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Infection Control in Hospitals: Strategies for Containing Prevalent Diseases

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Abstract

1. Introduction

Infection control is a core component of healthcare in both the hospital and community. It is the policies and procedures used to minimize the risk of spreading infections and it involves a range of disciplines including epidemiology, microbiology, behaviour, human factors and risk management An infection occurs when a germ enters a person’s body and grows in its tissues. Infection control focuses on the prevention of healthcare-associated infections (HAIs). HAIs, also known as nosocomial infections, can occur anywhere healthcare is delivered and affect patients, staff, and visitors. Most HAIs can be prevented with good infection control practices.

Methods: testing and containment measures were initiated within 48 hours of positive results, with all patients tested and isolated in their rooms until results arrived. Testing champions were assigned to each unit to manage this process. Staff were also tested and screened for symptoms, with symptomatic individuals sent home for testing. Limited staffing due to facility reopening after lockdown complicated testing needs. Some sites refused tests without symptom failure, while others were closed for high volumes. A mix of molecular, point-of-care, and antibody tests was used when rapid tests were unavailable. Results were reported to residents, staff, and health departments. Infection control policies on PPE use were increased, requiring masks, eye protection, gloves, and gowns, with staff compliance monitored at shifts' starts and reported to managers. An outbreak response hotline was set up for reporting unsafe practices, but received no reports. A PPE audit tool assessed compliance, showing increases with daily surveys, yet non-compliance persisted. Re-education was

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implemented to address issues like high staff turnover and misunderstandings about PPE necessity.

conclusion : Hospital epidemiologists and frontline health care workers need to be aware of cross-contamination risks and have contingency plans for inundation prior to handling of patients with prevalent hospital pathogens across multiple settings, including overcrowded inpatient wards, settings where basic infection control precautions might not be implemented, or point-of-care settings. Pre-admission screening via detecting a common multidrug-resistant organism at a day-of-appointment triage by PCR and 24-h quarantine might be an intervention to consider adopting in outpatient clusters. Independent reporting, metrics that incorporate structural and organizational competencies in the infection control program, and successful stakeholder engagement are all essential to consider in the prevention and control of hospital-acquired pathogens (Eckardt et al., 2022).

2. Understanding Infectious Diseases

It is essential to collect ongoing and historical information on the patient's health conditions, physical health, and behavior to determine the patient's medical condition on admission to the hospital. On new admissions, a one-on-one individual assessment will be performed by a staff member. Among other things, this assessment will include questioning about recent hospitalization and travel history, exposure to transmission risk activities, and other pertinent travel history, which includes a check for travel to, or recent contact with individuals from areas affected by reversible infectious diseases and outbreaks. A record of the assessment will be kept. A copy will be given to the Infection Control staff as soon as possible. Information about the presence of fever and possible risk factors for exposure to infections will be collected immediately after notification of a possible source patient. This collection will use a standard procedure to ensure consistency and sustainability in this task (Branch-Elliman et al., 2015). This step could be followed by using the translated version of the questionnaire in the patient's language and asking for help from a translator when the staff doesn't speak the same language as the patient.

Careful medical history-taking to determine the patient's general backgrounds, travel history, recent hospitalization, and whether the patient had been in contact with possibly infectious individuals or exposure to risk factors for emerging infections will guide the physician to the possible causes of illnesses. Four main routes of transmission of infectious diseases are identified. They include direct transmission through exposure to infected patients, vectors, environmental transmission, and indirect transmission through contaminated food and water sources. To reduce the transmission of emerging infections that cannot be prevented through the vaccination of health care personnel, health care facilities must implement standard precautions, and infection control risk assessments of the health care supply chain will ensure continued practices, procedures, or products that are in place. Standard precautions are a wide

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range of enforcement policies designed to reduce the risk of infection in the general health care environment.

Compliance with standard precautions will be enforced strictly and by observation. Compliance will be evaluated according to the potential exposure risk of specific pathogens. Outbreak investigation plans for certain pathogens also will be devised, enforced, and evaluated. Health care facilities will avoid using sharps, introduce cut-resistant gloves, implement an occupational health program, and establish a central laboratory for coinfections. Protective safety and testing gear will be provided to patients with direct contact with infection safety staff. Health care facilities must also prepare administrative and engineering control measures to prevent the transmission of infectious diseases.

