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# Infection Prevention for the Emergency Department

## Out of Reach or Standard of Care?



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### KEYWORDS

- Infection prevention • Hand hygiene • Environmental cleaning
- Central line–associated bloodstream infection
- Catheter-associated urinary tract infection • Ventilator-associated pneumonia
- Emergency department

### KEY POINTS

- The emergency department (ED) presents unique challenges to infection control and prevention.
- Hand hygiene is a fundamental strategy for preventing the transmission of infectious disease in health care settings.
- Transmission-based precautions, environmental cleaning, and appropriate reprocessing of reusable medical devices provide added layers of protection to counter the spread of infectious disease.
- Health care–associated infections (eg, catheter-associated urinary tract infection, ventilator-associated pneumonia, central line–associated bloodstream infection) are often preventable but require systems-based strategies.
- Future research and innovation are needed to optimize infection prevention practices in the ED.

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Emergency departments (EDs) are the vanguard of modern health care systems, serving as a primary point of access to timely and life-saving medical care for the acutely ill or injured. In 2014, more than 137.8 million patient visits were made to US EDs, at a rate of 432 per 1000 population.<sup>1</sup> More than half of the 34.5 million inpatient admissions that occur annually in the United States originate in an ED. During mass casualty events, natural disasters, and public health emergencies, EDs play an integral part in local and regional response, absorbing rapid surges of patients requiring emergent medical attention. On a day-to-day basis, EDs function as a safety net for diverse and often vulnerable populations that might not otherwise receive routine health care. Infectious diseases factor prominently among the reasons patients seek care in the ED. Emergency clinicians must be well versed not only in the diagnosis and management but also in the control and prevention of infectious diseases.

Infection control and prevention have traditionally focused on inpatient health care settings with the objectives of reducing transmission of communicable infectious diseases and averting health care–associated infections. As a hybrid environment bridging ambulatory and hospital care, the ED presents unique challenges to this work.<sup>2,3</sup> By virtue of a concentrated geographic footprint, ED patients and healthcare professionals (HCP) routinely come in close contact with one another in busy waiting rooms as well as treatment areas. Undifferentiated clinical presentations of infectious disease delay recognition, patient isolation, and HCP use of appropriate personal protective equipment (PPE), increasing the potential for transmission of disease. Variable patient acuity, frequent HCP-patient interactions, and simultaneous care of multiple patients create obstacles to infection prevention practices, particularly when invasive procedures are necessary. Finite inpatient beds and isolation rooms lead to the boarding of patients with infectious illness in the ED. Overcrowding, be it from high patient volume or delays in hospital admission, can lead to the evaluation and treatment of patients in nontraditional environs such as a hallway or other overflow sites. Finally, rapid room turnovers frequently strain environmental cleaning services, allowing the persistence of infectious microorganisms on health care surfaces.

Infection prevention has garnered greater recognition as an essential component of high-quality emergency care.<sup>2,3</sup> In this review, the authors introduce the emergency clinician to the growing body of literature focused on hand hygiene, transmission-based precautions, environmental cleaning, high-level disinfection and sterilization of reusable medical devices, and the prevention of health care–associated infections in the ED.

## HAND HYGIENE

Hand hygiene is a fundamental principle of infection prevention. Health care provider hands have the capacity to transmit pathogens from one patient to another.<sup>4–6</sup> Microorganisms present on patient skin, from either infection or colonization, or shed into the health care environment can contaminate the hands of an HCP through direct patient contact or interaction with their environment (eg, bed rails, bed linen, bedside furniture, or patient care equipment). When these microorganisms are able to persist on skin and hand hygiene is lacking or inadequate, HCP hands can transmit them to another patient through direct contact or interaction with their environment. In the absence of visible soiling, routine hand hygiene using an alcohol-based hand rub is an effective and time-efficient means for reducing the cross-transmission of pathogenic microorganisms in health care settings.<sup>4</sup> Hand washing with soap and water is advised when HCP hands are grossly soiled or when caring for patients with suspected *Clostridium difficile* or norovirus infection, because alcohol-based products lack efficacy and mechanical friction associated with hand washing aids in the removal

of these pathogens. Although most emergency clinicians are accustomed to performing hand hygiene upon room entry and exit (ie, “foam in, foam out”) and before any procedure, the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) recommend hand hygiene before and/or after key actions, best codified within the latter’s “My Five Moments for Hand Hygiene”<sup>4,6</sup> (Fig. 1).

