Hand Washing & Infectious Disease Transmission in the Anesthesia Work Area

“The patient in the next bed is highly infectious. Thank God for these curtains”

Chuck Biddle  CRNA, PhD
Hospital acquired infections (HAI)
A national patient safety issue

- >35 million patients admitted to US hospitals yearly
- 5-10% of these acquire a nosocomial infection
- Nearly 100K of these patients will die as a result
- Cost of treating these infections ~ $4.5-5.7 billion

Provonost. NEJM. 2006;355:2725
Nosocomial Infections

Most often target the urinary tract, surgical wounds, blood & respiratory tract

Common causes: *Staphylococci*, *Enterococci*, *E coli*, *Listeria*, and *Pseudomonas aeruginosa*, *mrsa* vancomycin resistant enterococcus, *c difficile*

Transfer of microorganisms from the hands of healthcare workers is the main route of infection
Approximately 99,000 Americans die each year from preventable, hospital-acquired infections.

Central-line-associated bloodstream infections account for 1/3 or more of all related deaths.

*DeNoon, D. "99,000 Die Yearly From Preventable Hospital Infections" WebMD. 5/27/10
Estimating Health Care-Associated Infections and Deaths in U.S. Hospitals

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SYNOPSIS

Objective. The purpose of this study was to provide a national estimate of the number of healthcare-associated infections (HAI) and deaths in United States hospitals.

Methods. No single source of nationally representative data on HAIs is currently available. The authors used a multi-step approach and three data sources. The main source of data was the National Nosocomial Infections Surveillance (NNIS) system, data from 1990–2002, conducted by the Centers for Disease Control and Prevention. Data from the National Hospital Discharge Survey (for 2002) and the American Hospital Association Survey (for 2000) were used to supplement NNIS data. The percentage of patients with an HAI whose death was determined to be caused or associated with the HAI from NNIS data was used to estimate the number of deaths.

Results. In 2002, the estimated number of HAIs in U.S. hospitals, adjusted to include federal facilities, was approximately 1.7 million: 33,269 HAIs among newborns in high-risk nurseries, 19,059 among newborns in well-baby nurseries, 417,946 among adults and children in ICUs, and 1,266,851 among adults and children outside of ICUs. The estimated deaths associated with HAIs in U.S. hospitals were 98,987: of these, 35,967 were for pneumonia, 30,665 for bloodstream infections, 13,088 for urinary tract infections, 8,205 for surgical site infections, and 11,062 for infections of other sites.

Conclusion. HAIs in hospitals are a significant cause of morbidity and mortality in the United States. The method described for estimating the number of HAIs makes the best use of existing data at the national level.

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1.7 x10⁶ HAIs
33 K among NICU
20 K in newborn nurseries
417 K in ICUs
1.3 x10⁶ outside the ICU
Deaths → 98,987
June 6, 1944: Landing marines ashore
D-Day, Normandy Beach, France
Viennese obstetrician Semmelweiss
Blamed problem on doctors not washing hands
Enforced Dr. & nurse hand washing
Rate fell to ~1%

20% maternal mortality
Childbed (puerperal) fever
~1% mortality at home!

Semmelweiss was harshly criticized
Branded a lunatic—Drs. killing patients!?
Fired!

1847

Failed genius
20 years later Lister’s plea more persuasive
30 years later Koch & Pasteur provided the science
Formal guidelines for hand washing in hospitals not published until a 1975 release by the CDC

Current studies show health care workers average < 50% compliance with hand hygiene guidelines
Biofilms

Thin layer of organisms adherent to a surface
Provides a fortress against environmental stressors
Organisms + secreted polymers = biofilm

Resist immunologic, phagocytotic, chemical and physical forces
Often many different communal species
Biofilm highly resistant to antibiotics
Examples of biofilm disease

Pneumonia
Dental plaque
Cystic fibrosis
Infected knee prosthesis
Cardiac valvular infections
Infected pace-wires, intravenous catheters
Tracheal tube biofilms