2.1. Types of Infectious Diseases

Epidemiologic descriptions of infectious diseases typically include the agent, mode of transmission, and host, consisting of a susceptible or pre-disposed population. In the following sections, those factors affecting the transmission of infections within healthcare facilities, as well as personal measures to limit the potential for the acquisition of infection, will be discussed. The types of disease in each of those areas are vast. In general terms, all infectious diseases need a transfer from one organism to another. This cycle is defined by the presence of infectious agents on a reservoir, a portal of exit to a transmission medium, means of transmission, a portal of entry, and a susceptible host. Containing any step in that cycle will limit the risk of disease transmission .

Infection occurs through contact with an infectious agent, which is successfully transferred to a susceptible and/or pre-disposed individual. That transmission is a complex sequence of events, which has been broken down into categories describing its key components, including the agent, portal of entry, mode of transmission, and host. Details of each factor significantly change depending on the infectious disease, and variability at each point adds complexity to control efforts.

Infectious agents can be in several environmental forms, including bacteria, fungi, parasites, prions, viruses, and viroids. Those entities differ in structure and other characteristics. As a result, the potential for environmental stability and means of conveyance differ across those entities. Furthermore, the need for non-living viral capsids and complex parasite forms, the vulnerability to physical and chemical damage of other forms, as well as a host of other factors, interact with setting and other factors to determine the pervasiveness, reach, and risk associated with any one infectious agent.

2.2. Transmission Pathways

Infectious agents can be transmitted from one person to the next via various pathways dependent on numerous variables, including environmental factors and characteristics of the

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host and agent (Branch-Elliman et al., 2015). Accordingly, a hierarchy of infection prevention strategies must be applied curve, the greater the resources required to effectively impede transmission. Each of these approaches is important and must all be considered in the development of an effective infection prevention and control program.

Eliminating potential exposure to the agent is the single most effective means of controlling the spread of an infectious agent since no exposure implies no infection. While elimination may be possible in the context of an outbreak of limited duration, it is not feasible in the context of ongoing endemic spread. This often leads to considerable frustration for infection preventionists, as they coordinate efforts at declining prospects of success, with increasing resources and effort and competition with other priorities over time and in the absence of visible success.

A second important infection prevention strategy includes administrative controls that affect behavior. This could include universal vaccination in the case of measles, asking patients with influenza-like illness to wear a mask upon entering a facility, and limiting the number of visitors to a patient's room. These measures can be very effective in preventing person-to-person transmission of an infectious agent, but they depend on others in the healthcare system, health authorities, and the community following certain common practices, which can be problematic.

A third broad category of infection prevention strategies would include engineering or physical controls. These would encompass barriers to aid in product handling, design features in architecture to reduce exposure, or, in general, any feature of the built environment or medical equipment that can be leveraged to impede transmission.

3. Importance of Infection Control in Healthcare Settings

Infection control procedures aim to minimize the risk of infectious disease transmission among patients and to eliminate any possible sources of infection. Hospitals are commonly contaminated with Gram-positive and Gram-negative bacteria, including multidrug-resistant bacteria, which can be transferred from healthcare professionals and patient surroundings, causing hospital-acquired infections and outbreaks. Acquisition and colonization of multidrug-resistant bacteria are risk factors for infection, as is the invasive use of invasive procedures, devices, and antibiotic overuse. Moreover, failure to maintain essential infection control measures can result in increased colonization of the healthcare setting and hospital-acquired infections (Y. Liang et al., 2018).

Most hospital resources are aimed at patients suffering from prevalent infections, instead of preventive strategies, which are generally underestimated. Acute care hospitals can sometimes suffer from outdated units and structures of care not designed for paediatric patients. Everything that happens in the patient's room tends to be inconvenient and executed

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in the wrong space without proper equipment and tools, potentially exposing healthcare professionals to patients' secretions and excretions (D'Alessandro & Maria Fara, 2017). It is possible to implement an inexpensive, structured model to provide infection control officers with tools to contain primarily the most prevalent diseases, assess the critical infrastructure, and plan and implement targeted corrective actions. This model should stem from hospital and intensive care unit floors to the top of the organization, the board (i.e., main stakeholders). This model should be periodically reimplemented to evaluate improvements, monitor the progress of the proposed actions, and redefine priorities on the basis of newly occurring criticalities. It can also be adjusted and applied to different prevalent infections, hospital types, and countries.