Adherence to hand hygiene in the ED has historically been low, particularly among physicians.<sup>7–9</sup> Hand hygiene rates among emergency clinicians span anywhere from less than 10% to more than 90%,<sup>10–22</sup> with adherence assessed by trained observers in most of the existing literature. Perceived barriers to hand hygiene in the ED include urgent clinical situations requiring lifesaving intervention, insufficient time, and ambiguity about when to perform hand hygiene.<sup>22</sup> Glove use has also been associated with poor hand hygiene in emergency and trauma settings.<sup>13,15,20</sup> Although gloves provide an essential barrier to blood and other potentially infectious body substances as part of standard precautions,<sup>23,24</sup> their use does not obviate hand hygiene, because hand contamination can still occur during glove removal or through microscopic tears in the gloves themselves.

In a study examining more than 5865 hand hygiene opportunities in an urban academic ED, patient location in a hallway was the strongest predictor for poor HCP hand hygiene (relative risk = 88.9%, 95% confidence interval [CI] 85.9%–92.1%).<sup>13</sup> Similarly, a study of 1673 hand hygiene opportunities in another urban academic ED also found that hand hygiene adherence was lower in hallway care areas compared with semiprivate care areas (odds ratio [OR] = 0.73, 95% CI 0.55–0.97).<sup>19</sup> Adherence was even more significantly impacted when the ED was at its highest level of overcrowding, quantified using the National Emergency Department Overcrowding Scale (OR = 0.39, 95% CI 0.28–0.55).<sup>19</sup> In a Canadian study, time to physician assessment greater than 1.5 hours, a measure of ED

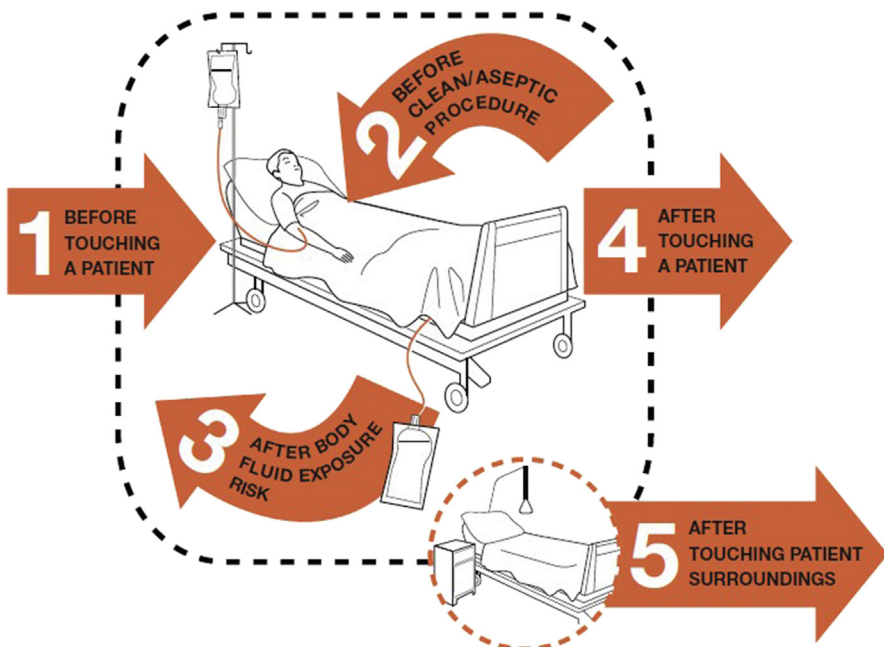


Fig. 1. WHO’s “My five moments for hand hygiene.” (Data from <http://www.who.int/infection-prevention/tools/hand-hygiene/en/>. Accessed May 29, 2018.)

workload and overcrowding, was also associated with decreased hand hygiene adherence (OR = 0.67, 95% CI, 0.51–0.89).<sup>16</sup> Emergency clinicians should understand how these unique aspects of ED care influence hand hygiene behavior and increase the risk for transmission of infection during vulnerable periods.

