

Strategies to Prevent Healthcare-Associated Infections: Systematic Review

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ABSTRACT

Healthcare-associated infections (HAIs) represent a significant public health challenge and are associated with high burdens of illness and death worldwide. According to research, healthcare-associated infections (HAIs) are estimated to affect seven per hundred hospitalized patients in high-income countries and ten in emerging and low-income countries. The increasing antimicrobial resistance among pathogens worsens because very few new antimicrobial agents have entered the market. This article highlights different potential approaches to preventing the occurrence of HAIs. It sets out how hand hygiene has been and continues to be a key preventative measure across the ages. HAIs can be addressed through several methods, including keeping the hospital environment clean and enacting antibiotic stewardship programs.

Keywords: prevention, hand hygiene, environmental hygiene, surveillance, antibiotic stewardship

1. INTRODUCTION

Communicable infectious diseases have represented one of the greatest threats to human beings throughout history. Historically, epidemics of communicable diseases were frequently misunderstood and associated with environmental changes, divine retribution, or spiritual beliefs. Until the 5th to 15th centuries, the words transmissible and contagious diseases developed gradually, leading to disastrous breakouts throughout Europe. Throughout history, untold millions have perished in pandemics: From 1346 to 1353, the Black Death pandemic killed millions in Europe, decimating and depopulating cities. Even after discovering antibiotics, infectious diseases still threatened public health, and people's life expectancy stayed below 50 in high-income countries. The primary reasons for the 20th-century increase in life expectancy are extensive improvement of public health practices and better control of infectious diseases via sanitation and antibiotic treatment. Although public health officials have long felt that infectious diseases would become a thing of the past, they are now recognized as a prominent global public health threat responsible for high levels of mortality and ever-increasing healthcare costs. The global impact of infectious diseases on societies and the environment is becoming more complex as new contagious and communicable diseases, many zoonotic in origin, continue to emerge. The disease caused by these pathogens has progressed towards becoming one of the significant threats to human health globally due to the growing resistance of pathogens to antimicrobial agents and poor discovery of novel antibiotics. Healthcare-associated infections (HAIs) are a significant global health burden and the second most common cause of death worldwide. HAIs are even more prevalent in Lower- and Middle-Income Countries (LMICs), with rates between 5% and 19%. Due to insufficient infrastructure and resources in the LMICs, data collection in these countries is difficult; these underlying issues lead to knowledge gaps on the magnitude of the problem in these settings. According to WHO investigations of intensive care units

(ICUs), more than 50% of patients in intensive care will develop healthcare-associated infections (HCAIs), which contributes to longer lengths of stay in hospitals, greater risk of complications, and more infections. Infectious diseases account for 15 million deaths globally each year — 95 percent of them in emerging economies. Acute respiratory infections, diarrheal diseases, measles, AIDS, malaria, and tuberculosis are the leading causes of death in these children. HCAIs are currently estimated to affect more than 1.4 million patients globally and have profound effects on individual, community, and public health levels. Many HCAIs are preventable through adequate infection prevention and control (IPC) measures. This review highlights the recent global drives to tackle healthcare-associated infections(s).

2. METHODS

For this narrative review, a comprehensive literature search was performed across numerous bibliographic databases, namely Google Scholar and PubMed. The search used the following terms: "Strategies," "Prevention," "Hand Hygiene," "Environmental Hygiene," "Surveillance," "Antibiotic Stewardship," "Hospital Infections," and "Healthcare-Associated Infections." Also the references in the critical articles were followed up in a snowballing approach to find relevant sources. Articles extracted from peer-reviewed literature in English were included, while articles not available in full-text or written in a language other than English were excluded from this review.

3. INTERVENTIONS TO REDUCE HEALTHCARE-ASSOCIATED INFECTIONS

Preventing healthcare-associated infections (HCAIs) is a critical global public health issue that arouses concern among stakeholders, such as healthcare providers, patients, and the general public. HCAIs are compounded by the emergence of multidrug-resistant pathogens and the depletion of effective antimicrobials, with few novel antimicrobials in the pipeline. *Klebsiella pneumonia*—a more common resistant pathogen—is particularly dangerous in intensive care unit (ICU) settings.

