Semmelweis Revisited: Hand Hygiene and Nosocomial Disease Transmission in the Anesthesia Workstation

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Hospital-acquired infections occur at an alarmingly high frequency, possibly affecting as many as 1 in 10 patients, resulting in a staggering morbidity and an annual mortality of many tens of thousands of patients. Appropriate hand hygiene is highly effective and represents the simplest approach that we have to preventing nosocomial infections. The Agency for Healthcare Research and Quality has targeted hand-washing compliance as a top research agenda item for patient safety. Recent research has identified inadequate hand washing and contaminated anesthesia workstation issues as likely contributors to nosocomial infections, finding aseptic practices highly variable among providers. It is vital that all healthcare providers, including anesthesia providers, appreciate the role of inadequate hand hygiene in nosocomial infection and meticulously follow the mandates of the American Association of Nurse Anesthetists and other professional healthcare organizations.

Keywords: Anesthesia workstation, biofilm, hand hygiene, hand washing, nosocomial infection.

Objectives
At the completion of this course, the reader should be able to:
1. Describe the important role of Semmelweis in coming to understand the epidemiology of nosocomial infections in hospitalized patients and its application to contemporary practice.
2. Characterize the normal flora of the hands and understand their role as an important vector for transmitting pathogenic organisms.
3. Cite recent research describing infection hazards in the anesthesia work area.
4. List the major recommendations described by the American Association of Nurse Anesthetists, the American Society of Anesthesiologists, and the Centers for Disease Control and Prevention related to hand-hygiene practice.
5. Appreciate the role of biofilms in producing infection.

In Memory of My Father
In 1991, my father died of a Listeria monocytogenes infection 3 days following successful pneumonectomy for small cell carcinoma. Systematic inquiry revealed that he acquired this via a healthcare worker’s inadequate hand hygiene from a patient 3 rooms away who was admitted for sepsis due to Listeria. This article is dedicated in loving memory to him and to current and future patients who may be spared a similar fate by our rigid adherence to excellent hand hygiene.

Introduction
In the 1840s, the Viennese obstetrician, Semmelweis, observed that 20% of women experiencing childbirth in the institutional setting died of a febrile illness, whereas maternal mortality in the home setting was only about 1%. Decades beyond the science of bacteriology that was to come, he posited that some toxin was somehow spread from patient to patient on the hands of the caregivers. This early epidemiological foray eventually led to Semmelweis demanding that physicians and nurses involved in obstetrical delivery wash their hands between patient contacts. The culprit here was the so-called childbirth fever (puerperal fever), a transmissible infectious process whose primary vector was the hands of the
providers who would move from one woman to another, readily and rapidly spreading the infection. Rates of maternal mortality plunged to a rate comparable to that of home delivery in Semmelweis’ hospital with simple hand washing.

Semmelweis’ passion evolved into zealotry. He publicly criticized colleagues as outright murderers if they did not follow his dictum and eventually fired from his post. Not until decades later, based on the subsequent work of Koch, Pasteur, and Lister, were Semmelweis’ principles and practices vindicated. Today, the simple epidemiology of hospital-acquired infection urges that we might collectively benefit by revisiting Semmelweis’ “zealotry.”

Nosocomial (Hospital-Acquired) Infection
The rate of new infections that patients acquire while hospitalized in the United States is staggering; it is suggested that approximately 1 in 10 patients may experience a nosocomial infection, with the rate in Canada perhaps slightly higher.1-3 There is strong evidence suggesting that the incidence and associated risk are only increasing, with an annual mortality conservatively estimated at many tens of thousands of patients (Figure 1).2-7 The intensive care unit is considered an epicenter of bacterial, viral, and fungal organisms for many reasons, including its population of patients with complex conditions with a wide range of pathophysiology, proximity to other patients, high density of “hands-on” interventions by staff, widespread use of mechanical ventilation, and antimicrobial resistance. Antimicrobial therapy resistance has become an issue of staggering short- and long-term importance. Furthermore, invasive fungal infections such as aspergillosis are occurring in patients who do not fit the profile of the traditional immunocompromised patient; at particular risk are mechanically ventilated patients and patients receiving corticosteroids. Diagnosis can be delayed, and patient prognosis is often grim.