3.1. Impact on Patient Safety

In a recent report, it was stated that there are 2 million people (out of which at least 130,000 die) each year in the United States due to hospital-acquired infections (HAI). The challenge presented by HAI usually turns out to be multi-drug resistant organisms (MDRO). Infection prevention and control (IPC) programs play a pivotal role in reducing HAI, although underfunded. Many infection control programs are required to be more efficient in carrying out their tasks. A multidisciplinary approach with collaboration, financial, and expert assistance is necessary to decrease the burden of less resourceful countries. The overview here summarizes common strategies in IPC for preventing HAI and their recommendations.

With the enhancement of allogeneic blood transfusion as well as organ transplantation, the power of antibiotics, immunosuppressive drugs, chemotherapy, and prolonged catheterization, implantations, and many other innovations, HAI is a sizable part of infectious disease burdens in developed countries. Among them, MDRO increasingly emerges with the capability of multi-drug resistance and community-acquired infections. Emerging infectious diseases, such as SARS-CoV-2, are put on alert. In developing and less resourceful countries, many important diseases related to unhygienic practices in personal living conditions or in environmental hygiene still present considerable burdens in all age groups. These diseases include schistosomiasis, dengue fever, cholera, tuberculosis, HIV, and many more (Ashraf et al., 2019).

In addition, pandemic and emerging infectious diseases display a special threat in this globally interconnected society. Therefore, to maintain national health as well as global health, the capability in IPC is essential for each country to possess. However, today's world, specifically the colonized world, hosts great disparities in control of infectious diseases and IPC. Under-resourced countries in terms of funding, personnel, knowledge, and technologies are more likely to be challenged by the threats posed by infectious diseases. In some extreme low-income countries, such as Haiti and some African countries, even basic hygiene, sanitation, clean water supplies, and routine vaccination are absent.

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3.2. Economic Implications

The findings suggest that the strategy of cohorting ultra-high-risk residents simultaneously with making hand hygiene stations available on all units is highly cost-effective for preventing acute gastroenteritis given a low background attack rate. Such considerations are essential for scalable and sustainable interventions in resource-limited settings, where human and fiscal resources remain scarce (K. Barker et al., 2020).

Infection prevention efforts in developing countries are often challenging due to economic constraints. Therefore, conducting an analysis of the cost-effectiveness of an intervention is helpful to prioritize resource allocation in order to maximize the efficacy of expenditures. In this review, the costs and effects of interventions presented in the previous chapter will be compared across various settings: high-income settings, middle-income settings and low-income settings. Of other diseases, only Methicillin-resistant Staphylococcus aureus (MRSA) was found to be studied in a low-income setting, namely India. In this study, implementing expanded screening was estimated to lead to approximately 5,710 fewer MRSA infections in a year for the 626-bed facility at an expected cost of US$1,031,000.

The cost-effectiveness for the hospital would thus be US$181 per averted infection which is acceptable for a low-income setting. On the other hand, because no studies for CDI, ESBL, C. auris, CRE and VRE were reported, it is still unclear which strategy would be cost-effective if applied to such a low-income setting. Given that some country has access to even more advanced diagnostic tools, highlighting that variable would be necessary in future studies (Wang et al., 2020).

4. Key Principles of Infection Control

The recognized armamentarium for infection control (IC) in health care facilities consists of the following categories—administrative controls; engineering controls; surveillance; outbreaks; multidrug-resistant organisms; methicillin-resistant Staphylococcus aureus; vancomycin-resistant Enterococcus; norovirus; Candida auris; and clostridium difficile. The key IC strategies and evidence-based protocols are reviewed as they would apply to specific high-prevalence disease states or organisms: 1. Human Immunodeficiency Virus (HIV) Infection; 2. Hepatitis B Virus (HBV) Infections; 3. Hepatitis C Virus (HCV) Infections; 4. Tuberculosis (TB) Disease; 5. Varicella-Zoster Virus (VZV) Infections; 6. Hospital-Acquired Methicillin-Resistant Staphylococcus aureus Bacteremia; 7. Respiratory Syncytial Virus (RSV) Infections; and 8. Outbreak Detection and Response (Branch-Elliman et al., 2015).

