1996;125:448–56.
- 21 Ayliffe GAJ, Lowbury EJJ, Geddes AM, *et al*. *Control of hospital infection. A practical handbook*, 3rd ed. London: Chapman and Hall, 1992.
- 22 Mitchell NJ, Hunt S. Surgical face masks in modern operating rooms—a costly and unnecessary ritual? *J Hosp Infect* 1991;18:239–42.
- 23 Orr NWM. Is a mask necessary in the operating theatre? *Ann R Coll Surg Engl* 1981;63:391–2.
- 24 Tunevall TG. Postoperative wound infections and surgical face masks: a controlled study. *World J Surg* 1991;15:383–7.
- 25 Jones JS, Hoerle D, Rickse R. Stethoscopes: a potential vector of infection? *Ann Emerg Med* 1995;26:296–9.
- 26 Genné D, de Torrenté A, Humair L, *et al*. Level of stethoscope contamination in the hospital environment. *Schweiz Med Wochenschr* 1996;126:2237–40. [In French.]
- 27 Marinella MA, Pierson C, Chenoweth C. The stethoscope. A potential source of nosocomial infection? *Arch Intern Med* 1997;157:786–90.
- 28 Menahem S, Shvartzman P. Is our appearance important to patients? *Fam Pract* 1998;15:391–7.
- 29 Wong D, Nye K, Hollis P. Microbial flora on doctors' white coats. *BMJ* 1991;303:1602–4.
- 30 Pittet D, Hulliger S, Auckenthaler R. Intravascular device-related infections in critically ill patients. *J Chemother* 1995;7(suppl 3):55–66.
- 31 Maki DG, Ringer M, Alvarado CJ. Prospective randomised trial of povidone iodine, alcohol and chlorhexidine for the prevention of infection associated with central venous and arterial catheters. *Lancet* 1991;338:339–43.
- 32 Hoffmann KK, Weber DJ, Samsa GP, *et al*. Transparent polyurethane film as an intravenous catheter dressing. A meta-analysis of the infection risks. *JAMA* 1992;267:2072–6.
- 33 Reynolds MG, Tebbes SE, Elliot TSJ. Do dressings with increased permeability reduce the incidence of central venous catheter related sepsis? *Intensive Crit Care Nurs* 1997;13:26–9.
- 34 Pearson ML. Guidelines for prevention of intravascular device-related infections. Part I. Intravascular device-related infections: an overview. The Hospital Infection Control Practices Advisory Committee. *Am J Infect Control* 1996;24:262–93.
- 35 Bregenzer T, Conen D, Sakmann P, *et al*. Is routine replacement of peripheral intravenous catheters necessary? *Arch Intern Med* 1998;158:151–6.
- 36 Garland JS, Dunne WM, Havens P, *et al*. Peripheral intravenous catheter complications in critically ill children: a prospective study. *Pediatrics* 1992;89:1145–50.
- 37 Snyderman DR, Reidy MD, Perri LK, *et al*. Safety of changing intravenous administration sets containing burettes at longer than 48 hour intervals. *Infect Control* 1987;8:113–16.
- 38 Gray G, Wainer S. Drip “flagging” [letter]. *S Afr Med J* 1993;83:298.
- 39 Newall F, Ranson K, Robertson J. Use of in-line filters in pediatric intravenous therapy. *Journal of Intravenous Nursing* 1998;21:66–70.
- 40 Jenner EA, Mackintosh C, Scott GM. Infection control—evidence into practice. *J Hosp Infect* 1999;42:91–104.