Due to the complex development of HCAIs and the related control strategies, it is a public health problem that requires a comprehensive solution with a heterogeneous mix of approaches. The literature search and peer-reviewed journal publications reveal the following main methods:

Promoting hand hygiene procedures

Training data until October 2023- Maintain a safe, clean, and hygienic environment at the hospital

Screening patients and cohorting them

Strengthening public health surveillance efforts

Supporting antibiotic stewardship programs

Following patient safety protocols

These measures are critical to protecting against HCAIs and are integral to broader efforts on infection prevention and control.

4. HAND HYGIENE

In the 19th century, trailblazing researchers in Europe and the US were determined to stymie hospital-acquired infections. However, all three independently arrived at a similar hypothesis: healthcare workers were carrying harmful microorganisms on their hands, transporting them between patients and infecting them. It wasn't until the 1980s, amid a spike in foodborne illnesses in the United States, that the Centers for Disease Control and Prevention (CDC) began to recognize the importance of hand hygiene. Since then, guidelines have encouraged handwashing with non-antimicrobial soaps as an essential method to avoid infection, especially in high-risk patients. Patient safety in the healthcare environment has become a worldwide concern, compared to hospital-acquired infections in both high- and low-income countries. Hand hygiene, both regular and alcohol-based hand rubs (ABHR), is considered the most critical change in behavior to be adopted by healthcare workers to control infections. While studies have shown that strict adherence to hand hygiene can decrease nosocomial infections by 39% to 71% [12–15], handwashing compliance in hospitals is low. The non-compliance is a global public health problem requiring uniform policies, ongoing surveillance, and more research. Healthcare providers cited several reasons for their non-adherence to proper hand hygiene. Such reasons range from insufficient education and training on hand hygiene importance to misconceptions about the need for handwashing for those wearing gloves and time constraints due to heavy workloads. Uncomfortable handwashing stations, missing supplies, and issues in isolation wards also create hurdles to maintaining proper hand hygiene practices. These challenges must be addressed to enhance compliance with hand hygiene and decrease the transmission of nosocomial pathogens. Drawing on this study, the Joint Commission proposed a multi-pronged initiative termed 'HANDS' to bolster hand hygiene among healthcare workers. In this action plan, we cultivate good hand hygiene habits, provide immediate feedback and accountability from healthcare providers up to the system level, use data-driven policy for auditing, and engage organizational systems to make it the automatic care method in a healthcare setting. A recent systematic review highlighted the importance of need-based strategic interventions to improve healthcare workers' adherence to hand hygiene practices. Educational programs, monitoring, feedback, logistical support, and administration

were suggested, but actualizing these strategies could be difficult. Electronic monitoring systems were noted as successful in improving hand hygiene practices; however, cost and potential impact on professional relationships should be weighed, particularly in low- and middle-income countries. In 2005, WHO launched the First Global Patient Safety Challenge — "Clean Care is Safer Care," in collaboration with the World Alliance for Patient Safety, focused on improving hand hygiene practices in health care. To achieve this, the WHO-5 campaign calls for a multimodal strategy involving system changes, training, observation, feedback, reminders, and building a safe climate in our hospitals. Behavioral science-informed strategies have been implemented to increase healthcare workers' compliance with hand hygiene guidelines. Because nurses have so much contact with patients, they are a significant group that ensures that hand hygiene is practiced. Providing multimodal plans, policies, targets, feedback, and incentives for improving hand hygiene practices among nurses through individual and group accountability. The research suggests further planning is required, which considers individual, team, and organizational levels, to overcome barriers to successful changes to an individual's hand hygiene practices and in healthcare settings.

