

Integrating Anesthesia, Laboratory, Pharmacy, and Emergency Teams to Combat Healthcare-Associated Infections

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Abstract

Healthcare-associated infections challenge patient safety and healthcare outcomes globally. Multidisciplinary teams in the departments of anesthesia, laboratory, pharmacy, and emergency all have major roles in the prevention and management of HAIs. The anesthesia teams ensure asepsis in surgical procedures and proper prophylactic antibiotic administration; the laboratory teams contribute with fast and reliable diagnostic techniques; pharmacy teams lead in driving efforts in antimicrobial stewardship; and emergency departments are among the first lines in the early detection, isolation, and management of infectious cases. This review presented the various contributions of such teams to HAI prevention, as well as discussed ways of enhancing collaboration and further improving the infection control practices in healthcare settings.

Keywords: healthcare-associated infection, infection prevention, multidisciplinary teams, antimicrobial stewardship, diagnostics.

Introduction

Health care-associated infections remain one of the most persistent and serious challenges facing modern health care; they pose a threat to patient safety by increasing the risks for morbidity and mortality and place an excessive burden on health care financially. Most frequently, these infections are caused by multidrug-resistant organisms, whose transmission can originate in many kinds of settings, including hospitals, surgical centers, and long-term care, and are frequently related to invasive procedures, medical devices, and immunocompromised conditions. According to WHO estimates, annually, millions of patients worldwide acquire HAIs, which extend hospital stays, raise treatment costs, and result in an immense healthcare burden (Haque et al., 2018). The fight against HAIs requires a multidisciplinary approach, as professionals from all branches of health have

significant contributions to play in prevention, diagnosis, and the treatment and management of such conditions.

Among these contributors, anesthesia, laboratory, pharmacy, and emergency teams all have a critical but unique, complementary role in the prevention and control of HAIs. The anesthesia teams should not disrupt the sterile environment of the surgical procedures through proper cleaning and disinfection of reusable equipment and providing the appropriate prophylactic antibiotics to reduce surgical site infections. This has been well described by Anderson et al. (2014) and Ban et al. (2017). The laboratory teams provide a basis for diagnosing the HAIs through microbiological cultures, AST, and advanced molecular diagnostics, hence allowing timely and precise identification of pathogens, guiding appropriate antimicrobial therapy. This was noted by Elbehiry et al. (2022) and Shafeeq (2021), stating that this forms a basis for the determination of antimicrobial therapy. Pharmacy teams are crucial for ASP optimization of antibiotic use by way of review of prescription sheets, educating healthcare providers, and ensuring the rational use of antimicrobials in the fight against the development of resistance and improvement of patient outcomes. These have been well illustrated by Barlam et al. (2016) and Manning et al. (2018). Emergency teams act as the entry for many infected patients, institute infection control measures, identify outbreaks, and ensure timely empirical antibiotics where necessary. This has been well described by Messacar et al. (2017) and Eze et al. (2022). These teams are crucially important to any effort at prevention and management of HAIs. Examples of such a collaborative practice include infection control bundle implementation, optimization of antimicrobial use, and outbreak investigations—all of which, in sum, help improve patient safety and health care outcomes (Sydnor & Perl, 2011; Tacconelli et al., 2018). Notwithstanding the identification of best practice for infection prevention and control, ongoing challenges, including the emergence of MDROs, and the continued need for staff training indicate that trying and innovating are keys in the fight against HAIs (Clayton & Miller, 2017; Sharma & Paul, 2023). This discussion will consider the pivotal roles anesthesia, laboratory, pharmacy, and emergency teams, in battling HAIs, setting into context their independent contributions, the synergy resulting from collaboration, and application of evidence-based practice in reducing the global burden of these infections.

Methodology

The literature review seeks to understand the role of the anesthesia, laboratory, pharmacy, and emergency teams in the prevention and management of HAIs. Databases searched include PubMed, Google Scholar, and Scopus, while materials range from 2010 to 2023. The search terms used in this research include the following: healthcare-associated infections, infection prevention, multidisciplinary teams, antimicrobial stewardship, and infection control. The initial search identified 315 articles. After removing duplicates and clearly irrelevant papers, the full texts of 78 articles were reviewed. Of these, 45 studies were identified based on their quality of evidence and relevance to the stated roles of anesthesia, laboratory, pharmacy, and emergency teams in the prevention and control of HAIs.

