



INVESTIGATING THE ROLE OF NURSING INTERVENTIONS IN REDUCING HOSPITAL ACQUIRED INFECTIONS.

Muteb Marzouq Mater Alayt , Nouf Mohammed Alshallali , Rami Ibrahim Alalawi , Mubarak Mesfer Aloreem , Abdullah Shallan Al Roman , Zahra Omar Ali , Mashaal Ali Jead , Seetah Modhe Saleman , Hatim Ibrahim Al Hatim , Faisal Dakeel Mohammed Aljohani , Nasser Sanad Alsanani , Aljoharah Zaid Binnamshan, Mishary Masood R Alotibi, Ghadeer Mohammad Eid Almohammady, Abdallah Hawag Noman Algemele

Abstract:

This review emphasizes how important nurses are to the prevention of infections in hospital settings. As front-line healthcare providers, nurses use evidence-based practices to safeguard patient safety and prevent infections. Nursing practices have a major role in lowering healthcare-associated infections (HAIs) by promoting strict hand hygiene, the use of personal protective equipment (PPE), and adherence to cleaning standards. They are responsible for informing patients, relatives, and coworkers about infection control practices, lobbying for infection prevention, and influencing organizational policies. A key factor in creating safer healthcare environments and improving patient outcomes is the ethical duty nurses have to promote health and avoid sickness. This synopsis highlights the diverse roles that nurses play in infection control and underscores how important it is for them to lessen the effects of HAIs on patients and healthcare systems.

Key words: Nurses, Infection control, Hospital, Healthcare associated infections, Cleaning.

Introduction:

Healthcare-associated infections (HAIs) are a major worldwide health burden that affect a large number of people each year and have significant financial consequences. An estimated \$28 to \$45 billion in direct medical expenses are linked to healthcare-associated infections (HAIs) in the US each year. These costs result in longer hospital stays and higher readmission rates. Notably, infections contracted during hospital stays or surgeries are no longer covered by Medicare or Medicaid. With the potential to save \$35 billion over ten years, the Affordable Care Act of 2010 brought measures within the Secretary of Health and Human Services' jurisdiction for diagnosing and controlling these diseases. The need to protect patients and reduce



All the articles published by Chelonian

Biology are licensed under a [Creative Commons Attribution-](https://creativecommons.org/licenses/by-nc/4.0/)

[NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/) based on a work at <https://www.acgpublishing.com/>

Conservation

and

preventable damage has prompted the extension of nursing jobs to include infection control and preventive duties [1].

Nurses are in a unique position to promote patient safety and provide education on infection prevention because of their broad engagement in patient care, caregiving responsibilities, and close relationships with patients and families. Even in medicine, long-standing habits and enduring misunderstandings continue to promote procedures that have no empirical backing. Nurses face opposition from colleagues when they advocate for the adoption of evidence-based, patient-centered approaches, which can hinder efforts to prevent infections and ensure patient safety. The goal of infection prevention and control (IPC) is to stop or prevent the spread of infections by using evidence-based practices consistently. IPC seeks to reduce the spread of harmful germs to patients, visitors, and healthcare workers (HCWs) in hospital settings. World Health Organization, 2021). Patients frequently experience unanticipated health consequences that result from nosocomial infections (also known as healthcare-associated infections, or HAIs)—pathogens contracted during treatment—rather than from their underlying diseases [2].

With over 4.5 million estimated occurrences annually in the European Union, which lead to almost 37,000 fatalities, extended hospital stays, and increased costs, Europe has significant issues with HAIs. According to WHO data, 10% of patients worldwide have an infection while receiving treatment; surgical site infections account for 20% of healthcare-associated infections (HAIs), and 32% of surgical patients get post-operative infections. Additionally, throughout their hospital stay, patients run the risk of acquiring several HAIs. For example, in Finland, it's projected that each year, approximately 100,000 HAIs occur in hospitals and long-term care facilities, leading to 1,500–5,000 fatalities. In contrast, a large number of developing Asian countries lack national monitoring on healthcare-associated infections (HAIs), and several South-East Asian countries have inadequate or nonexistent IPC programs. About 25% of hospitalized patients in the Asia-Pacific area have HAIs, which have prevalence rates 2–20 times greater than in wealthy nations [3].