Administrative controls are policies and procedures designed to prevent and reduce exposure and transmission of organisms within a health care facility. Health care personnel at all levels (including administration, education, patient care, and maintenance) must maintain a high level of awareness for potential threats to ability identify communicable or pathogenic

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infectious diseases and are responsible for the implementation of controls to limit transmission. Examples of policies and practices include mandating influenza vaccination among all health care personnel; requiring education of health care personnel; and implementing syndromic screening in high-risk areas using isolation and barrier precautions. It should be noted that successful IC is multi-disciplinary with representatives from all levels of health care personnel.

Most regulatory authorities recommend a form of active surveillance of health care personnel. This should include the identification of specific sentinel events likely to initiate a hospital-acquired infection in a susceptible population followed by an observational and educational study of practices. Periodic assessments should be undertaken to ensure quality sustainability and consistency.

4.1. Standard Precautions

Infection Control in any health facilities is a very important duty. Hospitals are the sites of many prevalent diseases. Due to extensive investment, research and development in hospitals, it is believed that the values for the costs for hospital provision are significantly greater than the costs of providing health care, with the implicit assumption that health care provides better health. A large body of evidence suggests that hospitals and other health care facilities enhance the spread of infections.

Standard precautions describe a set of infection prevention measures and work practice controls for all health care workers (HCW). The purpose of these measures is to prevent patient/patient and HCW/patient transmission of pathogens. The measures are divided into two (2) categories: general precautions which should always be performed regardless of the level of risk and additional precautions which should be performed for particular infectious diseases or outbreaks and include airborne, droplet, and contact precautions (Mehta et al., 2014). Among general precautions, hand hygiene is essential, and in certain situations, where the potential for contamination of hands is high, gloves are required. The choice of glove material depends on the situation. Non sterile disposable vinyl gloves should be used for cleaning and handling soiled linen. Non sterile latex gloves comply with the procedure described and when collecting urine, stools or saliva specimens from suspected cases of infectious diseases. Non sterile double-bag disposable polyethylene gloves should be used for handling body fluids and tissues during autopsy procedures in suspected cases of infectious diseases. Non sterile single-use plastic aprons should be used for high-risk cleaning duties and for all procedures where clothing is at risk of blood/body fluid contamination.

Used patient-care equipment soiled with blood, body fluids, secretions, or excretions should be handled carefully to prevent skin and mucous membrane exposures, contamination of clothing and transfer of microorganisms to HCW, other patients or the environment. Ensure

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that reusable equipment is not used for the care of another patient until it has been cleaned and sterilized appropriately. Ensure that single use items and sharps are discarded properly. In addition to standard precautions, the following should be observed in those patients known or suspected to have airborne, contact or droplet infections: Disease-causing microorganisms may be suspended in the air as small particles, aerosols, or dust and remain infective over time and distance. Isolate with negative-pressure ventilation. Respiratory protection must be employed when entering the isolation room. Use the disposable N-95 respirator mask, which fits tightly around the nose and mouth to protect against both large and small droplets. This should be worn by all persons entering the room, including visitors. Isolation is required. Non-critical patient-care equipment should preferably be of single use. Limit transport of the patient. Microorganisms are also transmitted by droplets generated during coughing, sneezing and talking. Isolation is required. Respiratory protection must be employed when entering the isolation room or within 6-10 ft of the patient. Use the disposable N-95 respirator mask, which fits tightly around the nose and mouth to protect against both large and small droplets. Limit transport of the patient. In addition to the standard and transmission-based precautions, there are several strategies focused on prevention of specific nosocomial infections in critically ill patients.

4.2. Transmission-Based Precautions

Infection prevention and control depends on understanding the modes of transmission of a known pathogen. Knowledge of the mode of transmission enables selection of precautions that should be instituted to prevent transmission to other patients and health care personnel. Decision trees for implementing transmission-based precautions have been posted (Ely Tarrac, 2008). When a known or suspected Transmission-based precaution patient is identified, adherence to the universal guidelines must be assessed. This will include evaluation of the health care worker’s knowledge of the mode of transmission and spread of the pathogen, as well as proper use of personal protective equipment, disinfectant, and barriers. These precautions are then instituted and confirmed to reduce further risk of exposure to susceptible patients and health care personnel. When a new or unknown pathogen is identified, the care of the index patient should continue under standard precautions, along with droplet precautions. Information is gathered about the pathogen’s transmission and spread. As the timeline of transmission lengthens, other transmissible diseases of similar concern should be ruled out. Educational measures involving infection control personnel are required to address behavior and policy changes.