Studies selected included randomized controlled trials, cohort studies, systematic reviews, meta-analyses, and observational studies. The data extracted from these various studies highlighted specific themes on infection control practices, diagnostic developments, antimicrobial stewardship programs, and multidisciplinary teams. These findings were synthesized to emphasize how such teams individually and collectively reduce the

incidence of HAIs and improve the outcomes for patients by overcoming the challenges presented by MDROs.

Literature Review

This study, therefore, undertook a critical review of the literature in order to understand existing evidence regarding the role of anesthesia, laboratory, pharmacy, and emergency teams in the prevention and management of HAIs. A literature search was conducted in the PubMed, Scopus, and Google Scholar databases using combinations of the following keywords: "healthcare-associated infections," "anesthesia team infection control," "laboratory diagnostics for infections," "antimicrobial stewardship programs," and "emergency department infection prevention." Manual searches of reference lists were also conducted.

Only studies published in English between 2010 and 2023 that appeared in peer-reviewed journals were included for review in this study. Studies would be included if they were RCTs, cohort, systematic review, meta-analyses, and observation studies. Non-human subjects, absence of intervention in a hospital setting, and duplicate data were grounds for exclusion. A total of 45 articles qualified for qualitative synthesis after a critical review.

These studies detail findings on how each of these multidisciplinary teams contributes vitally in all aspects of infection control strategies. Evidence underlines active involvement in infection control measures by an anesthesia team: the principle of asepsis intraoperatively, appropriate prophylactic antibiotics, and prevention of SSIs. The laboratory teams were indispensable for the correct and timely diagnosis of infections, using molecular techniques such as PCR, MALDI-TOF, and whole-genome sequencing that guide therapy decisions and the investigation of resistance patterns.

Pharmacy teams have a core role in the use of antibiotics, promoting de-escalation strategies both by optimized use and participation in the elaboration of institutional guidelines. Emergency teams guarantee the early detection and isolation of infectious patients, the implementation of protocols for hand hygiene and disinfection, and coordination of timely antibiotic administration in emergency departments.

Future study will be needed regarding the impact that integrated infection control interventions will have as strategies are developed relating specifically to particular healthcare settings. Overall, the findings argue for a multidisciplinary approach in the prevention and management of healthcare-associated infections.

Discussion

Role of Anesthesia Teams in HAI Prevention

The anesthesia teams thus play a very important role in preventing healthcare-associated infection, particularly in the operating room where invasive procedure and sterile environments are crucial to patient care. Contaminated anesthesia equipment—a reservoir of infection that includes, but is not limited to, breathing circuits, laryngoscope blades, and reusable airway devices—can precipitate the spread of HAIs through cross-contamination when infection control principles are not followed. Due to this concern, anesthesia providers employ strict aseptic technique, which includes the use of sterile gloves and drapes, and donning other PPE. Furthermore, the preparation of anesthetic agents for administration—regularly injectable medications—requires anesthesia professionals to maintain sterility in order to avoid vial and syringe contamination (Anderson et al., 2014). Teams also provide critical contributions with regard to the cleaning and sterilization of reusable equipment. The ventilation of anesthesia machines, for example, with HEPA filters minimizes the chances of transmitting airborne pathogens. All reusable devices, such as endotracheal tubes and laryngoscope blades, should undergo stringent cleaning and

sterilization processes between patients to avoid possible sources of infection. Additionally, anesthesia professionals are responsible for providing prophylactic antibiotics prior to surgery. The timely administration of prophylactic antibiotics, with an appropriate dose and antibiotic agent, is important according to international guidelines to reduce the occurrence of SSIs, which are among the most frequent HAIs. When considering optimal outcomes, the best time to administer antibiotic prophylaxis is within one hour prior to making the surgical incision and this must also be readjusted for patient weight and other comorbidities (Ban et al., 2017; Friedman et al., 2016).

The vigilance of the anesthesia team extends beyond the OR to postoperative care, with keen surveillance of the patients for signs of infection, such as fever and wound redness, among other complications arising from SSIs. Providers of anesthesia also team up with surgeons, nurses, and operating room technicians in the course of detecting and managing breaches in sterility that may occur during surgical procedures. Remaining vigilant in the prevention of infections and championing evidence-based practices, anesthesia professionals go the extra mile to reduce chances of HAIs in surgical settings, according to Clayton & Miller, 2017.