- ETTs covered with biofilms inside & out within hours
- The longer in situ, the greater the risk of VAP
- Colonization/innoculation often from oral flora

SEM of multispecies biofilm aggregate on the lumenal surface of an ETT. The uvula-shaped aggregates have a rubbery texture and routinely break off and are aspirated into patients’ lungs.
The bactericidal effect of silver nanoparticles

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Received 21 June 2005, in final form 13 July 2005
Published 26 August 2005
Online at stacks.iop.org/Nano/16/2346

Abstract
Nanotechnology is expected to open new avenues to fight and prevent disease using atomic scale tailoring of materials. Among the most promising nanomaterials with antibacterial properties are metallic nanoparticles, which exhibit increased chemical activity due to their large surface to volume ratios and crystallographic surface structure. The study of bactericidal nanomaterials is particularly timely considering the recent increase of new resistant strains of bacteria to the most potent antibiotics. This has promoted research in the well known activity of silver ions and silver-based compounds, including silver nanoparticles. The present work studies the effect of silver nanoparticles in the range of 1–100 nm on Gram-negative bacteria using high angle annular dark field (HAADF) scanning transmission electron microscopy (STEM). Our results indicate that the bactericidal properties of the nanoparticles are size dependent, since the only nanoparticles that present a direct interaction with the bacteria preferentially have a diameter of ∼1–10 nm.
Silver-Coated Endotracheal Tubes and Incidence of Ventilator-Associated Pneumonia

The NASCENT Randomized Trial

RCT, 54 centers, 2003 adults

S-C ETT ➞ 4.8% VAE
Reg ETT ➞ 7.5% VAE

Silver

- Broad spectrum antibiosis
- Reduces bacterial adhesion
- Blocks biofilm formation
- Nontoxic

JAMA. 2008;300:805
Hand bacterial counts: $5 \times 10^3 - 5 \times 10^6$ units/cm²

Hair, groin and underarm areas are higher

Skin crevices are bacterial respites

Fingernails harbor enormous #

Jewelry & watches $\rightarrow$ worse

US Center for Disease Control, 2008
Morbidity & Mortality Weekly Report
WWW.CDC.GOV
Effect of Antiseptic Handwashing vs Alcohol Sanitizer on Health Care–Associated Infections in Neonatal Intensive Care Units

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Background: The Centers for Disease Control and Prevention, Atlanta, Ga, recommend use of waterless alcohol hand products in lieu of traditional handwashing for patient care, but there are few data demonstrating the impact of this recommendation on health care–associated infections.

Objectives: To compare the effect of 2 hand hygiene regimens on infection rates and skin condition and microbial counts of nurses' hands in neonatal intensive care units.

Design, Setting, and Participants: Clinical trial using a crossover design in 2 neonatal intensive care units in Manhattan, NY, from March 1, 2001, to January 31, 2003, including 3932 neonatal hospital admissions (51760 patient days) and 119 nurse participants.

Intervention: Two hand hygiene products were tested: a traditional antiseptic hand wash and an alcohol hand sanitizer. Each product was used for 11 consecutive months in each neonatal intensive care unit in random order.

Results: After adjusting for study site, birth weight, surgery, and follow-up time, there were no significant differences in neonatal infections between the 2 products; odds ratios for alcohol compared with handwashing were 0.98 (95% confidence interval [CI], 0.77-1.25) for any infection, 0.99 (95% CI, 0.77-1.33) for bloodstream infections, 1.61 (95% CI, 0.57-5.54) for pneumonia, 1.78 (95% CI, 0.94-3.37) for skin and soft tissue infections, and 1.26 (95% CI, 0.42-3.70) for central nervous system infections. The skin condition of participating nurses was significantly improved during the alcohol phase (P = .02 and P = .049 for observer and self assessment, respectively), but there were no significant differences in mean microbial counts on nurses' hands (1.21 and 3.11 log_{10} colony-forming units for handwashing and alcohol, respectively; F = .38).

