Infection Risk in Hospitals: Clinician Attire and Hand Sanitizer Fire Risk
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Hospital Infection Transmission by Clinician's Attire

1. Haun, Hooper-Lane & Safdar, 2016 (*Infection Control and Hospital Epidemiology*)
    a. Systematic review of 72 studies between 1995 and 2015 evaluating bacterial contamination of healthcare personnel attire and commonly-used medical devices in varied clinical settings
    b. Findings:
        i. White coat contamination rates of 0-16% with methicillin-resistant *S. aureus* (MRSA) and 0-42% with gram-negative rods (GNR), common causes of hospital-acquired infections
        ii. Necktie contamination rates of 3-32% with MRSA and 11-23% with GNR
            1. A study of orthopedic surgeons (Steinlechner, 2002) found 45% concordance between bacterial species found on neckties and patient wounds
                a. 25 neckties were samples and compared to 361 positive wound cultures from patients in the orthopedic ward over the preceding year; the clinically significant bacteria in the wounds matched the bacteria on the tie in 45% of cases
        iii. Contamination of clinician's stethoscopes, phones, and tablets with MRSA, GNR, and *C. difficile* also observed
    c. Limitations: White coat area sampled varied between studies. Patient bacterial colonization rates varied between studies.

2. John, et al., 2018 (*Infection Control and Hospital Epidemiology*)
    a. Randomized experimental trial to test whether short-sleeved white coats reduce the risk of pathogen transmission when compared to long-sleeved coats
    b. Methodology:
        i. Healthcare personnel first conducted a standard physical exam on a mannequin contaminated with viral DNA and then repeated the exam on a second uncontaminated mannequin
        ii. Researchers also observed physicians performing physical exams during real-life patient interactions
    c. Findings:
        i. Viral DNA was transferred to sleeves and/or wrists significantly less often when participants wore short-sleeved white coats
        ii. Short-sleeved participants transferred viral DNA to the environment surrounding the second mannequin significantly less often than long-sleeved participants
        iii. The rate of viral transfer to the mannequin was lower among short-sleeved participants, but this difference was not statistically significant
        iv. Physician sleeve cuffs contacted patients and/or adjacent environmental surfaces in 44% of observed real-life physical exams

3. Petrilli, et al., 2018 (*BMJ Open*)
    a. Survey of 4062 patients across 10 academic hospitals in the US in 2015 assessing patient preference of physician attire
    b. Methodology: Photographs of a male and female physician dressed in 7 different outfits in various clinical settings were shown in a questionnaire; respondents rated the providers across 5 domains: knowledgeable, trustworthy, caring, approachable, and comfortable
    c. Findings:
        i. 53% of respondents indicated that physician attire was important to them during care
        ii. 55% agreed or strongly agreed with the statement that doctors should wear a white coat when seeing patients in the office; however, 44% agreed that doctors should wear a white coat when seeing patients in the emergency room
        iii. Overall, among the 7 outfit options, the highest proportion of respondents (44%) felt doctors should wear formal attire with a white coat, with scrubs and a white coat as second most highly rated at 26%; in other words, 70% of respondents preferred the two options in which the physicians were wearing a white coat
        iv. For surgeons and emergency room doctors, scrubs without a white coat were the most preferred option
        v. Doctors in formal attire with a white coat received the highest mean Average Composite Rating Score (compiling scores for the 5 domains)

4. Petrilli, et al., 2015 (*BMJ Open*)
    a. Systematic review of 30 studies between 1991 and 2014 involving 11,533 patients from 14 countries to evaluate patient perception related to physician attire
    b. Findings:
        i. 70% of studies reported a patient preference for or positive influence of physician attire, but only 4 of the 10 US-based studies reported that attire influenced patient perceptions of physicians
        ii. 50% of studies found a preference for white coat, and this preference was more prevalent among older patients and varied by geography
        iii. Studies involving procedural, emergency, or intensive care specialties were less likely to find a patient preference for white coats
        iv. Studies that surveyed patients immediately after a physician care encounter found attire preferences less frequently than studies surveying patients who did not receive clinical care