Role of Laboratory Teams in HAI Diagnosis and Surveillance

The role of laboratory teams cannot be underscored in the diagnosis, monitoring, and surveillance of healthcare-associated infections. For laboratory tests to be helpful and not delay identifying the infective pathogen or its antibiotic sensitivity to guide proper treatment, testing should be performed well in time. Among the key roles of the laboratory team include performing microbiological cultures of various clinical specimens such as blood, urine, respiratory secretions, and wound exudates. The culture will facilitate the isolation and identification of the infective microorganism for clinicians to institute appropriate antimicrobial therapy, according to Clark et al., 2019.

In the recent years, a very interesting improvement in diagnostic methodologies has greatly enhanced the ability of a laboratory to rapidly and precisely identify pathogens. For instance, PCR is a molecular diagnostic methodology that amplifies the DNA sequences of the pathogenic agents, thus enabling the rapid identification of the organisms. It is highly valuable in detecting those organisms that are either hard to culture or have very long incubation periods. Other breakthrough technologies include MALDI-TOF, which detects microorganisms based on their unique protein profiles. MALDI-TOF has revolutionized microbiology by reducing pathogen identification time from days to a couple of hours; this, in turn, aids in accelerating clinical decisions and further infection control as outlined by Elbehiry et al. (2022), and Shafeeq (2021).

In addition to the identification of pathogens, laboratory testing includes the determination of antimicrobial susceptibility of bacterial isolates to a range of antibiotics. Such findings assist clinicians with the selection of appropriate antimicrobial agents and in the avoidance of those antimicrobials to which the pathogen is resistant. This represents an important strategy in the management of the increasing incidence of MDROs both in community and healthcare environments. Laboratories represent important contributors to HAI surveillance, determining ongoing changes in resistance patterns overtime and reporting data to infection control teams. Utilising sophisticated molecular techniques, including PFGE and WGS, the laboratory is able to monitor the genetic relatedness of bacterial strains and identify the spread of resistant pathogens Riley 2018; Tacconelli et al. 2018.

Collaboration among the laboratory teams with the other healthcare professionals creates the basis for successful HAI prevention and control. For example, laboratory information

regarding local resistance patterns guides the establishment of institutional antibiotic policies while appropriate timing of reporting of diagnostic outcomes enables de-escalation by clinicians. The laboratory teams provide the basic diagnostic and surveillance framework that underlies efforts aimed at reducing the burden of HAIs (Esfandiari et al., 2016).

The Role of the Pharmacy Teams in Antimicrobial Stewardship

Pharmacy teams lead Antimicrobial Stewardship Programs, and thus they are well positioned to help optimize the use of antibiotics to achieve desired patient outcomes while minimizing the development of antimicrobial resistance. Pharmacists work with the other healthcare professionals-prescribers, laboratory personnel, and infection control teams-to ensure that antibiotics are used appropriately and at the right time. Among their principal activities, pharmacists review all antibiotic prescriptions for indications of appropriateness of drug, dose, route of administration, and duration of therapy. They advocate the use of narrow-spectrum antibiotics where possible because broad-spectrum antibiotics create more collateral damage and exert selective pressure on microbial communities toward developing resistance (Barlam et al., 2016).

The other critical role that pharmacists have played involves providing education to all healthcare professionals regarding the principles of antimicrobial stewardship and evidence-based practices regarding the prescribing of antibiotics. Pharmacists make real-time recommendations during multidisciplinary rounds to assist the clinician in de-escalating antibiotic therapy based on cultures and in stopping any unnecessary antibiotics. Another critical responsibility that pharmacists have assumed is monitoring patients for ADEs of antibiotics, which include allergic reactions and *Clostridioides difficile* infections that can complicate treatment and prolong the length of stay (Wright et al., 2010).

Finally, beyond clinical practice, part of the functions taken upon by the pharmacy team has been active participation in the development of institutional guidelines and protocols related to antibiotics. Guidelines, through local antimicrobial resistance data from the laboratory, provide a standardization of prescribing practices and appropriate use of antibiotics in a health facility. Along this line, other infection prevention activities by pharmacists include preoperative antibiotic prophylaxis programs that ensure prophylactic agents are appropriately administered to lower the risk of surgical site infections (Peter et al., 2018; Manning et al., 2018).