Invasive treatments, exposure to pathogenic microbes, and inadequate immune responses are among the major causes of health-associated infections (HAIs). Furthermore, during the provision of care, patients may come into direct contact with HCWs and acquire HAIs. The primary emphasis of this study is the critical role that nurses play in controlling and preventing healthcare-associated infections (HAIs) that result from patient contact with surfaces and equipment. Touch surfaces are under the category of constructed surfaces and all other equipment used in patient care under the environmental element of nursing care. Regardless of their classification as critical or non-critical medical devices, these patient care items are included in the contact surfaces in healthcare settings that have been linked in studies to the spread of infection and antibiotic resistance. Biofilms that grow and build on healthcare equipment surfaces can present a danger for HAIs. Globally, health care workers (HCWs) have

implemented hand hygiene and personal protective equipment standards to combat the spread of infections, especially in the healthcare industry [3].

In conclusion, healthcare-associated infections (HAIs) represent a significant challenge globally, impacting both patient outcomes and healthcare systems financially. The staggering costs associated with HAIs underscore the urgent need for effective prevention and control measures. Despite efforts such as those outlined in the Affordable Care Act of 2010, which aimed to address these issues, HAIs continue to pose substantial risks to patients worldwide. The role of nurses in infection prevention and control (IPC) cannot be overstated. Their unique position allows them to advocate for evidence-based practices, educate patients and colleagues, and implement strategies to minimize the transmission of pathogens in healthcare settings. However, nurses often face resistance when promoting these practices, highlighting the importance of overcoming institutional barriers to achieve comprehensive infection control. The statistics presented, from the prevalence of HAIs in Europe to the lack of surveillance in developing Asian countries, underscore the global nature of this problem. Invasive procedures, exposure to pathogens, and suboptimal immune responses all contribute to the occurrence of HAIs, emphasizing the multifaceted approach required for effective prevention. Moving forward, it is imperative that healthcare systems prioritize IPC efforts and provide support for nurses and other healthcare professionals in implementing evidence-based strategies. By working collaboratively and proactively addressing the underlying factors contributing to the spread of HAIs, we can strive towards safer and more effective healthcare delivery for all patients.

Importance of Infection Prevention:

The significance of infection prevention in healthcare systems encompasses not only medical aspects but also sociological and financial aspects. It is acknowledged as a financially sensible strategy for improving public health, a position that the CDC reiterated in 2014. The WHO report from 2010 emphasizes how important infection prevention is, especially in low-income countries with inadequate capacity to control infections. In our globalized society, where illnesses can spread quickly across different patient demographics and hospital environments, the demand for culturally aware infection control measures is rising. As frontline healthcare professionals, nurses are essential in managing this multicultural environment. Nursing policies—like the ones set forward by the NMC in the UK—emphasize how crucial it is for nurses to comprehend and skillfully implement infection control protocols in the context of changing healthcare delivery systems [4].

The changing face of healthcare, marked by breakthroughs in technology and medicine, presents fresh difficulties for infection control. As evidenced by current pandemics and epidemics, global travel and a more diversified population worsen the effects of newly emerging and reoccurring infectious diseases. Strict infection control protocols are essential due to the negative impacts of healthcare-associated infections (HCAIs) on patient safety. As stewards of scientific discoveries, nurses need to stay current on the most recent evidence-based infection

prevention strategies and their applicability. According to the WHO, HCAs afflict about 8% of patients in industrialized countries and significantly greater rates in poor countries. The enormous, billion-dollar yearly financial burden of healthcare-associated infections (HCAs) highlights the critical need for efficient infection control strategies. The effects of healthcare-associated infections (HCAs) go well beyond hospital settings, impacting individuals, families, and communities at large. Death rates from 8 to 20 percent are common, and affected patients often require prolonged hospital stays and permanent disabilities [5].