Educational interventions to improve ED hand hygiene have included distribution of written policies and other instructional materials, in-person teaching followed by observation with direct feedback, use of fluorescent markers to demonstrate cross-transmission of microorganisms through contact, and posting visual reminders in patient care areas.<sup>9,15,25</sup> Other efforts have focused on improving access to hand hygiene products in the ED, including the use of wearable hand sanitizer dispensers.<sup>26–28</sup> Workflow standardization and optimization can help reduce the number of hand hygiene opportunities and increase adherence during necessary moments.<sup>15</sup> Multimodal interventions combining HCP education, a culture of safety, recruitment of ED clinician champions, improved access to hand hygiene products, and routine auditing with feedback have led to significant albeit modest improvements in adherence in at least 2 quasi-experimental ED-based studies.<sup>18,29,30</sup> More research is needed in ED settings to identify simple and sustainable strategies to promote and maximize hand hygiene adherence.

## TRANSMISSION-BASED PRECAUTIONS

Transmission-based precautions target microorganisms spread through airborne droplet nuclei, large particle droplets, or direct contact using a combination of PPE and patient isolation. In most instances, the decision to initiate transmission-based precautions in the ED will hinge on the patient's presenting clinical syndrome and a differential diagnosis of infectious diseases that may be responsible. Failure to initiate transmission-based precautions when warranted exposes HCPs and patients alike to communicable infectious diseases. Emergency clinicians should understand how common microorganisms are transmitted from person-to-person as well as the precautions necessary to protect themselves and their patients based on guidance from the CDC<sup>31</sup> (Table 1).

Airborne transmission of an infectious disease occurs via droplet nuclei ( $\leq 5 \mu\text{m}$  in size) that can linger for several hours at a time in enclosed and poorly ventilated

Airborne	Droplet	Contact
Tuberculosis	Meningococcus	MRSA
Varicella zoster virus (chickenpox, disseminated zoster)	Seasonal influenza Rhinovirus Respiratory syncytial virus German measles	Vancomycin-resistant <i>Enterococcus</i> Multidrug-resistant gram-negative bacteria (eg, carbapenem-resistant <i>Enterobacteriaceae</i> , extended-spectrum $\beta$ -lactamase producing bacteria)
Measles	Mumps	<i>C difficile</i>
Smallpox	Pertussis Diphtheria Pneumonic plague	Norovirus Lice, scabies
Highly pathogenic influenza		
Severe acute respiratory syndrome		
Middle East respiratory syndrome		

From Siegel JD, Rhinehart E, Jackson M, et al. Guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings. 2007. Available at: <https://www.cdc.gov/infectioncontrol/guidelines/isolation/index.html>. Accessed May 29, 2018.

spaces. Tuberculosis, measles, and varicella (including disseminated zoster) are classic airborne diseases that pose a risk to emergency clinicians. Several emerging pathogens, including smallpox, highly pathogenic influenza, severe acute respiratory syndrome coronavirus (SARS-CoV), and the Middle East respiratory syndrome coronavirus (MERS-CoV), are readily transmitted in this manner as well. Airborne precautions mandate HCP use of an N95 or powered air-purifying respirator during patient care and prompt placement of the infected patient within a single-occupancy airborne infection isolation room (capable of generating negative room pressure and  $\geq 12$  air exchanges per hour).<sup>31</sup> EDs are decidedly vulnerable and highly likely to be involved in the initial care of a patient infected with an airborne pathogen. Use of screening tools and clinical decision-making instruments can aid recognition of airborne infections based on symptoms, risk factors, and objective clinical findings<sup>32–34</sup> and may in turn help expedite initiation of airborne precautions in the ED. Education and access to appropriately fitting PPE are necessary if adherence to these precautions is to be improved.<sup>35</sup> Finally, limited availability of isolation rooms remains a significant barrier for many EDs, particularly when caring for multiple patients requiring airborne precautions.<sup>36,37</sup> The added time required to completely exchange the air in an isolation room after a patient has left imposes further burden on its availability for the next patient.