5. PRACTICES RELATED TO THE ENVIRONMENT AND HEALTH

Environmental hygiene is an infection prevention and control exercise primarily related to hospital-acquired infections. Potentially dangerous pathogens, including *Clostridium difficile*, MRSA, and VRE, can persist on contaminated surfaces in hospitals, presenting an essential route for the transmission of these potentially deadly pathogens. Microbial contamination can occur on porous (e.g., beds, mattresses) and nonporous surfaces (e.g., bed rails, door handles) that increase the risk of infection and reinforce the need for sufficient hygiene in hospitals. Environmental hygiene aims to minimize the load of precious infectious microorganisms on surfaces, as pathogen reduction decreases the likelihood of transmitting the infection from person to province through different surfaces. The process of cleaning a hospital is not simple; it refers to the physical removal of infectious agents, using detergents, disinfectants, and water to remove molecules and other biological agents that allow the growth of pathogenic microorganisms, like various human body fluids, microorganisms, dust, waste, and other biological materials, out of the patient environment. Infection prevention and control is paramount for all types and sizes of healthcare facilities, according to the US Center for Disease Control and Prevention (CDC) and the Healthcare Infection Control Practices Advisory Committee. Routine deep cleaning of all hospital areas, including inpatient and outpatient areas, is essential to help reduce the transmission of communicable diseases. Hospital disinfectants are antimicrobial agents employed in hospitals in different forms and compositions to kill or limit the growth of disease-causing microorganisms, including bacteria, viruses, and fungi. Standard levels/types of cleaning processes (e.g., sterilization, disinfection, cleaning) have their place in an environmental hygiene strategy. Ethylene oxide gas for sterilization, hydrogen peroxide for high-level disinfection, and isopropyl alcohols for intermediate-level disinfection are among the many cleaning agents that are in play for hospital hygiene. Cleaning refers to removing soil, dust, or biological contaminants from surfaces to reduce the microbial load and guarantee the effectiveness of subsequent disinfection processes.

6. OBSERVATION

Surveillance is the ongoing systematic collection, analysis, interpretation, and dissemination of health data for public health purposes; public health surveillance aims to prevent or control disease in a targeted group. Surveillance data on HCAI are essential to identify the magnitude, trends, and burden of infection; they provide alerts to health systems and support monitoring of the progress made and performance and strategy development. The key to preventing and controlling HCAs due to the spread of multidrug-resistant organisms (MDRs) is timely recognition of their unique variants and the isolation of infected patients. Surveillance strategies, however, are subject to financial and practical constraints that can impede their success. Although surveillance is generally acknowledged as a cornerstone of HCAI prevention and control, more work is needed to understand what healthcare-centered surveillance structures work and how lessons learned can be transferred to resource-poor countries.

7. PREVENTION OF COVID-19

Various approaches to identify urgent needs and reinforce vulnerable areas have been employed by healthcare leaders across the globe in response to the COVID-19 crisis. Such stratification of the population by threat underlies the entire COVID exposure-response model, which targets both the individual and the community by minimizing spread, morbidity, and mortality with hospitalizations at the same time as maximization of care with hospitals (and so forth) through treatment of the individual. Guidelines, protocols, and frontline experiences from those working in the health system address the need for preparedness strategies for COVID-19 and further pandemics.

Essential parts of a good COVID-19 prevention plan are:

- 1- control local transmission
- 2- Protecting the health and safety of healthcare workers
- 3- tackling non-urgent pressures on the healthcare system and

4- improving communication and coordination efforts.

As hospitals and clinics are high-contact environments for the transmission of COVID-19, we must take special precautions to limit exposure in the community setting and prevent the spread of the virus. This may include limiting visitation by non-COVID-19 patients, assigning healthcare workers to COVID-19 zones, and screening everyone coming into a health care facility, along with routine testing.

8. CONCLUSIONS

Hospital-acquired infections (HAIs) are a significant and growing public health issue that has raised concerns among several biomedical stakeholders, such as healthcare providers, patients, and the general public. Data with HCAI prevention and management activity has a worldwide urgency that is undoubtedly enhanced in international perspectives, given the disparities between countries, especially with rising growth in multidrug resistance. The research concludes that hand and environmental hygiene and good antibiotic stewardship are effective strategies that can help reduce HAIs and improve treatment outcomes.