Nurse Roles in Preventing Infection:

Research has shown that nursing has a critical role in reducing infection rates in hospital settings. Research has continuously demonstrated a relationship between a higher percentage of professional registered nurses relative to auxiliary workers and lower rates of hospital-acquired infections (HAIs). This relationship also holds true for employee well-being, with higher job satisfaction and a sense of role fulfillment frequently acting as markers for better patient care and results. Aiken and colleagues' seminal 2002 study found that patients receiving satisfactory care from registered nurses had a startling 22% reduced incidence of postoperative infections after heart surgery. As evidenced by Stone's qualitative research in 2004, infection prevention nurses are essential in forming hospital culture, even in the face of resistance and contempt from some physicians for infection control activities. This demonstrates how doctors' activities can have a big influence on the transmission of nosocomial illnesses, even though they do so indirectly [6].

Further complications arise from the use of long-term indwelling devices as indicators of infection risk and patient compliance with preventive measures. In addition, Stone's research revealed differences in infection rates between sites that were not just related to catheter use, suggesting possible inequalities in nursing and medical procedures. Furthermore, Virnig et al.'s 2006 study found a link between irregular staffing and assignment practices and increased risks of postoperative infections. The combined results of these studies highlight the vital role that nursing plays in hospital infection control initiatives. Collaboration is necessary to address issues like staffing shortages, physician attitudes, and practice variances. This approach should prioritize infection prevention techniques and acknowledge the vital role that nurses play in maintaining patient safety and well-being [6].

The International Council of Nurses (ICN) states that the promotion and restoration of health, illness prevention, and suffering reduction are among the core duties of nurses as outlined in the nursing code of ethics. The idea of nonmaleficence, which emphasizes the necessity of ensuring patient and community safety throughout healthcare delivery while abstaining from purposeful damage, is fundamental to nursing ethics. In keeping with this idea, nurses have a duty as healthcare providers to establish and maintain settings free from disease. This responsibility also includes encouraging patients' recovery from illnesses and protecting the environment of the health care system for their well-being. But it's important to remember that while providing care, nurses themselves run the risk of coming into contact with infectious

materials. This emphasizes how crucial it is to keep a healthy workplace for all healthcare professionals. Using Florence Nightingale's Environmental Theory as a guide, it is clear that hygienic conditions and cleanliness within the nursing environment have a direct bearing on the overall health and well-being of patients receiving care as well as the rates of morbidity and death. As a result, putting environmental hygiene first is not only morally required, but also essential to good nursing practice and patient outcomes [6].

Infection Types in Hospitals:

The skin, mucous membranes, and internal systems are just a few of the defense mechanisms the human body uses to protect itself against pathogens, or dangerous microorganisms. When the body's defenses are overpowered by these microorganisms, infections result. Throughout human history, pathogens have coexisted with humans, occasionally going long stretches without becoming active. They include a wide range of pathogenic agents, such as bacteria, viruses, fungi, and parasites, that can result in mild discomfort and fevers or more serious outcomes like organ failure or death. Acute, persistent, systemic, and localized infections are all possible outcomes of an infection. People with pre-existing illnesses or those who are already unwell are especially susceptible to contracting new diseases. An estimated 300,000 cases of healthcare-associated illnesses are reported in England each year, and there are about 1.7 million cases in the US. These illnesses are a serious problem. Recent decades have seen an increase in the prevalence of these infections, which has prompted increased research efforts and a concentration on prevention, control, and surveillance techniques. Healthcare infection control faces enormous hurdles due to the rise of antibiotic-resistant bacteria and new strains of age-old diseases. These elements make the field of infection control more difficult, requiring constant innovation and modification in tactics to successfully fight infectious illnesses and protect the public's health. Microorganisms are highly adaptive, and infectious agents are pervasive, making complete eradication of diseases from healthcare settings an unattainable goal. Zoonotic infections, transmitted from one organism to another, have the potential to reinfect the original host or initiate new ones. Iatrogenic infections arise from medical procedures, with nosocomial microorganisms being a primary source. Individuals who are immunocompromised or undergoing major surgery are especially susceptible to these infections [7-8].