5. Loh, Ng & Holton, 2000 (*Journal of Hospital Infection*)
    a. Cross-sectional study of 100 medical students at University College Hospital Medical School in London in 1999 with sample collection from the cuff, side pocket, and back of the white coat
    b. Findings:
        i. 68% of students reported daily use of their white coats, and the majority stored their coat in a locker

ii. 71 of 100 students self-reported their white coats as dirty; students' estimates of whether or not their coats were dirty correlated with the bacterial count
iii. Approximately one-third of students laundered their coats at monthly intervals; there was no association between frequency of laundering and bacterial counts, suggesting that coats become quickly contaminated once worn
iv. Sites with highest contamination with *Staphylococcus* were the sleeve and the pocket; however, no bacteria with concerning infection risk (such as MRSA or pathogenic strains of GNR) were found

6. Treakle, et al., 2009 (*American Journal of Infection Control*)
    a. Cross-sectional study of 149 attendees of two University of Maryland hospital grand rounds conferences in 2006, evaluating bacterial colonization of white coats
    b. Findings:
        i. Overall, 22.8% of attendees were contaminated with *S. aureus* and 4% contaminated with MRSA. No coats were contaminated with vancomycin-resistant enterococci (VRE)
        ii. No association was found between time since laundering and contamination by *S. aureus*
        iii. 64% of participants had not washed their white coat in more than a week; 17% had not done so in more than a month

7. Lopez, et al., 2009 (*American Journal of Infection Control)*
    a. Cross-sectional study comparing bacterial colonization of ties vs. shirt pockets of 50 male doctors at a London Hospital
    b. Findings:
        i. 32% of participants had never cleaned their tie, and 40% could not remember when they had cleaned it; mean time from last cleaning for the remaining 28% of participants was 73 days; all shirts had been worn for less than 2 days since last wash
        ii. The mean *S. aureus* count was higher on ties than those from the paired shirts (95 cfu on ties vs. 51 cfu on shirts, $p = 0.002$); *S. aureus* was found on 26% of ties and 16% of shirts

8. Perry, Marshall & Jones, 2001 (*Journal of Hospital Infection*)
    a. Cross-sectional study evaluating bacterial contamination of 57 nurses' uniforms before and after a 24-hour shift
    b. Findings:
        i. 39% of uniforms were positive for one or more of MRSA, VRE, or *C. diff.* prior to the beginning of the shift; 54% of uniforms were positive for one or more of these bacteria at the end of the shift
        ii. Contamination of uniforms with VRE increased between pre- and post-shift measurements from 21% to 38%, 12% to 19% for *C difficile*, and 12% to 14% for MRSA; this finding indicates that nurses' uniforms become contaminated with infectious organisms while working

iii. Some uniforms were positive for MRSA, VRE, or *C diff* at the beginning of the shift but negative at the end of the shift; unclear whether this indicates transfer of these bacteria to patient

9. Bearman, et al., 2012 (*Infection Control & Hospital Epidemiology*)
    a. Randomized crossover study on the impact of antimicrobial scrubs compared to standard scrubs on MRSA/VRE/GNR contamination of clothing of 30 healthcare workers, and the effect of hand hygiene training on compliance and hand contamination
    b. Methodology:
        i. Crossovers between identically appearing control scrubs and antimicrobial scrubs occurred every 4 weeks, with each participant serving as their own control twice
        ii. Each HCW underwent once weekly unannounced garment and hand cultures
            1. The scrub pant cargo pocket and the two abdominal area pockets were the garment areas chosen for culture because they were areas of high touch and high bacterial colonization potential
        iii. A single trained observer assessed hand hygiene practice compliance in the ICU for a total of 100 hours
        iv. An anonymous questionnaire was administered at the end of the study
    c. Findings:
        i. The degree of MRSA colonization at the abdominal pockets and leg cargo pocket was lower in the antimicrobial scrubs; antimicrobial scrubs had less MRSA colonization overall
        ii. Hand hygiene (sanitize before and after patient contact) adherence was 78%
        iii. No differences observed in frequency or percent of HCWs with MRSA-, VRE-, or GNR positive cultures by scrub type
        iv. Respondents reported laundering their scrubs 1.5 times a week on average