Decision Trees: Support for Post-Exposure Management Implementation of appropriate postexposure measures must include information about the infected healthcare worker’s known or suspected disease to help shape the response. Information about the patient’s known or suspected disease is also critical to appropriately diagnose illness in potentially

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exposed patients. Both types of information must be gathered rapidly, and one piece may be more available than the other. A comprehensive and effective approach to post-exposure management was developed that includes members from each of the health care system and public health teams (Branch-Elliman et al., 2015). Understanding the pathogen's mode of transmission is critical to determining if post-exposure management is warranted and what form it should take. An effective post-exposure management program must educate personnel about high-risk behaviors and routes of transmission to help propel adoption of appropriate infection prevention protocols. When errors occur, a nonpunitive approach to education should be adopted immediately to ensure full disclosure and assessment of potential harm.

5. Hand Hygiene Practices

Clean hands are an individual's best protection against harmful germs and prevent the spread of infection and illness. To break the chain of transmission and maximize the potential benefits offered by hand hygiene actions, the World Health Organization recommends hand hygiene actions at five critical times when health-care workers' hands may be contaminated by the direct or indirect care of patients in order to protect patients from health care-associated infection (Mohanty et al., 2020). The goal of this study was to determine the knowledge and perception of hand hygiene among health care workers and other staff of a newly setup teaching hospital, to find out the association between knowledge and perception, to identify the areas of acceptance or concern regarding hand hygiene, and to suggest recommendations including further aspects for evaluating some of the findings. Hand Hygiene is a simple but effective measure for preventing the spread of infection. Keeping hands clean is the most effective way of preventing infection and communicating and spreading diseases.

A total of 260 health care workers and others in a newly established institution participated in the survey using a structured questionnaire. Knowledge and perception regarding important aspects of hand hygiene were recorded. It was found that training and information regarding hand hygiene were lacking in health care workers who should actually be upholding this practice at all times. In most categories, others were already aware of hand hygiene knowledge important in preventing infection from transmitting health care workers to patient and service users, but there were aspects knowledge such as the 5 moments of hand hygiene and the types of soap, which had been the missing knowledge domains. Health care workers at all levels must be educated about the 5 moments of hand hygiene to motivate compliance and make hand hygiene their case study. Information and training regarding the other missing knowledge areas must be provided to complete the first phase of this process.

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5.1. Importance of Hand Hygiene

Infections resident in the body are usually harmless but cause infections in the event of a breakdown of the host's defenses (McLaws, 2015). Disease transmission is more likely to occur when the chain of transmission is intact. The causative agents of infectious disease must be: (i) present in adequate numbers; and (ii) able to pass from one reservoir to a portal of entry in a new host, allowing for the development of the infective process. In order to break the chain of infection, it is necessary to reduce or eliminate any one or more links in the cycle of transmission that will then, in turn, stop infectious disease transmission in the population. Transmission routes available for contagious diseases include: (a) airborne; (b) direct contact; (c) vector-borne; and (d) vehicle-borne. Each controllable route of transmission can be targeted by specific methods, generally called infection control measures.

Hospitals play a key role in health care. They provide treatment and care for the sick, wounded, and dying. Patients entering a hospital may pick up a micro-organism from a visitor or health care worker through direct contact. Micro-organisms may also be airborne, pass from room to room and enter a susceptible host through a mucosal membrane. Such hospital-acquired infections may require aggressive antibiotic treatment and complicate the illness for patients, extending their stay in hospital. Using hand hygiene procedures, hospital staff can remove these micro-organisms from their hands and arms, thus breaking the chain of infection and preventing hospital-acquired infections. Hand hygiene is a behavioral semi-technical activity like driving a car or answering a telephone and is an essential component in the execution of any infection control measure in hospitals. This invention will assist with the compliance assessment of hand hygiene measures by an automatic and continuous collection of a record of each hand hygiene event. It will provide the opportunity of immediate feedback on personal performance and give an early warning of any deterioration in practice. Hand hygiene should be endorsed by the hospital as a high priority and compliance should be lower than or equal to the benchmark after 1 year.