The long-term “solution” to the problem does not depend on the pharmaceutical industry. While technological and chemical advances in the molecular killing of microbes are surely forthcoming, simpler, practical, and low-cost interventions are currently available to reduce the rate of nosocomial infection. Efforts designed to enhance our knowledge of the process and mechanisms of nosocomial infection must be aggressively pursued so that effective interventions can be recommended, implemented, and complied with.

Absence of Evidence Is Not Evidence of Absence!
The nature of our exposure (anesthetic care) to a given patient is defined by a relatively brief period of intense and invasive procedure-based interventions with little in the way of meaningful follow-up once the patient leaves the perioperative area. Postoperative visits, when performed, usually occur within 24 hours of anesthetic care and will not alert us to complications that require a day or more to manifest. Examples of complications that we may have a significant yet unappreciated role in include issues such as transfusion-related acute lung injury, peripheral nerve injury, cognitive impairment, awareness

Figure 1. Projected Mortality Attributable to Nosocomial Infection2-7
The x-axis assumes mortality rates of 10% to 30%. Straight-line plots assume hospital infection rates of 2.5%, 5%, or 10%. Even in the very best scenario, many thousands die of mostly preventable circumstances.
under anesthesia, vision disturbances, and infectious processes. Because we do not see it and are temporarily remote from the complication's clinical manifestation, we may not recognize our role in causing it. Because we do not see it does not mean it is not there. Absence of evidence is not evidence of absence.

The Anesthesia Workstation: A Complex and Dangerous Place

Maslyk et al. assessed the density and diversity of microbial organisms on a variety of randomly selected anesthesia machines following routine, full-day use. These investigators not only cited the risk of disease transmission to the patient, but also speculated on the risk posed to anesthesia providers working with this equipment. A wide variety of pathogenic (α Streptococcus, Acinetobacter, Staphylococcus aureus, and gram-negative rods) and non-pathogenic organisms were cultivated; this was noted to be a threat to patients and staff alike. In a particularly poignant case, the investigators found Acinetobacter, a pathogenic organism cultured in the intensive care unit where the patient was cared for preoperatively, then isolated on the anesthesia workstation where the patient was subsequently cared for, and later isolated in the adjoining operating room as well. The authors commented on how readily organisms can be transferred around a complex environment like the one we work in every day. Healthcare workers serve as important infectious disease vectors in the workplace.

Anesthesia providers daily perform a large number of interventions in which there is routine, direct contact with patients, often with their blood and bodily fluids. A study performed more than 10 years ago that sampled laryngoscopes found that 20% of blades and 40% of handles tested positive for occult blood. Although we rarely consider the implications, the intraoperative environment itself is frequently inoculated with aerosolized particulates, especially during procedures involving motorized instruments, percussive hammering, or pressurized flushing or debridement of wounds. In this case, the room air is likely to contain microscopic and macroscopic particles that may harbor pathogenic biomaterials. Again, anesthesia providers may hold the belief that because there is a lack of evidence that our routine practices may not have direct negative, iatrogenic implications for patients, we are not participatory in the genesis of infective risk and complications.

Behavior in Our Anesthesia Workstations: Not as Clean as We Think?

The anesthesia work area is a fertile environment for all kinds of pathogens. Included in this work area are the anesthesia machine, the supply cart(s), the surgical bed, and specialized equipment such as infusion pumps, warming devices, intravenous (IV) line poles, phones, and other items. Aerosolized particles, liquids from patients, and potentially ubiquitous contamination of hard and soft surfaces abound in our environment. Consider your own behavior: Do you ever touch a flowmeter control, vaporizer dial, or the adjustable pressure-limiting valve immediately after manipulating your patient's airway without removing your gloves? Have you ever suctioned the airway and then touched the reservoir bag without changing gloves? What about the pen you use to chart with, or if you have an electronic record-keeping system, the keyboard? What about nondisposable blood pressure cuffs that are applied and reapplied to subsequent patients? What about the electrocardiograph leads that are reused from patient to patient, sometimes having fallen on the floor, that may have been dragged through a patient's blood or secretions, or are simply in proximity to the patient's armpits, which are known to be reservoirs of methicillin-resistant S aureus (MRSA) in people who are carriers? And how about the syringes and medication bottles that are handled over and over again by hands that may harbor biological particles? And what about “cost-saving” short-cuts that may result in cross-patient contamination such as the recently reported case when anesthesia providers reused syringes in patients undergoing ambulatory diagnostic endoscopy procedures in the Las Vegas area?