10. Bearman, et al., 2014 (*Infection Control & Hospital Epidemiology*)
    a. A guideline statement from the Society of Healthcare Epidemiology of America (SHEA) Guidelines Committee, review of 26 studies from 1990-2013 on patient preference of healthcare professional (HCP) attire, review of current evidence on contamination of HCP attire, and survey of SHEA members' opinions on HCP attire policies
    b. Guidance Statement:
        i. Evidence on optimal healthcare professional (HCP) attire in clinical, nonsurgical areas is limited
        ii. Policies related to HCP attire can be considered on a voluntary basis and should be accompanied by educational campaigns for HCPs and patients:
            1. "Bare below the elbows" (BBE): BBE approach (short sleeves, no wristwatch, no ties, no jewelry) can be considered
            2. White coats: For institutions that mandate/encourage white coats: provide multiple white coats, provide accessible laundering

services for white coats, provide hooks to allow HCPs to remove white coats and other long-sleeved outerwear prior to contact with patient or patient's immediate environment
3. Other HCP attire: Cannot recommend limiting neckties or any other HCP attire based on current evidence; neckties should be secured if worn
4. Laundering: White coats should ideally be laundered daily, but no less frequently than once a week and when visibly soiled; if laundered at home, bleach and high heat settings should be used
5. Shared equipment: Shared equipment, such as stethoscopes should be cleaned between patients

c. Review of patient preference regarding HCP attire
   i. Even though most surveys indicate a preference for formal attire and white coat, patient's trust, satisfaction, comfort, and confidence in the physician is unlikely to be affected by attire choice
   ii. Patients do not perceive white coats or neckties as posing infection risk, but, when informed of potential risks, patients are willing to change their preferences for HCP attire
   iii. Consistently, ability to identify an HCP was rated among the highest attributes of HCP attire
d. Review of bacterial contamination of HCP attire
   i. Contamination with pathogens such as *S. aureus*, VRE, and GNR occurs for all types of HCP apparel
   ii. HCP apparel could hypothetically pass on pathogens, *but no clinical data demonstrates this*
   iii. Hospital policies on HCP attire from 7 US teaching hospitals:
      1. All reviewed hospital attire polices included provisions on general appearance or dress code for professional attire, but few had specific requirements or enforcement policy
      2. Only one hospital had specific requirements, following BBE policy: no white coats, neckties, long sleeves, wristwatches, or bracelets
   iv. Unclear whether institutional laundering or home laundering of HCP attire is better
   v. UK has a BBE policy for inpatient care and some studies show enhanced hand hygiene to the level of the wrist while others do not show any benefit; there is also no evidence on its impact on patient hospital-associated infection rates

11. Ditchburn, 2006 (*Journal of Hospital Infection*)
    a. Cross-sectional study on bacterial contamination of 40 physicians' ties in the UK
    b. Findings:
       i. 8/40 (20%) of ties carries *S. aureus*, of which only one was MRSA
       ii. 70% of physicians had never cleaned their tie; on average, 20 weeks had passed since the last cleaning among those who had cleaned their ties

iii. 93% of people surveyed in the hospital (staff and non-staff respondents) had no objection to doctors not wearing ties; of the 7 respondents who objected, 6 were NHS staff

12. Munoz-Price, et al., 2012 (*American Journal of Infection Control*)
    a. Cross-sectional study investigating a correlation between bacterial contamination of 119 healthcare workers' hands and white coats or scrubs
    b. Findings:
        i. HCW's with GNR on hands were more likely to wear a white coat also contaminated with GNR; association not seen for scrubs
        ii. 13% of hands were negative for any bacteria, and 70% had normal skin bacteria; the remaining 17% of hands had pathogenic bacteria *S. aureus*, GNR, or *Enterococcus*
        iii. These pathogens were present on 28.8% of scrubs and 45.4 % of white coats
        iv. 19% of *S. aureus*-positive scrubs were MRSA; no VRE or antibiotic-resistant GNR were found