5.2. Effective Handwashing Techniques

Healthcare-associated infections (HAIs) are infections acquired during the course of receiving healthcare treatment for other conditions in a healthcare setting, and they remain a major cause of morbidity and mortality worldwide. They represent a significant burden on health systems and threaten the effectiveness of healthcare treatments by undermining infection control, increasing the costs of care, and raising mortality rates. Hand hygiene compliance is low, and knowledge, gender, attitude, and environmental factors may negatively affect hand hygiene compliance.

Several initiatives have been introduced to encourage this simple practice. The launched "SAVE LIVES: Clean Your Hands" campaign to promote hand hygiene across the globe, the

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campaigns were established to promote hand hygiene using various methods, including pamphlets, posters, and audiovisual aids. Studies show a great variation in hand hygiene compliance among healthcare professionals. Furthermore, there is a lack of adherence to basic hand hygiene practice, which is considered the simplest and most effective intervention to prevent HAIs. Austere conditions in healthcare settings, such as chronic water shortages and lack of handwashing facilities, limit the quality of services and exacerbate HAI-prone conditions. According to reports, poor infection prevention is to blame for the high rates of healthcare-associated infections in developing countries like Ethiopia (Martos Cabrera et al., 2019). This is exacerbated by the lack of water and soap, the use of dirty water, a low level of hygiene awareness, inadequate infection prevention policy, and other organizational factors.

Handwashing plays a pivotal role in infection control and prevention. recommended the Five Moments for Hand Hygiene, i.e., before touching a patient, before a procedure, after a procedure, after touching a patient, and after touching patient surroundings, as crucial for preventing knowable microbes from spreading from the healthcare worker's hands to patients, and vice versa. Numerous studies have demonstrated that washing hands of healthcare workers (HCWs) with soap and water reduces MV transmission by 28%-50%. Compliance with handwashing should be measured during care delivery (Gebremeskel Kanno et al., 2022). Hand hygiene compliance among HCWs can be measured by direct observation, which is the gold standard, and/or by indirect methods using automated monitoring systems, either using RFID technology or using video recordings.

6. Use of Personal Protective Equipment (PPE)

Personal protective equipment (PPE) is specifically designed to protect the wearer from exposure to hazards. There is a wide spectrum of diseases, viruses, and concerns regarding safety and health within healthcare facilities. With recent disease outbreaks, reducing healthcare worker (HCW) risk while ensuring patient safety is of utmost importance. Audits of PPE use should be conducted to gauge HCW compliance and aid in identifying areas of practice in need of improvement and education (Mitchell et al., 2013).

An observational study was designed to assess the use of PPE during routine patient care activities by HCWs caring for patients with an identified focus of respiratory infection (FRI) before and after the implementation of body substance precautions in three acute care facilities. After originally piloting the study at one site, audits were conducted at each site before and after a change in engineering controls. Each site conducted 20 audits during both time periods, for a total of 120 audits. A structured coding form that captured demographic data, type of body substance precaution personal protective equipment worn, personal protective equipment selection prior to entry, specific duty, and order of personal protective equipment removal was used. Data were analyzed using descriptive statistics including percentages, frequencies, and means.

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Overall, PPE compliance was noted as low among HCWs when patients were on FRI precautions, with there being a 9% increase in compliance following the switch to engineering controls. Additionally, examination into the order of PPE removal demonstrated that 52% of HCWs did not follow the correct removal order. HCWs exposed to respiratory droplet precautions frequently did not wear eye protection when caring for FRI patients. Working in a pediatric unit was associated with not wearing PPE when entering the room of an FRI patient.

Transmissible diseases pose a unique challenge to all health care facilities. The challenges that arise are unique to the facility, the prevalent diseases in the geography, the population served in the facility, and the level of care provided. Furthermore, this article examined implementation strategies that shall be used to minimize transmission, including surveillance, engineering controls, policy and protocols, and ubiquitous components for implementation in any facility. Given the potential of increased virulence and transcontinental travel enabled by modern society, infection control should be an area of priority and financial investment for all health care facilities internationally.