A recent study at a large academic center involved the culturing of 61 anesthesia workstations randomly selected during a 6-day period. The data collected involved the first scheduled person cared for in each particular operating room. Sterile IV sets were used on each patient, and the anesthesia apparatus underwent routine decontamination. The internal lumens of the IV stopcocks, the adjustable pressure-limiting valve, and the vaporizer dial were cultured before patient care and at case completion. The IV stopcock lumens became contaminated with pathogenic bacteria in 32% of the cases. A similar rate of contamination of the anesthesia apparatus was found with no demonstrable influence of provider type, ASA physical status of patients, surgical procedure, or case duration. In fact, the researchers noted that the anesthesia work environment became contaminated within as few as 4 minutes of the start of intraoperative care and observed a clinically powerful association between increasing magnitude of anesthesia work area contamination and contamination of the IV stopcocks. This was attributable to likely variable and inconsistent aseptic practice on behalf of the anesthesia providers. It begs the question: Are we as clean (or careful) as we think that we are?

Also noted by the researchers, although of somewhat questionable validity, was their observation of a possible causal link between intraoperative stopcock contamination and mortality: “we have shown that such contamination is associated with a trend toward increased nosocomial infection rates and a significant increase in
postoperative mortality. Of interest was their culturing of MRSA and (vancomycin-resistant Enterococcus) VRE, pathogens that are currently of great concern owing to their conspicuous resistance to antimicrobials and their lethality. Such causal conclusions involving mortality are beyond the range of an observational study but certainly serve to focus attention on the concern.

Two recent studies, one from Switzerland, the other from the Middle East, explored the behaviors, attitudes, and practices of perioperative providers with respect to nosocomial infection risk. The first was an observational study of 3,143 patient care activities in a busy postanesthesia care unit involving 187 patients. Here, the average compliance with hand cleansing when a new patient was received was 19.6%, falling to 12.5% with subsequent hand cleansing during the ongoing care of the patient. Not only was failure to cleanse the hands extremely common, but also the greater the intensity of patient care activity, the greater the rate of failure. Here and in other studies, care providers were more likely to comply with better hand-washing activity if they perceived a personal threat.

The second, survey-type study demonstrated that adequate procedures designed to prevent nosocomial infections are not routinely in place or practiced. While the overwhelming majority of respondents claimed to be aware of the risks of infection transmission in the anesthesia workplace, they were inadequately compliant and often lacked a detailed knowledge of infection control.

In 1995, a survey of anesthesiology practice was undertaken to determine perioperative practices with respect to hand washing. Here again, it was demonstrated that a perceived threat to oneself resulted in greater compliance with hand washing. People who were providing care to patients believed to be harboring human immunodeficiency virus (HIV) or hepatitis B virus (HBV) washed their hands 95% of the time vs only about 58% of the time when caring for the same patients when HIV and HBV status was unknown. Likewise, 2 studies from Japanese clinical investigators have particular relevance to anesthesia workstation issues. These investigators also demonstrated the importance of allowing the hands to fully dry when using an alcohol-based solution to maximize bactericidal action. The second study explored the issue of keyboard contamination in the anesthesia workstation, a matter of growing concern as automated record-keeping systems and computer use find greater and greater perioperative use. Here, the researchers noted a disturbingly high rate of keyboard use with contaminated hands and gloves and the routine culturing of pathogenic organisms (including MRSA) from keyboards (Figure 2). An incidental finding was that only 17% of anesthesia providers performed any sort of hand hygiene before caring for a patient, although hand hygiene rose to 69% before they ate a meal.

What consistently emerges from these studies is the common theme that although we understand the role of hand washing and overall hand hygiene in preventing nosocomial disease transmission, we generally fail in applying this knowledge in routine practice. Although anesthesia-related outcome studies are sorely lacking in this domain, the implications are obvious.