Droplet transmission occurs via large particles ( $>5 \mu\text{m}$  in size) that travel short distances and generally do not loiter in the air for long periods. Seasonal influenza, meningococcal meningitis, and a wide range of other respiratory viral and bacterial infections fall under the umbrella of droplet transmission. Droplet precautions consist of HCP use of a surgical mask whenever working within a 3-foot radius of the infected patient.<sup>31</sup> Isolation is implemented either through physical separation ( $>3$  feet) from other patients and use of a privacy curtain, or placement of the infected patient within a single-occupancy room. Access to PPE, particularly during peak respiratory virus season, and diminished awareness of when to use them can hinder adherence to droplet precautions in the ED.<sup>38</sup> Education and reminders to HCPs, including through the electronic medical record, can improve adherence.<sup>39</sup> Promoting respiratory hygiene through patient education on cough etiquette, hand hygiene, masking and separation of patients with respiratory complaints in the ED waiting room at the time of triage, and optimization of HCP adherence to droplet precautions may also help reduce transmission of respiratory pathogens, but requires significant patient engagement.<sup>40,41</sup>

Microorganisms transmitted through direct contact include health care–associated pathogens, such as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus*, multidrug-resistant gram-negative bacteria, and *C difficile* as well as viruses associated with respiratory (eg, highly pathogenic influenza, SARS-CoV, MERS-CoV) and gastrointestinal infections (eg, norovirus). Contact precautions entail the use of protective gown and gloves to prevent HCP acquisition of these microorganisms on their hands, skin, or attire and preferably patient isolation within a single-occupancy room.<sup>31</sup> In the absence of a prior history of colonization or infection with a health care–associated pathogen, empiric contact precautions are generally recommended for patients with uncontained wound drainage or diarrhea with stool incontinence. However, significant variations in contact precaution policy exist among EDs.<sup>42</sup> Although several studies have demonstrated transmission of health care–associated pathogens to protective gown and gloves during routine patient care in hospital settings,<sup>43–45</sup> little is known about their risk of transmission within the ED to HCPs or other patients. As the evidence surrounding contact precautions and health care–associated pathogens continues to evolve, modified ED policies more focused on clinical conditions likely to contaminate the health care environment or deemed highly contagious may help facilitate implementation and improve adherence to contact precautions in the ED.<sup>46,47</sup>

## ENVIRONMENTAL CLEANING

The ED health care environment itself may serve as a reservoir for microorganisms. Although the ED microbiome has not been well characterized, limited prevalence studies have recovered MRSA from up to 7% of environmental surfaces sampled in 2 urban academic EDs.<sup>48,49</sup> In the absence of hand hygiene, HCP hands that come in direct contact with contaminated environmental surfaces in patient care areas can transfer microorganisms to other patients.<sup>50,51</sup> Evidence also suggests that patients may acquire health care–associated pathogens when hospitalized in a room previously occupied by a patient infected or colonized with that pathogen.<sup>52,53</sup> Effective environmental cleaning therefore plays an essential part in preventing health care–associated infections.

The Healthcare Infection Control Practices Advisory Committee divides environmental surfaces into 2 categories: medical equipment surfaces and housekeeping surfaces (eg, floors, walls, tabletops).<sup>54</sup> Housekeeping surfaces are further separated into “high-touch” surfaces (eg, door handles, bedrails, light switches) and those with minimal hand contact (eg, floors, ceilings).<sup>54</sup> The frequency with which cleaning is necessary for each of these surfaces is determined by the potential for direct patient contact, the degree and frequency of hand contact, and the risk of contamination with body substances or environmental sources of microorganisms (eg, soil, dust, water).<sup>54</sup>