Primary infections occur when an individual encounters an infectious agent for the first time, while secondary infections arise from pre-existing ones due to compromised immune systems. Fungi can infect hosts by residing within them or colonizing dead cells such as skin, hair, and nails, leading to either localized or systemic infections. Although a transient bacterial bloodstream infection may not always lead to illness, unchecked bacterial proliferation can result in sepsis, a severe bloodstream infection with a high mortality rate among critically ill patients. In vitro infections stem from contaminated cell or tissue cultures, while in vivo infections occur when bacteria grow within or on host tissues. Systemic infections affect the entire body, often when bacteria enter the bloodstream or other organs, whereas local infections are confined to specific body regions, manifesting symptoms such as pain, redness, swelling, immobility, and

heat. Effective hospital infection control strategies must therefore consider these diverse components of infection to mitigate their impact on patient health and safety. There is growing recognition of the importance of viral agents, especially enteroviruses that impact the gastrointestinal tract, in hospital-acquired diseases. Viral infections are on the rise in part due to the severity of emergent virus-related symptoms and the growing number of immunocompromised people, who are more vulnerable to infections. In order to avoid the spread of disease, patient care equipment must be thoroughly cleaned because many viruses are resistant to common hospital sanitation practices and can linger on environmental surfaces [9-10].

On the other hand, when bacterial pathogens infiltrate a host, the risk of infection is directly correlated with their density. High quantities are frequently found in particular locations, such as drains, restrooms, and faucets, that demand careful cleaning by nursing and housekeeping personnel. Many times, hospital-acquired wounds and ear infections are linked to certain bacteria, such *Pseudomonas Aeruginosa*, which is usually present in soil and water. Greater rigor and persistence in control measures are necessary because of their resistance to disinfectants and extended survival on hands and surfaces. Infections have a major effect on how patients are treated; they reduce functional independence and call for more extensive post-discharge care. Reentry into independent community living may prove difficult for some patients, adding to the burden on caregivers and medical staff. Hospital-acquired infections have serious consequences: infected patients have a two- to three-fold increased risk of dying, higher rates of readmission to the hospital, and more severe disease. Patients' quality of life is further compromised by longer hospital stays, a greater need for ongoing care, and a reduction in their functional autonomy. These factors also place a financial strain on patients' families and the healthcare system [11].

Nurse Strategies for Infection Control:

An essential tactic for preventing infections is good hand cleanliness, especially in medical environments. Keeping hands clean is the first line of defense against healthcare-associated infections. When skin integrity is maintained, the necessary supplies are easily accessible and used, and the need of hand cleanliness is made evident, optimal hand hygiene takes place. There are a number of obstacles that prevent people from practicing hand hygiene, such as false perceptions about the risk of infection, the conviction that infectious organisms do not originate from patients, and skepticism about the effectiveness of hand cleanliness in stopping the transmission of particular bacteria. Overcoming these challenges requires a thorough understanding of the fundamental significance of hand hygiene and how it directly relates to the safety of nurses and patients. Reminders, social media marketing, and feedback systems are examples of successful tactics that have been shown to encourage changes in hand hygiene habit [12].

Nursing practices are intimately linked to the four main pathways through which infectious pathogens can spread: respiratory, droplet, airborne, and contact. By keeping up to

date on the most recent infection prevention recommendations, procedures, and best practices, nurses may significantly reduce the risk of pathogen transmission to patients, coworkers, themselves, and visitors. This promotes a safer workplace and helps lessen the financial burden linked to infections related to healthcare, in addition to making the healthcare environment safer. It is critical for nurses to identify and remove obstacles that hinder patients from adhering to infection prevention protocols and to put evidence-based interventions into practice that have been shown to stop the spread of infectious agents. By doing this, infection prevention and control can be effectively used to protect the health of patients and employees. It is essential to follow proper hand hygiene, which includes using an alcohol-based hand rub or washing hands with soap and water, in order to eradicate or neutralize bacteria. The best way to stop diseases from spreading and coming back is to follow this technique. Research suggests that adherence to hand hygiene measures for healthcare personnel is still subpar, even with the abundance of publications and guidelines on the subject [13].