Conclusions: Infection rates and microbial counts on nurses' hands were equivalent during handwashing and alcohol phases, and nurses' skin condition was improved using alcohol. However, assessing the impact on infection rates of a single intervention is challenging because of multiple contributory factors such as patient risk, unit design, and staff behavior. Other practices such as frequency and quality of hand hygiene are likely to be as important as product in reducing risk of cross-transmission.


Arch Pediatr Adolesc Med
2005;159:377-383
Why we don’t wash our hands

- Patient care distracts us
- Male gender
- Forgetfulness
- Hand irritation
- Wearing gloves
- Hands don’t look dirty
- Takes too long / don’t have time
- Feelings of overwork or understaffing
- Lack of well-placed facilities (soap or sink)
- Lack of knowledge of guidelines
Will you wash your hands?

- Washing hands saves lives, and reduces the overall cost of healthcare
- As anesthesia providers we hold patients’ lives in our hands every time we enter the OR

*Shouldn’t those hands be clean?*
Wash Hands!
Use Gloves!

With labels:

Handwashing 92% vs 46%

Gloves 92% vs 43%
YOUR HANDS CAN BE DANGEROUS.
WASH THEM WITH SOAP AND WATER TO KEEP BACTERIA AT BAY.

Your 5 moments for Hand Hygiene:
1. Before patient contact
2. Before aseptic task
3. After body fluid exposure risk
4. After patient contact
5. After contact with patient surroundings
Promoting alcohol hand rubs improves hand hygiene habits in the ICU

When alcohol hand rub dispensers are near each patient’s bed, we clean our hands significantly more often than when only sinks are available.

Arch Intern Med. 2000;160:1017-1021
Cleaning hands with alcohol-based hand-rubs compared to soap and water

- takes less time to use
- more accessible than sinks
- less skin irritation and dryness
- more effective in reducing the number of bacteria
- has led to improved hand hygiene practices
% of surfaces contaminated with pathogenic bacteria

J Hosp Infect. 2006;65:50
Hand-cleansing during PACU care

A Study of Hand Hygiene in the Postanesthesia Care Unit—It's about Time!

As a hospital epidemiologist, my inclination when I reviewed the article by Pickett et al. entitled "Hand-cleansing during Postanesthesia Care" was to say, "It's about time some one addressed this issue in the PACU." In contrast, readers of the Journal may be asking, "What's the big deal?" These authors have demonstrated that poor compliance with hand-cleansing, or hand hygiene, in the PACU is linked to subsequent nosocomial infections. If that is how you responded, you are correct when you say the authors did not prove that poor compliance with hand hygiene caused nosocomial infections. In fact, their goal was simply to evaluate compliance with hand hygiene in their PACU. They accomplished this goal and documented that compliance with this basic infection-control measure was as low or lower than that previously reported from intensive care units (ICUs).

Before I go further, I want to congratulate the authors for addressing this difficult topic. I also want to congratulate nurses and physicians working in PACUs who take hand hygiene seriously. That said, I'd like to address skeptics in the reading audience. I also would like to address the issue of time—because it is not only about time someone did a study on this topic, but it is also time that makes this a difficult topic to study, and time (or lack thereof) that may prevent some staff from practicing good hand hygiene.

Given the brief time that patients are in the PACU, it will be difficult to prove that specific nosocomial infections occurring while the patient is in the surgical ICU or on the surgical ward were caused by the PACU staff's failure to perform hand hygiene appropriately. However, data from ICUs indicate that patients typically acquire pathogens from the hands of healthcare workers and that hand hygiene decreases the transmission of these organisms and prevents nosocomial infections. I cannot envision a study in which rules that apply to ICUs do not apply in PACUs. Thus, a Gram-negative organism may be carried on a PACU nurse's hands from the Foley catheter to the hub of the central venous catheter and from there into the bloodstream of a patient. When signs and symptoms of bloodstream infection are manifest, the patient will be in the surgical ICU. The infection-control program will report the infection to surgical ICU staff, and PACU staff will never receive feedback about that or any other infection.