Research has demonstrated that environmental service (EVS) workers frequently fail to decontaminate “high-touch” surfaces, including those in the ED.<sup>55,56</sup> At the authors’ facility, overall compliance with environmental cleaning of “high-touch” surfaces in ED treatment rooms was 32% when audited using a fluorescent marker to simulate contamination during routine quality improvement surveys (unpublished data, FOX, 2016). Surfaces with the highest rate of cleaning included the bed mattress (97%) and stretcher rail (72%). Surfaces with the lowest rate of cleaning included the procedure light handle (3%) and wall-mounted thermometer (0%). It is vital that ED, EVS, and infection prevention leaders work together to identify “high-touch” surfaces in treatment areas and prioritize their regular cleaning.<sup>54</sup> Emergency clinicians may perceive the time to correctly clean “high-touch” and other environmental surfaces as a barrier to providing prompt live-saving patient care. Pressure to turn over a treatment room or space expediently may lead to incomplete environmental surface disinfection. ED staff may be unaware of which cleaning and disinfection products are approved and compatible with medical equipment surfaces in the ED or the contact times necessary for these products to work effectively. Likewise, ED staff may be unfamiliar with which surfaces they are responsible for cleaning (eg, sensitive medical equipment) and which surfaces fall under the purview of EVS (eg, stretcher rails, countertops, door handles) at their facility, leading to confusion and poor compliance. In an ED in Brazil, coordinated efforts to educate nursing about environmental cleaning, standardize cleaning procedures and supplies, and conduct compliance audits with feedback increased compliance, but proved difficult to sustain over time.<sup>55</sup> Further studies addressing the dissemination and implementation of environmental cleaning best practices in EDs are greatly needed.

## HIGH-LEVEL DISINFECTION AND STERILIZATION OF REUSABLE MEDICAL DEVICES

The Spaulding classification system guides reprocessing decisions for reusable medical devices.<sup>57</sup> Critical devices (eg, surgical instruments) enter sterile tissues or the vasculature and require sterilization. Semicritical devices contact intact mucous membranes or nonintact skin (eg, endoscopes) and necessitate either high-level disinfection or sterilization. High-level disinfection is defined as the complete elimination of microorganisms

in or on a device, except for a small number of spores, using a chemical disinfectant (eg, glutaraldehyde, hydrogen peroxide). Noncritical devices (eg, stethoscopes, blood pressure cuffs) that only come in contact with intact skin may undergo low-level disinfection using an Environmental Protection Agency–registered product.

Although the standards and detailed methods by which different levels of reprocessing are achieved are beyond the scope of this review, it is important for emergency clinicians to recognize that several reusable medical devices common to ED clinical practice are considered semicritical, including reusable laryngoscopes, bronchoscopes, and endocavitary ultrasound probes. In one study, bacteria were isolated from 18.2% of laryngoscope blades and 28.2% of laryngoscope handles with knurled surfaces stored in emergency crash carts even before their use.<sup>58</sup> Human papillomavirus has been isolated from transvaginal ultrasound probes using polymerase chain reaction after patient contact, even with use of a probe cover and low-level disinfection.<sup>59</sup> Incorrect reprocessing of these reusable devices after ED use can result in unintentional transmission of pathogens between patients with the potential for subsequent infection.<sup>60</sup>

Most hospitals perform cleaning, disinfection, and sterilization of reusable medical devices in a central processing department to ensure standardization and quality control.<sup>57</sup> However, precleaning of the device at the point of use in the ED is crucial to ensure the completeness of reprocessing. Precleaning reduces the likelihood that patient body fluids and gross debris will adhere to and dry on the device, rendering cleaning and disinfection processes inadequate.<sup>60</sup> Some medical devices, such as endocavitary ultrasound probes, can safely undergo high-level disinfection in the ED using US Food and Drug Administration–approved technologies.<sup>61</sup> It is vital that ED leadership partner with infection prevention to assess reprocessing needs for reusable medical devices, ensure that reprocessing steps assigned to ED staff are performed correctly, and provide rigorous training on reprocessing to ED staff on a recurring basis.<sup>57</sup> Routine audits should be conducted to ensure competency with and adherence to cleaning, disinfection, sterilization, and proper device storage and transport procedures, followed by feedback to leadership.<sup>57</sup>