13. Gaspard, et al., 2009 (*Journal of Hospital Infection*)
    a. Study evaluating MRSA contamination of healthcare workers' uniforms at 3 geriatric long-term care facilities
    b. Methodology: Uniforms were sampled at the "waist zone" (between the two pockets at the waist level) and the "pocket zone" (upper part of the two pockets); these zones reflected points of contact with patients and the environment and were associated with hand contact by HCWs
    c. Findings:
        i. MRSA contamination of uniform waist zone ranged between facility from 27.3% to 80.0%; pocket zone contamination ranged from 18.1% to 60.0%
        ii. Lower uniform contamination rates seen only when all nurses and care assistants wore plastic aprons during activities with frequent contact with patients and their environment

14. Board of Trustees Report 3, 2010 (American Medical Association)
    a. AMA review of evidence on the significance of attire in transmission, prevention, and control of hospital-associated infection (HAI) and public perception of physician attire
    b. Findings:
        i. Research supports that pathogenic organisms survive on textiles, but inconclusive on whether clothing is a causative factor in hospital-associated infections; a systematic review of research conducted in the UK showed that neckties carried pathogens associated with the existing wound infections on hospital wards and carried the same bacteria that are regularly grown on wound swabs, and must be considered a potential vector
        ii. There is significant public concern with the cleanliness of doctors' attire; evidence suggests that physicians' uniforms convey legitimacy

c. Conclusions:
    i. Current science is not well-developed in the area of textile contamination and transmission regarding control and prevention of HAI, reduced patient harm, and cost-benefit ratio of potential interventions
d. Policy Recommendations to the AMA:
    i. Support further research into transmission of HAI via clothing
    ii. Encourage validation of research prior to advocating for adopting dress code policies
    iii. Encourage clinicians to adhere to best practices regarding HAI reduction
    iv. Encourage clinicians to wear clean attire when seeing patients

15. Munoz-Price, et al., 2012 (*American Journal of Infection Control*)
    a. Cross-sectional study surveying the laundering practices of 160 HCPs (faculty physicians, resident physicians, and medical students) at Jackson Memorial Hospital in Miami, FL
    b. Findings:
        i. Providers reported washing white coats on average every 12.4 days; 90% of respondents laundered their white coats at least once per month, while 4 of 160 respondents washed their white coats every 90 or more days (up to 12 months)
        ii. 90% of physicians acknowledged that they were aware their uniforms were potentially contaminated with hospital pathogens
        iii. Providers who wore their white coat while seeing patients washed their coats more often: every 9.5 days
        iv. Providers washed scrubs more frequently: every 1.7 days on average
        v. Faculty physicians who wore scrubs during patient care washed their scrubs more frequently than residents (every 1.0 vs 1.9 days, respectively)

16. Bearman, et al., 2014 (*Infection Control and Hospital Epidemiology*)
    a. Cross-sectional study at Virginia Commonwealth University Medical Center, where BBE policy was instituted in 2009 evaluating HCW's attitudes and perceptions about white coats
    b. Findings:
        i. 82% of respondents felt that white coats should be laundered at least weekly, whereas only 43% reported actually doing so; 45% of attending physicians, 31% of house staff, and 53% of students washed their white coats at least weekly
        ii. 40% reported washing their white coat monthly
        iii. 17% never washed their white coat

Hand Sanitizer Fire Risk

17. Boyce & Pearson, 2003 (*Infection Control and Hospital Epidemiology)*
    a. Survey of 840 members of 3 major US healthcare societies (SHEA, APIC, and EIN) in 2003 regarding routine use of alcohol-based hand rubs (ABHR), location

of dispensers in healthcare facilities, history of fires attributable to dispensers, and enforcement from local fire marshals on dispenser guidelines

b. Findings:
    i. Dispensers were located in patient rooms in 80% of facilities, in treatment rooms in 89% of facilities, and in hallways in 61% of facilities
    ii. None of the 798 respondents from facilities using ABHRs reported occurrence of a fire attributed to or involving an ABHR dispenser; there were no fires in 1430 hospital-years of ABHR use among 766 of the responding facilities
    iii. 8% of facilities reported local fire marshals had instructed them to change the location or size of ABHR dispensers
    iv. 11.4% of facilities reported that local fire marshals had told them to remove dispensers from hallways