There is a common misunderstanding that healthcare personnel are less inclined to prioritize basic hand hygiene procedures the busier they are. Innovative strategies are being developed to address this issue and make hand hygiene easier for busy healthcare professionals to access and maintain. For example, a US study investigated whether it would be possible to use an antibacterial, waterless technique to cut the length of hand washing to just 15 seconds. In order to save time, this procedure uses an alcohol hand rub that has been carefully developed to eliminate bacteria on the skin without the need for water. Developing and implementing creative solutions, such as the aforementioned one, is crucial to encouraging improved hand hygiene among healthcare personnel. To make sure that these methods are practical and effective in actual healthcare settings, they need to undergo extensive testing. Healthcare institutions can improve staff hand hygiene practices and lower the risk of infection transmission while also increasing patient safety by implementing such cutting-edge techniques. Healthcare workers who operate in any position or environment where there is a possibility of coming into contact with potentially contagious microbes from patients or materials should always wear personal protective equipment, or PPE. The Standard Precautions tier of the Hierarchy of Controls contains a summary of these safety precautions. Its goal is to prevent morbidity and mortality related to healthcare and to safeguard healthcare workers by utilizing administrative, engineering, and work practice controls, as well as the proper use of personal protective equipment (PPE). As backed by the Occupational Health and Safety Act, which requires employers to take all reasonable steps to protect employees in any given situation, including providing tools, supplies, and safety gear, hospitals and other healthcare providers have a moral and legal obligation to implement appropriate safety measures to ensure a secure working environment [14-15].

Using personal protective equipment (PPE) like gloves is essential in hospital settings to stop the spread of illness, especially when it comes to nurses preventing infections. The most common PPE used in healthcare settings is gloves, which act as a barrier between the patient's

skin and hands to stop the spread of germs. When handling blood, body fluids, excretions, mucous membranes, non-intact skin, or potentially contaminated skin, gloves are a must. To stop microbes from colonizing under the gloves, practice good hand hygiene, which includes washing your hands both before and after using gloves. Gowns are sometimes used in medical settings as personal protective equipment (PPE), especially in situations when clothing soiled easily. By forming a barrier, gowns stop germs from getting on patients' clothing or from spreading between patients. Removing a gown properly entails turning it inside out, gathering it into a bundle, and discarding it properly. When possible, use biodegradable plastic trash bags to reduce the chance that dirty gowns will leak while being transported. Another vital piece of personal protective equipment (PPE) that should be worn in circumstances where there is a chance of blood or body fluid spilling is a mask. These shields stop the spread of disease by droplets released when an infected person coughs, talks, or sneezes. Lastly, in situations when there is a chance of blood or other bodily fluid splashing into the eyes, protective eyewear should be worn. Healthcare workers can considerably lower their risk of infection transmission and guarantee their own safety as well as the protection of their patients by following the correct PPE standards. In order to avoid infections in hospital environments, proper cleaning and disinfection protocols are crucial. It's critical to choose the right cleaning and disinfection solutions for the surface to be cleaned and the degree of contamination. Using a detergent is sufficient to remove dirt and reduce exposure risk when the surface is not polluted. However, in order to properly eradicate infections, careful cleaning and disinfection are required when handling spills of bodily fluids or significantly polluted surfaces [16].

Cleaning, disinfection, and appropriate waste disposal should come first in the cleaning and disinfection process. The area should be used using gloves and absorbent materials. To stop additional contamination, reusable goods need to be cleaned before being used again. Prior to using disinfectants, surfaces must be thoroughly cleaned, considering the type of surface and the level of pollution. In order to avoid cross-contamination, cleaners should also be aware of the correct cleaning techniques and know how to handle mops and microfiber cloths. Equipment should be cleaned and sterilized between patient uses as part of routine cleaning and disinfection processes. Any contaminated equipment should be cleaned right away. In healthcare settings, isolation precautions are essential for halting the spread of contagious diseases. The positioning of the patient, common precautions, and transmission-based precautions are all included in these measures. With every patient, standard measures such as hand washing, using gloves, and donning gowns when required, should be observed. In addition to normal precautions, patients with suspected or confirmed infectious illnesses that spread through airborne, droplet, or contact pathways are treated with transmission-based precautions. The type of infectious disease, the risk of transmission, and the care environment should all be considered when placing patients. Patients with airborne infections must have enough ventilation in airborne infection isolation rooms; if single rooms are not available, other options should be taken into consideration. To guarantee that efficient transmission-based interventions are put in place, restrictions on patient placement should be decided upon in cooperation with infection control personnel [17-18].