Considered noncritical devices, external ultrasound probes are widely used in many EDs for a variety of point-of-care diagnostic and therapeutic purposes. Bacterial contamination of ED ultrasound probes is common and can include clinically significant pathogens such as MRSA, particularly after contact with patients with skin and soft tissue infections.<sup>62–65</sup> Low-level disinfection is effective in eliminating bacterial growth. Although many academic EDs mandated probe disinfection after each patient use, standardized protocols emphasizing required contact times for various products were frequently lacking in one study.<sup>66</sup> Infection prevention strategies targeting ED point-of-care ultrasound remain an area in need of further investigation and innovation.<sup>67</sup> Several studies have also demonstrated significant bacterial contamination of stethoscopes, blood pressure cuffs, pulse oximeters, and other devices commonly used in the ED.<sup>68–72</sup> Although bacterial growth on noncritical reusable medical devices has yet to be linked to infection, their routine disinfection promotes cleanliness and professionalism.

## DEVICE-ASSOCIATED INFECTIONS

### *Catheter-Associated Urinary Tract Infection*

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Although insertion of an indwelling urinary catheter (UC) is often necessary in emergency care, these devices also represent one of the largest preventable causes of health care–associated infection. Urinary tract infections contribute more than 12%



of all health care–associated infections, most of which are attributable to UCs.<sup>73</sup> UCs provide a direct avenue for bacteria to access and infect the bladder. Guidelines from the CDC and the Society for Healthcare Epidemiology of America (SHEA) recommend limiting use of UCs to the management of acute urinary retention and bladder outlet obstruction, accurate measurement of urine output in critically ill patients, clinical situations requiring prolonged immobilization (eg, pelvic fracture, spine trauma), and selected surgical procedures.<sup>74,75</sup> However, UCs are often inserted for inappropriate indications that may increase a patient's risk for a potentially preventable catheter-associated urinary tract infection (CAUTI).

In a study of the National Hospital Ambulatory Medical Survey, UCs were inserted at an annual rate of 2.2 to 3.3 per 100 adult ED visits between 1995 and 2010.<sup>76</sup> Among those admitted to the hospital with UCs inserted in the ED, 64.9% (95% CI 56.9%–72.9%) were considered potentially avoidable. In a teaching hospital in central Italy, 12.5% of all catheterized inpatients diagnosed with a CAUTI had their UC initially inserted in the ED.<sup>77</sup> In one US hospital, 8.7% of patients aged 65 years or older who received a UC in the ED developed a CAUTI.<sup>78</sup> Although CAUTI rates of ED-inserted UCs are not widely known, avoidance of unnecessary UC insertions across health care settings, including the ED, is an important and well-recognized CAUTI prevention strategy.<sup>75</sup>

Several barriers to appropriate UC utilization exist in the ED. Scenario-based assessments found wide variations in practice pattern and what HCPs thought constituted an appropriate clinical scenario for UC use.<sup>79</sup> Focus groups involving ED nurses identified lack of clarity and ownership in determining appropriateness of UC insertion, difficulty negotiating with families when a UC was not indicated, inadequate nurse education and evaluation of competency with UC insertion, and suboptimal collaboration and communication with hospital administration as barriers to safe and appropriate UC use in the ED.<sup>80</sup> In a qualitative study of 6 US EDs considered early adopters of CAUTI prevention strategies, inappropriate reasons for UC insertion, limited physician involvement in UC insertion decisions, patterns of UC overuse, and poor insertion technique were all considered ED-specific risk factors for CAUTI.<sup>81</sup> In a study of UC procedures performed in an academic ED, at least one major breach in aseptic technique (eg, breach or contamination of the sterile field, contamination of the UC during preparation or insertion) was observed in more than half of all insertion attempts, underscoring the need for improved education and auditing of UC insertion practices with HCP feedback.<sup>82</sup>

Emergency clinician engagement in identifying and addressing barriers to appropriate UC utilization can lead to significant reductions in ED UC insertions and is therefore essential to any CAUTI prevention strategy.<sup>83</sup> Multifaceted approaches combining ED HCP education, guidelines, and decision-making tools emphasizing clearly defined criteria for appropriate UC use supported by physician and nurse champions have been shown to be effective in curbing unnecessary ED UC use.<sup>84–86</sup> In a quality improvement initiative spanning 18 US EDs, implementation of a multifaceted intervention led to an overall reduction in UC insertions of more than 30%, with the greatest reductions seen at hospitals with a baseline UC use of  $\geq 5\%$ .<sup>84</sup>