18. Boog, et al., 2013 (*BMC Infectious Disease)*
    a. Qualitative and quantitative experimental study evaluating 20 healthcare workers (HCW) preferences on ABHR location in a patient room, workflow observations, and subsequent measurement of frequency of use of ABHR dispensers in 3 locations in a test patient room
    b. Findings:
        i. HCW reported that dispenser has to be in line of sight, has to be located on the workflow route, should be within reach during procedures and near certain objects or the patient, should not be obstructed, and should be located at a familiar location
        ii. Dispensers located at the entrance to the room and near the sink inside the test room were used most frequently; dispensers near the computer inside the test room were used less frequently

19. CMS-1345-F, 2006 (Center for Medicare & Medicaid Services)
    a. Final rule (CMS-1345-F) from CMS/HHS adopting a 2004 amendment to the National Fire Protection Association's (NFPA) Life Safety Code (LSC) that allowed placement of ABHR dispensers in egress corridors under specific conditions
        i. The 2000 edition of the NFPA LSC, adopted by CMS in 2003, prohibited ABHR placement in egress corridors but allowed placement in patient rooms and other appropriate areas
        ii. The 2004 amendment (TIA 00-1) to the LSC allowed certain healthcare facilities to place ABHR dispensers in egress corridors under certain conditions, based on a fire dynamic study commissioned by the American Society for Healthcare Engineering (ASHE) that showed low fire risk for ABHRs in egress corridors

20. Boyce & Pittet, 2002 (Centers for Disease Control)
    a. 2002 CDC hand hygiene guidelines state that the "highest possible adherence to hand hygiene practice is achieved when ABHR dispensers are in readily

accessible locations such as the corridor near the patient room entrance and inside patient rooms"

b. These guidelines are an update to the 1985 CDC guidelines for handwashing, and now include new studies supporting the in vivo efficacy of alcohol-based hand rubs and the low incidence of dermatitis associated with their use

21. World Health Organization, 2009 (WHO)
    a. WHO guidelines on hand hygiene in health care state that "although alcohol-based hand rubs are flammable, the risk of fires associated with such products is very low"

22. NFPA 101: *Life Safety Code*, 2012 (National Fire Protection Agency)
    a. Latest edition of the LSC that CMS requires participating health care facilities to adhere to, also endorsed by the Joint Commission
        i. Section 18.3.2.6 and 19.3.2.6: Alcohol-Based Hand-Rub Dispensers
            1. When dispensers are installed in a corridor, minimum corridor width should be 6 ft
            2. Dispensers must be separated from each other by at least 4 ft of horizontal space
            3. Dispensers shall not be installed above or to the side of an ignition source (e.g. electrical outlet, appliance, device) within 1 in. of horizontal distance from each side of the ignition source, or beneath an ignition source within 1 in. of vertical distance from the ignition source
    c. CMS adopted these codes in 2016, as did the Joint Commission

23. American Society for Health Care Engineering, 2015 (ASHE)
    a. Findings from a 2010 Canadian study included in the 2015 ASHE report on hospital hand hygiene, in which researchers conducted work flow observations, interviews, focus groups, surveys, automated counts of dispenser usage, and field tests to identify processes and environments that support hand hygiene
        i. Across health care settings (family medicine clinic, inpatient rehabilitation unit, intensive care unit, and an emergency department), the optimal location for dispensers was just outside the doorways to patient rooms within arm's reach of the door
            1. In this location, the dispenser is highly visible, on the route of the caregiver, and the action of entering the room is a trigger for the caregiver to perform hand hygiene
        ii. The ideal in-room location was less certain, but attaching a dispenser to the foot of every patient bed was another potential optimal in-room location consistently identified by HCP
    b. Fire risk
        iii. Fire regulations "represent an abundance of caution" because fires involving alcohol-based hand rub are rare
        iv. The 2003 Boyce study found no fires in 1430 hospital years of ABHR use

v. A study of 788 German hospitals found only 7 incidents in 25,038 hospital years of ABHR use; 4 incidents were due to personnel lighting cigarettes or candles or hands still being moist with ABHR, 2 incidents due to vandalism, and 1 incident due to suicide attempt
    1. 70% of hospitals had dispensers mounted in patient rooms and 80% in corridors