PACU staff members are extremely busy caring for patients who are unstable, in pain, have numerous invasive devices, and require substantial nursing care. Obviously, if the choice is between performing hand hygiene and performing a task that will save the patient's life, staff members should save the patient's life. However, this author suspects that staff members infrequently must choose between performing hand hygiene and saving the patient's life. Instead, I believe that PACU staff and other staff neglect to cleanse their hands because they have not been trained to identify all situations in which hand hygiene should be performed or because the culture in the unit is such that staff members do not put a high priority on this practice.

The argument that PACU staff members do not have time for hand hygiene is mitigated in part by the alcohol-based hand-hygiene products available in many hospitals. These products can be placed at the bedside so that staff members do not even need to cross the room to cleanse their hands. Moreover, Voss and Widmer documented that these products reduce by 50-75% the time needed for hand hygiene in an ICU.

Two recently published studies are pertinent to the study by Pickett et al. Rogers et al. documented that 33% and 41% of patients carried pathogenic organisms in their noses or on skin adjacent to their surgical sites when they were admitted to the PACU and when they were discharged, respectively. Ninety percent of staff also carried pathogenic organisms. These investigators concluded that cross-contamination could occur in PACUs and that staff needed education regarding hand hygiene, isolation precautions, and environmental cleaning. Hafiz and Nurtdin conducted surveillance for nosocomial infections related to anesthesia, which they defined as infections occurring within 72 hours of a general or regional anesthetic procedure. They identified 25 infections—12 respiratory, 9 vascular catheter-associated, 2 eye, and 2 mouth—for a rate of 3.4 infections/1,000 patients. The infections could have been acquired in the operating room, PACU, or surgical ICU. Although we can't rule out the possibility of nosocomial infections occurring in the PACU, we also can't prove that they didn't.

The PACU is usually an open ward without barriers, such as walls, between patients to remind staff members that they need to cleanse their hands when moving from one patient to another. Also, patients usually are not

Study aim:

Assess healthcare workers' compliance with hand washing and identify factors associated with poor compliance.
Study Parameters

- 2,300 bed academic center
- 12 open bed PACU  RN to patient  1:3
- 3 sinks & individual bed alcohol hand-rub
- Staff aware of monitoring / not of the study’s purpose

- Observed over continuum of PACU care

- Total observation time was 39 hours
- 120 nurses, 17 physicians, 16 nurse assistants
- Observed 3,143 patient care interventions
- 1,091 interventions had “strong risk” for cross transmission
Average compliance with hand-cleansing = 12.5%

Type of hand-cleansing when performed
  – Soap & water = 17%      Alcohol hand-rub = 83%

“A particularly low compliance with hand-cleansing in the PACU at time of patient admission & during stay.”
Factors moderating PACU compliance

- Intensity of care activities was very high
- Unpredictable events add to burden

Sense of personal exposure risk? $\rightarrow$ compliance

Increasing patient age $\rightarrow$ compliance
Intraoperative environment

- Aerosolized particles everywhere
- Liquids from patients and our work materials
- Ubiquitous hard & soft surface contamination

Paucity of objective evidence

- belief we have little role in nosocomial infection
• TRALI
• Awareness
• Acute ischemic stroke
• Cancer recurrence (?)
• Cognitive impairment
• Peripheral nerve injury
• Occult vision disturbance
• Occult hearing disturbance

Infection......
Pathogens in the Workplace

- Drug resistant microbes are increasing*
- ICUs are epicenters of bacterial colonization & resistance**
- ? the anesthesia workplace