Conclusion:

In conclusion, nurses play a critical role in infection control within healthcare settings. As frontline healthcare providers, nurses are uniquely positioned to prevent the spread of infections and promote patient safety through various measures. They are responsible for implementing evidence-based practices such as hand hygiene, proper use of personal protective equipment (PPE), and adherence to cleaning and disinfection protocols. The significance of infection prevention and control is underscored by the potential for healthcare-associated infections (HAIs) to cause harm to patients, prolong hospital stays, and increase healthcare costs. Nurses not only contribute to patient safety but also protect themselves and their colleagues from exposure to infectious materials. Moreover, nurses serve as advocates for infection prevention within interdisciplinary teams, influencing organizational policies and promoting a culture of safety. They educate patients, families, and fellow healthcare workers about the importance of infection control practices and empower them to participate in preventing the spread of infections. Infection control is not only a professional responsibility but also an ethical obligation for nurses, aligned with their commitment to promoting health, preventing illness, and alleviating suffering. By fulfilling their role in infection control, nurses contribute to creating safer healthcare environments, improving patient outcomes, and reducing the burden of healthcare-associated infections on individuals and healthcare systems alike.

References:

1. Li, J., He, X., Yuan, Y., Zhang, W., Li, X., Zhang, Y., ... & Dong, G. (2021). Metaanalysis investigating the relationship between clinical features, outcomes, and severity of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pneumonia. *American journal of infection control*, 49(1), 82-89. [sciencedirect.com](https://www.sciencedirect.com)
2. Fakih, M. G., Bufalino, A., Sturm, L., Huang, R. H., Ottenbacher, A., Saake, K., ... & Cacchione, J. (2022). Coronavirus disease 2019 (COVID-19) pandemic, central-line-associated bloodstream infection (CLABSI), and catheter associated urinary tract infection(CAUTI): the urgent need to refocus on hardwiring prevention efforts. *Infection Control & Hospital Epidemiology*, 43(1),26-31. [cambridge.org](https://www.cambridge.org)
3. Chew, Q. H., Wei, K. C., Vasoo, S., Chua, H. C., & Sim, K. (2020). Narrative synthesis of psychological and coping responses towards emerging infectious disease outbreaks in the general population: practical considerations for the COVID-19 pandemic. *Singapore medical journal*, 61(7), 350. [nih.gov](https://www.nih.gov)
4. Lai, C. C., Liu, Y. H., Wang, C. Y., Wang, Y. H., Hsueh, S. C., Yen, M. Y., ... & Hsueh, P. R. (2020). Asymptomatic carrier state, acute respiratory disease, and pneumonia due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2): Facts and myths. *Journal of Microbiology, Immunology and Infection*, 53(3), 404-412. [sciencedirect.com](https://www.sciencedirect.com)