**Semmelweis Revisited: Routine Hand Hygiene Is Not Optional!**

There is a powerful literature that has emerged that Semmelweis had it absolutely right more than a century and a half ago: Proper cleansing of the hands is highly ef-
Effective and represents the simplest approach that we have to preventing nosocomial infections. The Agency for Healthcare Research and Quality has targeted hand-washing compliance as a top research agenda item for patient safety.\textsuperscript{11,18}

While it is clear that there are many contributors to nosocomial infections, compliance with appropriate soap-and-water cleansing or disinfection with antiseptic foams or solutions is now considered the single most important intervention available for preventing nosocomial infections.\textsuperscript{5-7}

Why We Fail to Comply With Good Hand-Hygiene Practices

One defining attribute of anesthetic care includes performing interventions that involve close patient contact, often under performance pressure, and requiring complex and skillful technique, with a very small margin for error. Consequently, the inherent risk of patient-provider-equipment contamination during anesthetic care is great. Anesthesia providers work in a high-risk environment; risk factors abound for patient and provider. Further increasing patient risk is the concern, admittedly contentious as of this writing, that general anesthesia may suppress the immune response in patients, making them more vulnerable to acquired infection.\textsuperscript{19,20} Under such circumstances, how can we possibly not be fully compliant with excellent hand-hygiene practices?

In my integrative review of the current and remote literature, a number of common themes continuously emerged regarding why we do not wash our hands without fail. These major themes are listed in Table 1. A common, recurring theme involves production pressure, the need to get more done in less time; busy practitioners can be easily distracted and overwhelmed with task performance. Also common is the notion that our hands do not look contaminated (Figure 3). It is critically important to recognize that because there is little systematic evidence linking our workplace behaviors to causing nosocomial infections, we may speciously assume that the risks are minimal or nonexistent. Research such as that by Loftus et al\textsuperscript{10} is beginning to change that.

What the American Association of Nurse Anesthetists (AANA) Mandates

In its position statement of its Infection Control Guidelines, Tier I, Standard Precautions,\textsuperscript{21} the AANA indicates that compliance with standard precautions is mandatory to ensure a safe and healthy environment for patients and healthcare providers. Procedures for standard precautions include but are not limited to the following:

1. Handle blood and body fluids and substances of all patients as if they were potentially infectious.
2. Wash hands before and after all patient or specimen contact. Hand washing is the single most important step in preventing the spread of infection. Hands should be thoroughly washed before and after handling body substances or articles possibly contaminated with body substances. Hands should also be thoroughly washed after removing gloves at the completion of a task or procedure.

What the American Society of Anesthesiologists (ASA) Mandates

The ASA in its practice guidelines is very prescriptive on hand washing and hand hygiene.\textsuperscript{22} Here it indicates the following:

1. Wash hands before performing invasive procedures.
2. Wash hands after touching blood, body fluids, secretions, excretions, and contaminated items, whether or not gloves are worn.
3. Wash hands immediately after gloves are removed, between patient contacts, and when otherwise indicated to avoid transfer of microorganisms to other patients or environments.
4. It may be necessary to wash hands between tasks.
and procedures on the same patient to prevent cross-contamination of different body sites.

5. Waterless hand washing solutions may be considered when not able to leave the room.

6. Appropriate barrier precautions such as gloves, fluid-resistant masks, face shields, and gowns must be used routinely with all patients.

7. Remove gloves and gowns promptly after use, before touching noncontaminated items and environmental surfaces, and wash hands before seeing another patient.

What the Centers for Disease Control and Prevention (CDC) Mandates

The CDC is equally prescriptive regarding hand-hygiene practice and recognizes that pathogenic organisms of many types persist on human skin surfaces for long periods.⁶ Here, it indicates that healthcare workers decontaminate their hands as follows:

1. Before having direct contact with patients
2. Before donning sterile gloves when inserting a central intravascular catheter
3. Before inserting indwelling urinary catheters, peripheral vascular catheters, or other invasive devices that do not require a surgical procedure
4. After contact with a patient’s intact skin (eg, when taking a pulse or blood pressure, or lifting a patient)
5. After contact with body fluids or excretions, mucous membranes, nonintact skin, and wound dressings
6. After contact with inanimate objects in the immediate vicinity of the patient
7. After removing gloves
8. Before eating and after using the restroom, wash hands with a nonantimicrobial soap and water or with an antimicrobial soap and water.

Biofilms: Contemporary Understanding of Chronic Infections

It was the seminal work of Koch who, more than 150 years ago, isolated various strains of bacteria and developed the very culture methods that are used today in research and clinical care. A curious irony has emerged in that overreliance on the methods of Koch may have delayed development of a more complete appreciation of the continuum of microbial processes. In the reality of a chronic bacterial infection, small free-floating, single-cell phenotypes observed in Koch-based methods generally exist for only a short period and in relatively small numbers. Recent research has revealed the importance of the biofilm as the prevailing paradigm to describe chronic resident bacteria in their natural and pathogenic environments. The biofilm is a very thin layer of microorganisms that strongly adhere to organic (tissue) and nonorganic (eg, apparatus, bed linens, and light switches) material.