*Am J Infect Control. 2004;32:470
**JAMA. 2007;298:1763
Study Objectives:

• Characterize the risk of bacterial transmission during routine care

• Identify areas for risk modification
• 400+ bed, 28 OR medical center
• Anesthesia residents, attendings, CRNAs

• 6 days  61 patients in 61 randomly selected ORs

• First case of the day in each room
• Standardized machine sanitized prior to case
  • Cultured
• IV set / stopcocks sterile
  • Cultured

Case mix:
Gen 30%  Peds 15%  Ortho 13%  Gyn 11%
CT 10%   ENT 10%  Neuro  5%  Other  6%
Peripheral IV tubing became contaminated with pathologic bacteria in 32% (n=20) of cases.

Retrospective 30 day chart review:
5/20 with contaminated stopcocks → HAI
2/5 died (blood and respiratory infections)

5/41 without stopcock contamination → HAI
0 died

3/20 MRSA or VRE to stopcocks (2 died)
Risks of working in ICU & OR:

- Dangerous organisms everywhere
- Inconsistent / poor aseptic practice
- High task density
- Complex equipment
- Complex procedures
- Vulnerable subjects (patients and us!)

Work area contaminated in as few as 4 minutes

Early transmission likely occurs due to contamination of provider hands after induction
Authors’ Conclusions

“We demonstrated that variable aseptic practice of anesthesia providers leads to contamination of both intravenous tubing and the anesthesia work area with pathogenic bacteria”

“We observed patient mortality that may be due to stopcock contamination secondary to poor aseptic practice”
Trained observers

5/2009

114 Operating Rooms Randomized

(Before) Control Group
61 Operating Rooms

(After) Device Group
53 Operating Rooms
Hourly decontamination events increased 27-fold

**IV contamination:**
- 33% control group
- 7.4% Rx group

**HAI*: 
- 17.2% control group
- 3.8% Rx group

* Review of medical record over 30 postop days
In conclusion, our results demonstrate that the provision of a simple, cost-effective device containing an alcohol-based solution significantly reduces intraoperative transmission of potentially pathogenic bacterial organisms. Our study also suggests that use of this device reduces the incidence of postoperative healthcare-associated infections, but further study is required to verify these results.
A clandestine, observational study of the hand hygiene behaviors of anesthesia providers over the perioperative continuum at a large, metropolitan medical center

Research Session

AANA National Meeting, 8/2010
3-week period, trained observers recorded hand hygiene activity of providers in the preop, intraop and PACU domains

Standardized WHO recording instrument, data entered into an EXCEL spreadsheet

No names recorded. Only “provider type” and “nature of observation” was recorded
What was learned from hundreds of observations:

There were differences in the rates of failed hand hygiene among the four observed provider groups.

Indications for hand hygiene varied by domain & period of care, but not infrequently approached 15-35 / hour.

The hand hygiene failure rate ranged from 64% - 93% by group, with a mean failure rate of 82%.
Taxonomy of the major categories of hand hygiene failures:

- Moving between/among patients during preop assessment
- Before, during and after pain service interventions
- Innovian / Pyxis system keyboard use with soiled hands
- IV starts and blood draws (high rate of no gloves!)
- Drawing up meds for next case with soiled hands/gloves
- Soiled gloves left on after airway intervention
- Soiled gloves left on after Foley/IV/central line manipulation
OR vs ICU
A parallel comparison

ICU: published audits suggest that hand hygiene is indicated about 20 x per hour (1)

Direct observation suggests this number is higher in anesthesia particularly at the start / end of cases (2-4)