6.1. Types of PPE

Personal Protective Equipment (PPE) is designed to protect clinical and ancillary health care workers during procedures that carry risk of exposure to bodily fluids, airborne viruses, or both. Risks arise from use of machines and equipment, insect- and animal-borne infection, and taking care of patients with a risk of exposure. PPE has helped to reduce the risk of exposure through droplet, contact, and airborne means but is not a substitute for good practice and proper procedures. PPE protects healthcare workers from exposure to terrestrial and airborne viruses, bacteria, fungi, spores, cells, tissue, and prokaryotic proteins during daily activities (Poller et al., 2018). Surgical masks protect against droplets but not aerosolized particles sized 20 mm. N95 or higher masks filtration efficiency limits aerosolized particles to 300 mm for respiratory protection. Extended PPE may not be readily available, especially masks. Some healthcare workers have received training in extended PPE but actual use has been observed to be low (Mitchell et al., 2013).

PPE used during prior viral outbreaks, lessons learned, and recommendations for the current pandemic have been disseminated. In the past there was a lack of proper PPE such as CE marked surgical masks. This remains a serious public health concern currently. There can be inadequate P3 masks, gowns, and safety glasses, especially in developing countries hanging on to lessons learned during the past outbreaks. Failure to wear or use PPE properly can also arise from discomfort or the need for knowledge on proper donning and doffing. Other reasons can include unreasonable price, accessibility, type and size. Lack of ergonomic designs masks for easy on and off is another issue faced in developing countries. There has been emergence of studies on the ergonomics of fitted N95 masks. There are complaints of

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difficulty in hearing interference with voice communication with N95 masks and must maintain two meters distance after doffing. Wireless neck band headsets for communication have been proposed.

6.2. Proper Usage and Disposal

The proper usage and disposal of waste is essential to infection control and prevention. Hospital waste disposal is defined as the appropriate disposal of waste generated by healthcare facilities (Mehta et al., 2014). Effective waste disposal keeps the environment clean and the populace free from disease. Several unskilled laborers are directly involved in waste management and they continue to be high-risk areas as pathogens are resistant and able to survive for different time periods depending on environmental factors. The contact of these infectious agents with the susceptible host or environment can lead to colonization, infection, or disease. Health care professionals need to set operational standards for color-coded waste management in their hospitals. The color code should be intermittently audited for its compliance in the wards to reduce cross-contamination, inappropriate recycling, and post-disposal contamination.

Correct use of personal protective equipment is an important strategy to contain hospital-acquired infection. The use of equipment, like masks, eye-guards, face shields, gowns, gloves, and shoe covers, greatly reduces the treatment-related HIV infection risk. Most of the staff studied believed that black bags were used to dispose of sharp waste while the general waste was disposed of in yellow bags. Such disposal systems were non-compliant with guidelines. The hospital needs a training program to enhance hospital waste disposal management. The imaging department should also manage the disposal of irrigator tip waste and check the health status of concerned staff like radiographers. Hospitals can collect feedback from staff using a structured computer-based questionnaire for assessment and training on waste management and disposal.

7. Environmental Cleaning and Disinfection

Environmental cleaning and disinfection play a crucial role in preventing healthcare-associated infections (HAIs). The most efficacious cleaning strategies involve high frequency, adequate staffing, and the use of specific cleaning products. The "multimodal" approach, where organizational, behavioral, and video monitoring components are implemented, is the most well-supported strategy in the literature. Educational components around product use can also improve cleaning frequency and efficacy. For HAIs that are not addressed by these strategies, automated cleaning devices and the use of isolation methods and additional disinfectant are options that can further reduce disease transmission (Browne & G Mitchell, 2023).