The biofilm is a kind of fortress of microorganisms that has evolved a variety of coping and survival mechanisms against phagocytosis, ultraviolet radiation, dehydration, host immunity, and antibiotics.⁷ Once established, phagocytes, macrophages, and granulocytes become virtually useless in coping as they are unable to engage a biofilm in the manner that they would individ-

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Figure 4. The Nature and Development of Biofilm²³,²⁴

1. Initial bacterial attachment. 2. Irreversible attachment with strands of secreted extracellular polymeric substance. 3. Early maturation. 4. Late maturation. 5. Dispersion. The lower panel reveals associated photomicrograph development. Biofilm demonstrates enhanced resistance to antimicrobial and mechanical interventions.


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²³,²⁴
ual microorganisms. It is now well appreciated that a biofilm can withstand 100 to 1,000 times the concentrations of antimicrobials that inhibit or kill individual planktonic cells. Furthermore, biofilms possess genetic and phenotypic diversity that serves to render them very adaptable and, thus, resistant to a variety of environmental and chemical stressors. The bacteria of the biofilm actively produce and secrete a variety of protective polymers and incorporate existing environmental molecules into their community fabric, effectively binding the resident bacteria to one another and to the organic or inorganic surface that they reside on (Figure 4). The secreted matrix, termed extracellular polymeric substance, is composed of sugary molecular strands. A symbiosis develops as the bacterial community secretes pheromones that provide cell-cell signaling between the same and different bacterial species. The biofilm may come to house a dozen or more species of bacteria and fungi as well. In effect, a formidable, multispecies, disease-causing complex emerges. The CDC and others suggest that the overwhelming number of infections in hospitalized patients caused by bacteria are the result of biofilm and carry a substantial mortality. Better understanding of the biofilm has led to understanding its role in conditions such as cystic fibrosis, pneumonia, and infected surgical implants such as knee prosthetics and pacemakers. Perhaps the most common biofilm disease seen is dental plaque. Poor oral hygiene, as measured by plaque density and the extent of its distribution, has been known for some time to be an independent risk factor for cardiovascular disease (increased incidence of coronary artery disease), particularly in men younger than 50 years.

Table 2 lists some common areas where biofilm communities are known to reside and cause problems; of consequential importance to us is their residence on medical apparatus, such as the anesthesia machine and other inanimate objects. Given the nature of the biofilm, chemical and physical approaches are required to properly manage it.

**The Hands: A Veritable Germ Farm**

In its natural and normal state, human skin supports a number of organism microenvironments. Cosmetic ads directed at consumers target these environments using a variety of approaches. Dry regions are primarily represented by the hands and limbs and reveal a predominance of aerobic cocci such as *Staphylococcus epidermidis*, *S. aureus*, and micrococci. Wet regions include the head, axillae, anterior nares, intertriginous areas, and groin and have a predominance of aerobic diphtheroids such as *Corynebacterium* and *Brevibacterium*. The head, neck, trunk, and upper back constitute the oily regions and support anaerobic diphtheroids such as *Propionibacterium acnes*, *Propionibacterium granulosum*, and *Propionibacterium avidum*. The hands from a “dry” area to a “wet” area with predictable change in microorganism proliferation.

A large number and diversity of transient bacteria, viruses, and fungi can be found on the hands, depending on any number of factors, including personal hygiene practice, patient and equipment contact, environmental conditions, climate, and medication use. Normal hand bacterial counts are in the range of $5 \times 10^3$ to $5 \times 10^6$ units/cm², while the counts in groin and underarm areas are higher; in addition, microorganisms persist for long periods on the skin, retaining their potential for proliferation and infectivity. Skin crevices and fingernails are microorganism respires. Although hands may “look dirty” (see Figure 3), prompting aggressive cleansing, visible evidence of hand contamination is not a useful indicator to engage in hand-cleansing activities; trace, microscopic contamination, makes the hands an insidious but powerful transmission vector.

Patients with bacterial infections such as MRSA or VRE carry the organisms all over their bodies and on their clothing, linens, and inanimate objects such as their bed side rails, IV pump devices, room door handles, blood pressure cuffs, stethoscopes, and other objects that they come into contact with. The transfer of microorganisms readily occurs by many different vectors, the hands being the most prominent.