The Role of Asepsis during Neuraxial Instrumentation

Since the discovery of spinal anesthesia in 1895 by J. Leonard Comrie and its subsequent application in humans by August Bier in 1908, dose scrutiny has been paid to possibly complications related to this technique. Although neurologic complications after spinal anesthesia, including motoric, mental, or cardiovascular, were described as early as 1954, it was not until the Wosley and Hoe cases in 1947 that these complications were widely publicized. In these cases, two relatively young healthy males became paraplegic after spinal anesthesia secondary to contamination of the syringes and spinal needles by an ascitic ascariasis. Even since, dizziness continues to improve and modify this technique to increase safety and minimize complications. In this issue of Anesthesiology, Baer describes a review of cases of post-dural puncture meningitis (PDPH), purportedly related to a dural puncture. In another report in this issue of the journal, Rapport et al. present a meta-analysis of well over one million patients describing the incidence of serious neurologic injuries, including infection, after epidural anesthesia and anesthesia.

A statement on regional anesthesia approved by the House of Delegates of the American Society of Anesthesiologists states that regional techniques are best performed by an anesthesiologist who possesses competence and skills necessary for safe and effective performance. Although this statement emphasizes that recognition of complications and provision of appropriate postprocedure care is the duty of the physician, there is no reference to sterile technique. More importantly, a physician can be criticized for postoperative infection control. Recommendations for use of minimal sterile barrier precautions during central venous catheter infection but does not address anesthesiologists.

Baer correctly points out that unlike regional techniques, guidance for the prevention of intravascular catheter-related infections were developed by practitioners who insert catheters, including internists and anesthesiologists. They emphasize the use of minimal sterile barrier precautions during central venous catheter infection and the preferred use of 2% chlorhexidine preparation for skin antisepsis. Sterile precautions including cap, mask, sterile gown, sterile gloves, and large sterile drapes have been demonstrated to reduce the incidence of intravascular catheter-related bloodstream infections when compared with standard precautions, including sterile gowns and small drapes.

This begs the question of whether the same precautions ought to be used for the placement of neuraxial anesthesia. Central venous catheter-related infections are more common than neuraxial-related infections, and the use of minimal sterile barriers while placing central lines was targeted by the Agency for Healthcare Research Quality as a practice that needs widespread implementation. Interestingly, although there are no data supporting the use of all components of minimal precautions when performing neuraxial techniques, aseptic practice for neuraxial techniques varies tremendously between practitioners. Despite the abundance of data cited by Baer demonstrating that aerosolized organisms often originate from the physician performing a dural puncture, somone even questions the use of a surgical mask while performing these techniques. Even in the presence of laminar airflow in operating rooms, bacterial counts measured on settle plates at head and waist height were higher when either hat or mask was not worn. The increase in count was greater when a mask was not worn, and the absence of both hat and a mask led to an exponential increase. Other basic components of aseptic technique are often breached. Although the bacterial contamination of skin disinfectants (povidone-iodine and chlorhexidine) peaks at 2 min, it is common to leave skin cleaning as the last step before skin infiltration, which does not leave adequate time for skin disinfectants to be effective. Medications are frequently drawn up without a sterile needle, although microscopic particles are often found in local anesthetics or other sterile solutions after the syringe has been filled. Some have expressed skepticism that true sterile technique is actually practiced. Pointing to the many possible breaches leading to potential contamination, they have emphasized the need for a consensus conference to clarify the meaning of good aseptic practice for neuraxial techniques. To this end, the American Society of Regional Anesthesia and Pain Medicine convened a con-
Emergence of a new antibiotic resistance mechanism in India, Pakistan, and the UK: a molecular, biological, and epidemiological study


Summary

Background Gram-negative Enterobacteriaceae with resistance to carbapenems conferred by New Delhi metallo-beta-lactamase (NDM-1) are potentially a major global health problem. We investigated the prevalence of NDM-1 in multidrug-resistant Enterobacteriaceae in India, Pakistan, and the UK.