24. Cure, et al. 2013 (*Health Care Management Science*)
    a. Literature review of 58 articles that provide recommendation on location of hand sanitizer dispensers in hospitals and development of a mathematical model to systematically select optimal locations within a hospital unit based on three criteria: usability, standardization, and conformity with fire safety code constraints and other regulations
    b. Findings:
        i. Recommended locations for ABHR dispensers found in literature included:
            1. At the entrance to patient care rooms
            2. Immediate proximity to the point of care
            3. Immediately adjacent to bed, visible from bedside
            4. At the foot of every patient bed
            5. Easily accessible outside the patient room
        ii. Mathematical model takes into account:
            6. Usability criteria:
                a. Easily visible upon entry
                b. Easy and unobstructed access
                c. Within arm's reach or less than one step from the entrance/exit
                d. Visible from the (possible) point(s) of care
                e. Along the (possible) physical workflow path(s)
                f. Within arm's reach or less than one step from the point of care
                g. Placed at optimal height (85-110cm above the floor)
            7. Standardization is a key component of compliance; having dispensers at the same location in every patient room makes it easy to do the right thing
            8. A dispenser configuration must conform to the national fire regulations and internal hospital regulations
        iii. A case study using data from a 33-room general adult care hospital unit in the US was performed to demonstrate the mathematical model
            9. Current dispenser locations were by the entrance door of each patient room, which was convenient upon entering and exiting but not visible or accessible from the point of care inside the room
            10. The model identified the optimal location configuration based on the three criteria to include a dispenser by the foot the bed within each patient room and several dispensers strategically distributed throughout the hallways; this configuration met usability criteria,

was standardized across all rooms, and met fire safety regulation requirements

25. Garner, et al. 1985 (Centers for Disease Control)
    a. CDC guidelines for prevention of surgical wound infections from 1985 did not support the routine use of ABHRs, recommending they only be used in areas where no sinks were available
        i. "The absolute indications for handwashing with plain soaps and detergents versus handwashing with antimicrobial-containing products are not known because of the lack of well-controlled studies comparing infection rates"
        ii. "Although handwashing is considered the most important single procedure for preventing nosocomial infections, two reports showed poor compliance with handwashing protocols by personnel"
        iii. "Antimicrobial-containing products that do not require water for use, such as foams or rinses, can be used in areas where no sinks are available"
    b. CDC guidelines later updated in 2002 given new evidence in support of ABHRs

26. Thomas, et al. 2009 (*Journal of the American Osteopathic Association*)
    a. Observational study in an intensive care unit comparing standard dispenser location with conspicuous/proximal location and standard location with dramatic increase in number of dispensers
    b. Hand washing is considered the single most important hospital infection-control strategy
    c. Methods:
        i. The conspicuous/proximal experiment consisted of a trapeze-bar apparatus that suspended the ABHR dispenser at eye level over 16 hospital beds
        ii. The increase in dispenser number experiment consisted of removing the trapeze-bar dispensers and placing 36 dispensers in customary locations, increased from 8 dispensers in the control period
    d. Findings:
        i. Increasing the number of dispensers did not increase use
        ii. Conspicuous and proximal placement of dispensers produced a statistically significant increase in daily ABHR consumption

27. Centers for Disease Control, 2018 (CDC)
    a. "On average, healthcare providers clean their hands less than half of the times they should"

28. Centers for Disease Control, 2018 (CDC)
    a. "On any given day, about 1 in 31 hospital patients has at least one healthcare-associated infection"

29. Schmier, et al. 2016 (*ClinicoEconomics and Outcomes Research*)

a. Low- and high-end estimates of avoided hospital costs associated with use of antiseptics for prevention of hospital-acquired infection are $142 million and $4.25 billion, respectively