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Cleaning and disinfection (C&D) of surfaces are crucial strategies to prevent and control healthcare-associated infections (HCAIs). Environmental surfaces are frequently contaminated by pathogens during routine clinical care, which can then be transmitted to patients through direct or indirect contact. Environmental contamination was also highlighted as a factor contributing to the global threat posed by high burden antibiotic resistant (ABR) Gram-negative bacteria (GNB). Although manual C&D can be effective in reducing environmental contamination, a combination of factors (i.e. understanding, human behavior and workload, availability and contamination of the cleaning supplies) can lead to poorly cleaned or disinfected surfaces. There are also concerns related to the C&D products used (acute toxicity, chronic skin jurisdiction, fumes), surface contact times and concurrent patient activity. Finally, even when physically cleaned and disinfected, surfaces can be re-contaminated by staff or equipment, or through the movement of patients or visitors within a facility. For these reasons, there is a need to develop multimodal interventions that provide comprehensive solutions to the barriers and product limitations pertaining to the C&D of surfaces. Successful interventions can then be adapted and implemented in different clinical settings, across state jurisdictions, and internationally.

15. Future Directions in Infection Control

The unprecedented scope of the pandemic propelled infection prevention and control to the forefront of hospitals and clinics. The cooperation and collaboration of infection preventionists, hospital and clinic executives, employees, and volunteers was unmatched in the history of infection prevention. However, emergency departments (EDs) experienced the most unanticipated and widespread challenges. The unprecedented high patient volume, unprecedented low provider staffing, missed infections in excitement and anxiety, and inadequately isolated individuals led to preventable ED-cluster outbreaks that spread community-wide on several occasions. The year 2020 marked the greatest and gravest test of infection control in modernity (Y. Liang et al., 2018). It demonstrated the need for further research on protecting frontline ED staff and preventing infectious disease outbreaks in communities.

Health care epidemiologists have for a long time promoted measures that successfully reduced infections and transmission of infecting agents in EDs. They have built evidence that adequately protecting EDs also protects the whole hospital, and indeed the community. Health care epidemiologists have furthered implementation science that effectively expands patient safety in EDs. Incorporating better innovations with pandemic modeling to predict abnormal patient volume in future emergencies may avert disasters. While the time from emergence of infection to a sustainable and effective vaccine is unknown, research on new diagnosis tools and sustainable means for community-level and hospital-level containment of infectious agents is critical (Branch-Elliman et al., 2015). With expectations that a costly

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infectious disease never be neglected again, modern and innovative delivery modes embrace hospitals and clubs economies, and fast and advanced tests for national security are possible.

16. Conclusion

In an environment with a high-risk scenario, such as an intensive care unit with patients afflicted with COVID-19 or an outbreak caused by a highly infectious pathogen, it seems improbable that a hospital would be able to admit another patient, especially a COVID-19 patient who would be initially placed in quarantine. However, it can become necessary due to a surge of cases or the opening of a new quarantine facility to prevent overflowing. Thus, a hospital management response must be put in place. This situation arose at UPMC Presbyterian Hospital in Pittsburgh, Pennsylvania, in April 2021, when the alpha variant of SARS-CoV-2 was dominant in the area, and it was necessary to open a new COVID-19 ICU in the adjacent cardiothoracic surgery (CTS) select unit. The ICU had its own nursing staff, and the location had been prepared as a cohort unit. However, parking an incomplete HVAC unit outside during construction raised concerns from the infection prevention department (Eckardt et al., 2022).

With the initial planning of cohorting patients on April 1, 2021, teaching and preparation began to cohort wave 3 patients previously unstudied. This process aimed to identify any knowledge gaps in clinical practice and develop a teaching plan based on them. There was concern about opening a new COVID-19 unit with staff unfamiliar with handling COVID-19 patients. A transition team, along with the first and second shifts, comprised nurses and clinical nurse specialists who were already treating patients with COVID-19 or cohorted patients. The teaching team planned an extensive teaching shift, with each cohort unit having an ICU nurse with simple teaching materials prepared for each normal ICU patient-generated activity. A robust pedometer-based system was also developed. In addition to standard bedside report, a report sheet format and an easy-to-use app were created.

The biggest concern about managing the COVID-19 select unit for nursing staff was the process of donning off PPE and cleaning equipment after patient care. This concern was highlighted by watching supervisors go through rapid cleaning processes under time constraints and PAPR reuse processes. Daily drills were initiated to address this apprehension, and it was assumed that incompetency in PPE or self-infection anxiety would cause severe anxiety. The first two drills served as practice rounds. The relatively high turnover of international and new-to-term staff in the cod unit was a notable barrier, along with a lack of team coordination that complicated communication. Language barriers were addressed with translation applications, and international staff were welcomed to relay their needs (Ashraf et al., 2019).

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