It must be understood that our patients may not necessarily be “infected” with pathogens, but rather may simply be “colonized” with them, thus acting as mobile infective reservoirs. Recently, University of Colorado researchers revealed that women tend to have a greater variety and density of bacteria on their hands compared with men, a finding that differs from conventional
belief28 (Figure 5). Whether male or female, the range of bacteria varied considerably among the 51 college students tested, even from hand to hand in the same person; the investigators found 4,742 species of bacteria, only 5 of which were on everyone’s hands.29 Good hand hygiene is the cornerstone intervention in controlling the dispersion of microorganisms yet has very poor overall compliance, despite the knowledge that even just one breech in practice can be associated with catastrophic implications.

Musings on the Future: Time to Think Outside the Box

The following are some ideas that I want to suggest to clinicians, researchers, inventors, business leaders, insurance representatives, and thinkers of all kinds. I believe the current situation is a national healthcare disgrace, yet one amenable to solution. It is time to initiate input from a wide range of minds within and outside of our discipline. Consider the following factors and questions:

• I have practiced as a nurse anesthetist for 28 years and still use the same manner of cardiac monitoring leads that I used as a student. As an inanimate, between-patient contamination vector, nothing may rival these. Why do we not have cheap, effective, personal (disposable) leads?

• The surgical lights are moved about, and it is not uncommon to see a shower of particulates fall from them, inoculating the air, and we are frequently asked to position them. Why do we not have recessed, remote-control lights built high into the ceiling?

• Why do we all not wear (on our belts, around our necks, clipped to our scrubs, whatever) small, highly portable, hand sanitizer dispensers, with audible or vibrating signals to “remind” us to engage in hand hygiene?

• Why not have visual or audible “reminders” placed around the anesthesia workstation to prompt us to cleanse our hands, when the current system of appealing to our professional training seems not to be working?

• Why not somehow “reward” practitioners for complying with excellent hand hygiene? Perhaps microbial tracking devices of some kind could be used that assess the quality of our hand hygiene. Practitioners with particularly outstanding assessments would be somehow rewarded.

• The surgical environment is one where infection prevention is a way of life. It would never occur to a scrub tech or surgeon to begin surgery without fully scrubbing using mechanical (scrubbing) and chemical (disinfectant soap) approaches in combination. What components of that mindset, education, and training can we draw from in anesthesia?

• Future anesthesia machines and electronic record-keeping devices should be designed to allow easier between-case disinfection by using flat-panel technology like we see in many of the current generation cell phones and handheld computers.

Figure 5. Battle of the Sexes: Who Has the “Cleaner” Hands?
Recent research reveals that women have a greater bacterial hand burden than men.

• Anesthesia department aides, assistants, and other ancillary personnel who clean, stock, and otherwise maintain our equipment must be highly prioritized in their training so that they understand the importance of their role in the infection-transmission chain.

• The use of sterile gloves, masks, and gowns should be considered in neuraxial procedures, not just in central line placement. A compelling literature has evolved that suggests highly variable aseptic practice for neuraxial techniques and an associated morbidity and mortality. We are likely amidst a movement mandating full barrier protection when performing regional anesthesia.29 Infectious complications from such techniques can be catastrophic, and more stringent and uniform infectious disease safety practices seem an obvious, proactive, and rational approach.

• Educate, reeducate, and then relentlessly educate—not just staff, but patients and the lay public at large. Educational approaches that have consistent feedback reminders combined with policy changes can have a significant effect on hand hygiene compliance.30-32

• On an individual provider level, focus attention on the responsibility that we assume when we take care of a patient; consider the value of developing an emotional connection with your patients by asking yourself, “How would I like a healthcare provider to take care of me or a family member?”

Summary

Not only are nosocomial infections occurring more often and in more debilitated patients than ever, but they are also becoming increasingly virulent, difficult, and costly to manage. Our mothers told us to always wash our hands before eating, after using the bathroom, and after playing with a friend who had a cold. It is time we listened to our mothers.

Since this paper was accepted for publication a rele-
vant study was published from a prominent US center noting the extremely low rate of hand hygiene decontamination by anesthesia providers. The authors note the active harm that anesthesia providers cause patients with inconsistent hand hygiene practices. In their nonrandomized study, they demonstrated that a personal hand hygiene device with auditory prompts resulted in a marked increase in rate of hand hygiene with a resultant few events of anesthesia work area and patient contamination.

REFERENCES


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