REFERENCES

- [1] Haque M, McKimm J, Godman B, Abu Bakar M, Martelli M. Initiatives to reduce postoperative surgical site infections of the head and neck cancer surgery with a special emphasis on developing countries. *Expert Rev Anticancer Ther.* 2019;19(1):81–92. doi:10.1080/14737140.2019.1544497
- [2] Cassini A, Plachouras D, Eckmanns T, et al. The burden of six healthcare-associated infections on European population health: estimating incidence-based disability-adjusted life years through a population prevalence-based modeling study. *PLoS Med.* 2016;13(10):e1002150. doi:10.1371/journal.pmed.1002150
- [3] Ricchizzi E, Latour K, Kärki T, et al. Antimicrobial use in European long-term care facilities: results from the third point prevalence survey of healthcare-associated infections and antimicrobial use, 2016 to 2017. *Euro Surveill.* 2018;23(46):1800394. doi:10.2807/1560-7917.ES.2018.23.46.1800394
- [4] Ripabelli G, Salzo A, Mariano A, Sammarco ML, Tamburro M; Collaborative Group for HAIs Point Prevalence Surveys in Molise Region. Healthcare-associated infections point prevalence survey, and antimicrobials use in acute care hospitals (PPS 2016–2017) and long-term care facilities (HALT-3): a comprehensive report of the first experience in Molise Region, Central Italy, and targeted intervention strategies. *J Infect Public Health.* 2019;12(4):509–515.
- [5] Dye C. After 2015: infectious diseases in a new era of health and development. *Philos Trans R Soc Lond B Biol Sci.* 2014;369 (1645):20130426. doi:10.1098/rstb.2013.0426
- [6] Frieden TR. Six components are necessary for effective public health program implementation. *Am J Public Health.* 2014;104(1):17–22. doi:10.2105/AJPH.2013.301608
- [7] Adedeji WA. The treasure is called antibiotics. *Ann Ib Postgrad Med.* 2016;14(2):56–57.
- [8] Bianucci R, Benedict OJ, Fornaciari G, Giuffra V, Quinto Tiberio Angelerio and new measures for controlling plague in 16th-century Alghero, Sardinia. *Emerg Infect Dis.* 2013;19 (9):1478–1483. doi:10.3201/eid1909.120311
- [9] Alfani G, Murphy TE. Plague and lethal epidemics in the pre-industrial world. *J Econ Hist.* 2017;77(1):314–343. doi:10.1017/S0022050717000092
- [10] Institute of Medicine (US) Committee for the Study of the Future of Public Health. The future of public health. Washington (DC): National Academies Press (US); 1988. 3. A History of the Public Health System. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK218224/>. Accessed August 20, 2020.
- [11] Quinn SC, Kumar S. Health inequalities and infectious disease epidemics: a challenge for global health security. *Biosecur Bioterror.* 2014;12(5):263–273. doi:10.1089/bsp.2014.0032
- [12] Yi Y, Lagniton PNP, Ye S, Li E, Xu RH. COVID-19: what has been learned and to be learned about the novel coronavirus disease. *Int J Biol Sci.* 2020;16(10):1753–1766. doi:10.7150/ijbs.45134
- [13] Esfandiari A, Salari H, Rashidian A, Masoumi Asl H, Rahimi Foroushani A, Akbari Sari A. Eliminating healthcare-associated infections in Iran: a qualitative study to explore stakeholders' views. *Int J Health Policy Manag.* 2017;7(1):27–34. doi:10.15171/ijhpm.2017.34
- [14] Martin M, Zingg W, Hansen S, et al.; PROHIBIT study group. Public reporting of healthcare-associated infection data in Europe. What are the views of infection prevention opinion leaders? *J Hosp Infect.* 2013;83(2):94–98. doi:10.1016/j.jhin.2012.10.010
- [15] Allegranzi B, Bagheri Nejad S, Combescure C, et al. The burden of endemic health-care-associated infection