### ***Central-Line Associated Bloodstream Infection***

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Central venous catheters are often inserted as part of the resuscitation of a critically ill patient or when peripheral venous access is not available. Colonization of a catheter by microorganisms present on the patient's skin or the hands of a HCP at the time of insertion can lead to a central line–associated bloodstream infection (CLABSI). Using administrative and billing data, the CLABSI rate of ED-inserted catheters in an urban

academic medical center was found to be 1.93 per 1000 catheter-days (95% CI 0.50–3.36), comparable to that of the intensive care unit (ICU).<sup>87</sup> In a prospective observational study at another urban academic medical center, the ED rate was 2.0 per 1000 catheter-days (95% CI 1.0–3.8), concurrent to an institutional ICU rate of 2.3 per 1000 catheter-days (95% CI 1.9–2.7).<sup>88</sup>

Tremendous strides have been made in reducing CLABSI rates through the implementation of insertion and maintenance bundles. Guidelines from multiple organizations support a systems-based approach comprising education, procedure checklists, a standardized catheter cart or kit, hand hygiene, use of maximal sterile barrier precautions (sterile surgical gown, sterile gloves, mask, cap, and large sterile drape), avoidance of femoral catheter insertion given its high rate of infection, chlorhexidine-alcohol skin antiseptics, and use of ultrasound guidance for internal jugular catheter insertion.<sup>89,90</sup> Successful implementation of CLABSI prevention bundles in EDs requires staff engagement, clinician champion recruitment, clear delineation of staff responsibilities, workflow redesign, observer empowerment to ensure compliance, and feedback to HCPs on bundle compliance and CLABSI rates associated with ED-inserted catheters.<sup>91</sup>

### ***Ventilator-Associated Pneumonia***

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Emergency airway management in the critically ill patient frequently calls for endotracheal intubation and the use of mechanical ventilation. Ventilator-associated pneumonia (VAP) arises when bacteria present within environmental reservoirs (eg, a contaminated respiratory circuit) or the patient's oropharynx or gastrointestinal tract gain entry to the lungs through microaspiration, with subsequent infection. VAP is defined as the diagnosis of a new pneumonia after  $\geq 48$  hours of mechanical ventilation, not present at the time of intubation. At least half of all cases of VAP are thought to be preventable.<sup>92</sup> Endotracheal intubation in the ED and prolonged ED stay have been associated with higher VAP rates when compared with the ICU.<sup>93–98</sup>

SHEA guidelines outline several basic VAP prevention strategies supported by good evidence and that pose little risk of harm to the patient, including elevating the head of the bed to 30° to 45°, minimizing sedation whenever possible, subglottic suctioning, and changing visibly soiled or malfunctioning ventilator circuits.<sup>99</sup> Avoidance of intubation with the use of noninvasive positive pressure ventilation in clinically appropriate situations may also be considered. In one academic ED, a VAP prevention bundle comprising several of these interventions along with other common and more labor-intensive ICU practices (eg, oral care, sedation titration, and vacations) led to a significant reduction in VAP rates, even after accounting for complexities in establishing true rates.<sup>100</sup> Nursing engagement is integral to the successful implementation of these bundles.<sup>100,101</sup>

### **SUMMARY**

Infection prevention is part of our basic responsibility to patients as clinicians to *first, do no harm*. Although EDs pose unique operational and environmental challenges not often encountered in traditional inpatient or ambulatory settings, a growing body of evidence demonstrates that effective and sustainable infection prevention in emergency care settings is achievable, although not without cost or commitment, or need for future research and innovation.<sup>2,3,102</sup> Hand hygiene remains the bedrock of preventing the spread of infectious diseases. Transmission-based precautions, environmental cleaning, and appropriate reprocessing of reusable medical devices each provide additional levels of protection to patients and HCPs alike. Health care–associated infections are preventable in many instances but require systems-based approaches.

As frontline HCPs' on the leading edge of health care, emergency clinicians can and already play an invaluable role in infection prevention.

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