Methods Enterobacteriaceae isolates were studied from two major centres in India—Chennai (south India) and Haryana (north India)—and those referred to the UK's national reference laboratory. Antibiotic susceptibilities were assessed, and the presence of the carbapenem resistance gene \( mcr-1 \) was established by PCR. Isolates were typed by pulsed-field gel electrophoresis of XbaI-restricted genomic DNA. Plasmids were analysed by S1 nuclease digestion and PCR typing. Case data for UK patients were reviewed for evidence of travel and recent admissions to hospitals in India or Pakistan.

Findings We identified 44 isolates with NDM-1 in Chennai, 26 in Haryana, 37 in the UK, and 73 in other sites in India and Pakistan. NDM-1 was mostly found among Escherichia coli (56) and Klebsiella pneumoniae (11), which were highly resistant to all antibiotics except to tegicycline and colistin. K pneumoniae isolates from Haryana were donor but NDM-1 producers from the UK and Haryana were clonally diverse. Most isolates carried the NDM-1 gene on plasmids, which were unique to those from UK and Chennai and were readily transferable whereas those from Haryana were not conjugative. Many of the UK NDM-1-positive patients had travelled to India or Pakistan within the past year, or had links with these countries.

Interpretation The potential of NDM-1 to be a worldwide public health problem is great, and co-ordinated international surveillance is needed.

Funding: European: Uniao, Wellcome Trust, and Wyeth.

Introduction

Bacteria from clinical and non-clinical settings are becoming increasingly resistant to conventional antibiotics. Over the past year, concern has centred on Gram-positive bacteria, particularly meticillin-resistant Staphylococcus aureus and vancomycin-resistant Enterococcus spp. Now, however, clinical microbiologists are increasingly aware that multidrug-resistant Gram-negative bacteria pose the greatest risk to public health. Not only is the increase in resistance of Gram-negative bacteria faster than in Gram-positive bacteria, but also there are fewer new and developmental antibiotics active against Gram-negative bacteria and drug development programmes seem insufficient to provide therapeutic cover in 10–20 years.

The increase in resistance of Gram-negative bacteria is mainly due to mobile genes on plasmids that can readily spread through bacterial populations. Standardisation of plasmid typing methods is essential to evaluate the impact of the host range of carriage, and their worldwide distribution. Moreover, unprecedented human air travel and migration allow bacterial plasmids and clones to be transported rapidly between countries and continents. Much of this dissemination is undetected, with resistant clones carried in the normal human flora and only becoming evident when they are the source of endogenous infections. The CTX-M-1 extended-spectrum \( \beta \)-lactamase (ESBL) encoded by \( mcr-1 \) was first identified in India in the mid-1990s. The gene jumped from the chromosome of its natural hosts, K. pneumoniae, to plasmids that have subsequently spread widely, establishing CTX-M-1 as the globally-dominant ESBL, and the primary cause of acquired resistance to third-generation cephalosporins in Enterobacteriaceae. Recent surveys have identified ESBLs in 79–90% of Enterobacteriaceae in India, and although these collections might be a biased sample, they do suggest a serious problem, making the widespread use of ESBLs for the treatment of infections extremely difficult. Rates of ESBL resistance are lower in other countries but the growing prevalence of ESBL producers is sufficient to drive a greater reliance on carbapenems. Consequently, there is growing concern for carbapenem resistance in Enterobacteriaceae, and its emergence is a worldwide public health concern since there are few antibiotics in

New Delhi metallo-beta-lactamase (NDM-1)

Mutation that renders bacteria highly resistant to chemotherapy

Lancet. Sept 2010
Best evidence: what can we do?

- Be aware → hand hygiene!
- Timely periop antibiotics
- Attention to aseptic practices
- Chlorhexidine-alcohol skin prep (1)
- Optimize tissue oxygenation
- Maintain normothermia (4)
- Minimize RBC transfusion (2,4)
- Consider salutary (?) role of regional anesthesia (3,4)

1) Darouiche. NEJM. 2010;362:18-26
3) Chang. Anesthesiology. 2010;113:279-84
4) Sessler. Anesthesiology 2010;113:265-7