30. Bischoff, et al. 2000 (*JAMA Internal Medicine*)
    a. Observational study of the effect of an education/feedback intervention program and patient awareness program compared with new, increasingly accessible ABHR dispensers in two ICUs and a general ward
    b. Methods:
        i. The control period was followed by an education/feedback intervention program and a social pressure campaign, in which patients were given flyers encouraging them to request all HCP to wash their hands
        ii. Secondly, new ABHR dispensers were installed near ICU sinks at a dispenser-bed ratio of 1:4
        iii. Lastly, the dispenser-bed ratio was increased to 1:1 in close proximity to beds
    c. Findings:
        i. There was a non-significant change in handwashing compliance after the education/feedback intervention program
        ii. ABHR dispenser accessibility significantly improved compliance

31. Budnick, 2013 (*The Oregonian*)
    a. News report from Oregon of an incident in which static electricity ignited a large amount of undissolved hand sanitizer, causing an 11-year-old girl to suffer third-degree burns

32. Bryant, et al. 2002 (*American Journal of Infection Control*)
    a. Case report of a flash fire caused by static electricity igniting undissolved ABHR on the palm of a HCW who had just removed a 100% polyester gown in a Kentucky hospital
        i. Encouraged proper education of HCWs about the need to allow ABHR to dry or evaporate completely
        ii. Underscored the need to reduce static discharge in the healthcare settings via maintenance of humidification levels at national standards or by incorporating anti-static carbon fiber or antistatic finish into polyester isolation gowns

33. Kendall, et al. 2012 (*American Journal of Infection Control*)
    a. Review of practices and recommendations regarding point of care (POC) hand hygiene in the healthcare setting
    b. Findings:
        i. POC hand hygiene solutions exist, but are not pervasive in US health care settings
            1. “Emphasis on hand hygiene on entering and exiting patient rooms as the definition and measurement of compliance has perhaps further diluted a US focus on POC hand hygiene”

2. "Given the complexities of observation at the POC and the lack of proven electronic measurement methods…the primary method of measurement…is observation of 'in' and 'out' indications only"
3. "As the Joint Commission has primarily promoted room entry/exit hand hygiene, the role of POC hand hygiene has been underemphasized by US health care facilities and hand hygiene programs"

ii. Personal carriage is the use of individual bottles of ABHR that may be carried on a HCW's person
1. Simply providing personal-carriage dispensers does not always translate to their use by HCWs
2. Providing personal ABHR bottles may results in these resources being removed from the institution
3. Their use may also further complicate measurement of compliance
4. Research indicates that personal ABHR bottles are cost-effective
5. Personal carriage also prevents access by patients or visitors, minimizing safety concerns due to the potential for product ingestion or misuse

34. Chan, et al. 2013 (*Infection Control & Hospital Epidemiology*)
a. Observational study from a Dartmouth hospital in which the number of wall-mounted ABHR dispensers in a small medical unit was sequentially increased to evaluate the effect on hand hygiene performance
b. Methods:
i. 6 interventions to increase the number of dispensers from 13 to 51 in an inpatient medical unit with 10 rooms over a 6-month period
ii. Dispensers were mounted just inside the doorway, by the end of each bed, and outside the bathroom
iii. Daily use counts were collected from each dispenser using electronic counters
c. Findings:
i. Addition of more dispensers beyond a certain point did not improve the hand hygiene event rate; the optimal number of dispensers appeared to be around 2 dispenser per bed for this particular unit
ii. 56% of hand hygiene events involved hallway dispensers; for in-room dispensers, 75% of hand hygiene events involved the dispenser inside the doorway and only 19% involved the dispenser near the end of the bed

35. St. Clair, 2016 (Office of Disease Prevention and Health Promotion)
a. Blog post on health.gov explaining Clean Hands Count, a campaign from the CDC to encourage patients to keep their own hands clean and ask their HCPs to do the same
b. The article cites a review of literature on patient empowerment and hand hygiene that found that encouraging patients to call out HCPs on their hand hygiene practices can increase handwashing compliance, and that patients are willing to be empowered