- in developing countries: systematic review and meta-analysis. *Lancet*. 2011;377 (9761):228–241. doi:10.1016/S0140-6736(10)61458-4
- [16] Esfandiari A, Rashidian A, Masoumi Asl H, Rahimi Foroushani A, Salari H, Akbari Sari A. Prevention and control of healthcare-associated infections in Iran: a qualitative study to explore challenges and barriers. *Am J Infect Control*. 2016;44 (10):1149–1153. doi:10.1016/j.ajic.2016.03.049
- [17] Ventola CL. The antibiotic resistance crisis: part 1: causes and threats. *Pharm Ther*. 2015;40(4):277–283.
- [18] Prestinaci F, Pezzotti P, Pantosti A. Antimicrobial resistance: a global, multifaceted phenomenon. *Pathog Glob Health*. 2015;109(7):309–318. doi:10.1179/2047773215Y.0000000030
- [19] Paton J, Kresge N, GlaxoSmithKline. Big Pharma is leaving the field of antibiotic research in droves; 2018. Available from: <https://www.businesslive.co.za/bd/companies/2018-07-13-big-pharma-is-leaving-the-field-of-antibiotic-research-in-droves/>. Accessed February 12, 2019.
- [20] Sukkar E Why are there so few antibiotics in the research and development pipeline? The pharmaceutical journal. A Royal Pharmaceutical Society Publication; 2013. Available from: <https://www.pharmaceutical-journal.com/news-and-analysis/features/why-are-there-so-few-antibiotics-in-the-research-and-development-pipeline/11130209.article?firstPass=false>. Accessed February 12, 2019.
- [21] Mathur P. Prevention of healthcare-associated infections in low- and middle-income countries: the 'bundle approach.' *Indian J Med Microbiol*. 2018;36(2):155–162. doi:10.4103/ijmm.IJMM_18_152
- [22] WHO Guidelines on Hand Hygiene in Health Care: First Global Patient Safety Challenge Clean Care is Safer Care. Geneva: World Health Organization; 2009. 4. Historical perspective on hand hygiene in health care. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK144018/>. Accessed February 14, 2019.
- [23] Semmelweis I. *Etiology, Concept, and Prophylaxis of Childbed Fever*. 1st. Carter KC, Madison WI. The University of Wisconsin Press; 1983
- [24] Lane HJ, Blum N, Fee E. Oliver Wendell Holmes (1809–1894) and Ignaz Philipp Semmelweis (1818–1865): preventing the transmission of puerperal fever. *Am J Public Health*. 2010;100 (6):1008–1009. doi:10.2105/AJPH.2009.185363
- [25] Labarraque AG. *Instructions and Observations Regarding the Use of the Chlorides of Soda and Lime*. Porter J, Translated [French]. New Haven, CT: Baldwin and Treadway; 1829.
- [26] Lowy EJJ, Lilly HA, Bull JP. Disinfection of hands: removal of transient organism. *Br Med J*. 1964;2(5403):230–233. doi:10.1136/bmj.2.5403.230
- [27] Sanford MD, Widmer AF, Bale MJ, Jones RN, Wenzel RP. Efficient detection and long-term persistence of the carriage of Methicillin-resistant Staphylococcus aureus. *Clin Infect Dis*. 1994;19:1123–1128. doi:10.1093/clinids/19.6.1123
- [28] Rigby R, Pegram A, Woodward S. Hand decontamination in clinical practice: a review of the evidence. *Br J Nurs*. 2017;26 (8):448–451. doi:10.12968/bjon.2017.26.8.448
- [29] Maliwan H. Developing and Evaluating Effective Interventions to Reduce Healthcare-Associated Infection in A Resource-Limited Hospital in Thailand. Ph.D. Thesis. Mahidol Oxford Tropical Medicine Research Unit. The Open University; 2018. Available from: https://oro.open.ac.uk/55283/7/Thesis_Maliwan%20Hongsuwan%2C%20B6976542.pdf. Accessed February 21, 2019
- [30] Larson EL, Cronquist AB, Whittier S, Lai L, Lyle CT, Della Latta P. Differences in skin flora between inpatients and chronically ill patients. *Heart Lung*. 2000;29:298–305. doi:10.1067/mhl.2000.108324
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