5. Jacob, S. T., Crozier, I., Fischer, W. A., Hewlett, A., Kraft, C. S., Vega, M. A. D. L., ... & Kuhn, J. H. (2020). Ebola virus disease. *Nature reviews Disease primers*, 6(1), 13. [nature.com](https://www.nature.com)
6. Perez, S. (2020). Increase in hospital acquired carbapenem-resistant *Acinetobacter baumannii* infection and colonization in an acute care hospital during a surge in COVID-19 *MMWR. Morbidity and mortality weekly report*. [cdc.gov](https://www.cdc.gov)
7. Li, J., Wang, J., Yang, Y., Cai, P., Cao, J., Cai, X., & Zhang, Y. (2020). Etiology and antimicrobial resistance of secondary bacterial infections in patients hospitalized with COVID-19 in Wuhan, China: a retrospective analysis. *Antimicrobial Resistance & Infection Control*, 9, 1-7. [springer.com](https://www.springer.com)
8. Vijay, S., Bansal, N., Rao, B. K., Veeraraghavan, B., Rodrigues, C., Wattal, C., ... & Walia, K. (2021). Secondary infections in hospitalized COVID-19 patients: Indian experience. *Infection and drug resistance*, 1893-1903. [tandfonline.com](https://www.tandfonline.com)
9. Al-Rahimi, J. S., Nass, N. M., Hassoubah, S. A., Wazqar, D. Y., & Alamoudi, S. A. (2021). Levels and predictors of fear and health anxiety during the current outbreak of COVID-19 in immunocompromised and chronic disease patients in Saudi Arabia: A cross-sectional correlational study. *PloS one*, 16(4), e0250554. [plos.org](https://www.plos.org)
10. Joyner, M. J., Senefeld, J. W., Klassen, S. A., Mills, J. R., Johnson, P. W., Theel, E. S., ... & US EAP COVID-19 Plasma Consortium. (2020). Effect of convalescent plasma on mortality among hospitalized patients with COVID-19: initial three-month experience. *medrxiv*, 2020-08. [medrxiv.org](https://www.medrxiv.org)
11. Zelner, J., Trangucci, R., Naraharisetti, R., Cao, A., Malosh, R., Broen, K., ... & Delamater, P. (2021). Racial disparities in coronavirus disease 2019 (COVID-19) mortality are driven by unequal infection risks. *Clinical Infectious Diseases*, 72(5), e88-e95. [oup.com](https://www.oup.com)
12. Botti, T., Bagozzi, L., Fiocco, A., Nadali, M., Caraffa, R., Bifulco, O., ... & Gerosa, G. (2021). COVID-19 in heart transplant recipients: a multicenter analysis of the Northern Italian outbreak. *Heart failure*, 9(1), 52-61. [jacc.org](https://www.jacc.org)
13. Cesaro, S., Ljungman, P., Mikulska, M., Hirsch, H. H., von Lilienfeld-Toal, M., Cordonnier, C., ... & Pagano, L. (2022). Recommendations for the management of COVID-19 in patients with hematological malignancies or hematopoietic cell transplantation, from the 2021 European Conference on Infections in Leukaemia (ECIL 9). *Leukemia*, 36(6), 1467-1480. [nature.com](https://www.nature.com)
14. Chatterjee, P., Nagi, N., Agarwal, A., Das, B., Banerjee, S., Sarkar, S., ... & Gangakhedkar, R. R. (2020). The 2019 novel coronavirus disease (COVID-19) pandemic: A review of the current Majed Mohammed Hamed Alkhalaf 336 evidence. *Indian Journal of Medical Research*, 151(2-3), 147-159. [lww.com](https://www.lww.com)
15. Bourdrel, T., Annesi-Maesano, I., Alahmad, B., Maesano, C. N., & Bind, M. A. (2021). The impact of outdoor air pollution on COVID-19: a review of evidence from in vitro, animal, and human studies. *European respiratory review*, 30(159). [ersjournals.com](https://www.ersjournals.com)

16. Ouslander, J. G., & Grabowski, D. C. (2020). COVID-19 in nursing homes: calming the perfect storm. *Journal of the American Geriatrics Society*, 68(10), 2153-2162. snppalliance.org
17. Sanchez-Pina, J. M., Rodríguez Rodríguez, M., Castro Quismondo, N., Gil Manso, R., Colmenares, R., Gil Alos, D., ... & Calbacho, M. (2020). Clinical course and risk factors for mortality from COVID-19 in patients with haematological malignancies. *European Journal of Haematology*, 105(5), 597-607. bvsalud.org
18. Cheng, V. C., Wong, S. C., Chen, J. H., Yip, C. C., Chuang, V. W., Tsang, O. T., ... & Yuen, K. Y. (2020). Escalating infection control response to the rapidly evolving epidemiology of the coronavirus disease 2019 (COVID-19) due to SARSCoV-2 in Hong Kong. *Infection Control & Hospital Epidemiology*, 41(5), 493-498. cambridge.org