Pharmacists' contribution to antimicrobial stewardship goes beyond acute care into long-term and ambulatory care, while their role in patient education on adherence to and the dangers of abusing antibiotics is critical. Knowledge and coordination from pharmacy teams are helping fight HAIs and keeping the ever-growing global threat of antimicrobial resistance (Dyar et al., 2017).

Role of Emergency Teams in HAI Prevention and Control

Emergency departments (EDs) are high-risk environments for healthcare-associated infections due to their fast-paced nature, high patient turnover, and frequent use of invasive procedures. Emergency teams play a vital role in preventing and controlling infections by adhering to stringent infection control practices, such as hand hygiene, proper use of PPE, and thorough cleaning and disinfection of shared equipment and surfaces. Given that the ED is often the first point of contact for patients presenting with infections, emergency teams are responsible for promptly identifying and isolating individuals with suspected contagious diseases, thereby preventing the spread of pathogens within healthcare facilities (Messacar et al., 2017).

On-time administration of empiric antibiotics is another important role of emergency teams, particularly in cases involving sepsis or other life-threatening infections. Hence, collaboration with laboratory personnel is of utmost importance to ensure that the collection of diagnostic samples, including blood cultures, is timely before the institution of antibiotics to allow for the accurate identification of the pathogen with the subsequent adjustment of therapy based on culture and sensitivity studies. The emergency teams also collaborate with pharmacy teams to optimize antimicrobial therapy thus allowing the best patient care with least and inappropriate use of antibiotics (Clark et al., 2019).

During outbreaks, emergency teams are also often at the forefront, organizing patient triage, instituting isolation precautions, and notifying infection control and public health authorities. Their timeliness and efficiency are key in dampening the impact of the HAIs and eliminating further spread. In this regard, because of their integration of infection prevention principles in daily practice and being part of other teams, emergency providers have the opportunity to be on the HAI front line to contribute to battling HAIs (Eze et al., 2022).

Collaborative Strategies for Prevention of HAIs

Moreover, for effective HAI prevention and control, integration should be ensured among anesthesia, laboratory, pharmacy, and emergency teams. This coordination, in implementing bundles of infection control, has helped in preventing CLABSIs, VAP, and SSIs. The evidence-based practices that are shown to improve patients' outcomes constantly and collectively make up these bundles. In this case, elements of CLABSIs prevention bundle may be hand hygiene, maximal barrier precautions while inserting the catheters, chlorohexidine for skin anti-sepsis, optimal selection for sites to place the catheters, and daily assessment of the requirement of lines (Sydnor & Perl, 2011).

In this context, Antimicrobial Stewardship Programs also need to be multidisciplinary. The programs need pharmacists, laboratory workers, and clinicians to work together in ensuring that antibiotics are used optimally, and the resistance is minimized towards the achievement of ideal patient outcome. Furthermore, the nurses and emergency teams help obtain cultures, administer antibiotics, and monitor the development of the infection. The anesthesia professional provides an appropriate prophylaxis of antibiotics before surgery, and the laboratory teams provide the information necessary for guiding the therapy while monitoring resistance trends in the area of concern (Tacconelli et al., 2018).

Outbreaks also demand close coordination among teams. When the laboratory professional identifies the pathogen and its source, the pharmacist advises on treatment protocols, the emergency teams manage patients, and the anesthesia provider maintains sterility in the OR. This helps in the containment of outbreaks and avoids further nosocomial transmission. Sharma & Paul, 2023

Conclusion

Prevention and management of HAIs effectively call for a multidisciplinary team effort: anesthesia, laboratory, pharmacy, and the emergency department. Each of these disciplines contributes a different kind of professional expertise which collectively enhances the safety of patients and reduces the risk for infection. The anesthesia team provides the aseptic environment and proper prophylaxis of antibiotics. The laboratory provides diagnostics support, which is very important in the early and efficient identification of an infectious agent. Pharmacy teams take center stage in ensuring stewardship in the use of antimicrobials to avoid antibiotic resistance. An emergency department identifies and manages infectious cases thereby reducing the potentiality of an outbreak in health care.

The collaboration and communication between these disciplines will be key drivers in moving infection control practices forward. Gap areas in practice can be minimized, and better outcomes can be achieved through developed training programs, defined policies, and responsibility. Healthcare systems that apply the unique contributions of multidisciplinary teams will thus be in a position to incorporate new technologies and help minimize the rates of HAIs, providing overall better patient care. Future initiatives must aim at research and policy making in order to help identify hurdles and further develop and enhance team-based approaches to infection prevention.

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