



Developing Pediatric Pulmonology Infection Control Guidelines: A Quality Improvement Project

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Abstract

Research shows that infection prevention and control measures aim to protect patients and families seen in the healthcare setting. The main goal of this project was to develop comprehensive infection control guidelines based on a systematic review of published literature for infection control guidelines or recommendations for pediatric pulmonology patients. The Division of Pediatric Pulmonology at a Midwestern Hospital does not have infection control guidelines for the division. More specific research should be conducted regarding infection control protocol for pediatric pulmonology patients. However, there is an ample body of literature containing recommendations for patients with cystic fibrosis, children who have tracheostomies, and other high-risk pediatric populations. This literature was analyzed along with other related studies involving infection control practices in inpatient and outpatient settings. Comprehensive infection control guidelines were developed, approved, and implemented in a pediatric pulmonary clinic at a Midwestern Hospital.

Keywords: Pediatric Pulmonology; Infection Control; Guidelines

Introduction

Infection control practices are a part of all healthcare systems. "Infection prevention and control measures aim to ensure the protection of those who might be vulnerable to acquiring infection both in the general community and while receiving care due to health problems" [32]. Infection control measures are designed to protect both the patient and the healthcare worker. The introduction of infection control guidelines and procedures has been proven to reduce the acquisition of nosocomial infections and can reduce healthcare costs. There is a concept of opportunity cost that can be used to add quantitative value to infection control practices-reducing the length of stay, reducing treatment burden, and increasing patient satisfaction [11].

Background and Significance

Historically, the nursing profession plays a crucial role in infection prevention and the health and well-being of the patient. The nursing profession is based on sound, safe, and evidence-based care. Infection control is necessary to help keep the patient safe and to promote an environment of healing. Many chronically ill and medically complex children are at greater risk for infection as these children tend to frequent medical clinics and hospitals more than their peers. Working in a pediatric pulmonary practice

brings different patient types to the office, from generally healthy to chronically ill to critically ill. With that in mind, it is essential to have infection control guidelines that protect the most vulnerable and at-risk patients, and nursing plays an invaluable role in the development and execution of the guidelines.

More specific research should be conducted regarding infection control protocol for pediatric pulmonology patients. However, there is an ample body of literature containing recommendations for patients with cystic fibrosis, children who have tracheostomies, and other high-risk pediatric populations. This literature was analyzed along with other related studies involving infection control practices in inpatient and outpatient settings.

Problem statement

The main goal of this project was to develop comprehensive infection control guidelines based on the results of a systematic review of published literature for infection control guidelines or recommendations for pediatric pulmonology patients. The Division of Pediatric Pulmonology at a Midwestern Hospital does not have infection control guidelines for the division. The division primarily sees pulmonology patients ages 0-18; however, there is an adult cystic fibrosis center located in the pediatric pulmonology clinic

that sees adults 18-76 years old. The clinic sees children diagnosed with chronic cough, abnormal breath sounds, congenital lung diseases, recurrent respiratory infections, empyema, asthma, allergic bronchopulmonary aspergillosis, lung nodules, cystic fibrosis, multi-system genetic conditions, tracheostomy-ventilated patients, and many more complex diseases. Given the complexity of the patient population seen in the pulmonary clinics, there is a concern about possible person-to-person transmission of infection. Therefore, a review of current literature and best practices was needed to develop overarching infection control guidelines to reduce and/or prevent the spread of infection to these pediatric patients.

Clinical question

The PICO question is: In a pediatric pulmonology clinic (P), can a systematic review of literature of infection control practices (I) be used to develop comprehensive infection control guidelines (Co)?

Systematic Review of Literature

A systematic review of published literature utilized the following search terms: pediatric infection control, pediatric pulmonology isolation, pediatric pulmonology infection control, cystic fibrosis infection control, intensive care unit infection control, and chronic illness infection control. A total of 6,793,200 articles were retrieved with the first search. It became evident that more specific search terms needed to be utilized. The search term 'guidelines' was added to all search terms. Any reference to antibiotics, therapeutic and invasive intervention, and African, Asian, and Australian-based studies were removed, along with all articles published before 1992. Adjusting the search parameters narrowed the search to just 102 articles, with 20 articles being used for the project. Because there are limited publications specific to the pediatric population, 1992 became the threshold for literature review instead of the traditional review of publications in the previous five years.

Critique of evidence

A strength of all studies was the focus on patient outcomes and the practical use of infection control in inpatient and outpatient patient care areas. Strengths of the systematic reviews include the volume and variety of research, including detailed literature analysis and practical applications for further research [7], [20]. Some of the limitations of the systematic reviews were that some studies did not include the whole body of evidence [7], [20]. None of the studies discussed minority, low-income, or rural patients [7], [20], so it is unclear if these populations were included in the research. This is important information to know when assessing at-risk populations for pathogen exposure and treatment. Authors of

both systematic reviews of the literature [7], [20] discussed that infection control is difficult to analyze due to the extraneous factors that may lead to the acquisition or eradication of a pathogen; the authors also recommended that more well-designed research is needed but may be difficult to complete.

Diekema and Edmond [9] provided guidelines that used a scaffolding approach for improving infection control measures and surveillance in the hospital setting. The approach was presented in an easy-to-understand manner that is consistent with the goal of improving infection control practices. However, a limitation of the study was that there was no mention of how to pay for the additional recommended surveillance cultures. These cultures are expensive and can add significant cost to the patient and the health-care facility.

Saiman., *et al.* [26] provided clearly written infection control practices for all cystic fibrosis centers nationally accredited by the Cystic Fibrosis Foundation; the recommendations from these guidelines must be included in all infection control policies.

Griffiths., *et al.* [12] showed a 7% decrease in epidemic strain prevalence after implementing strict infection control guidelines. The change in prevalence was statistically significant, with a $p = 0.004$, indicating the benefit of implementing infection control guidelines. The authors did not discuss any extraneous factors that may have also led to the reduction of pathogen prevalence. For example, more information about cohorting or decreased patient-to-patient exposure would have been appreciated.

Macartney., *et al.* [14] showed a cost savings of \$1563 per prevented nosocomial infection. This study emphasized that infection control interventions can be both easy and cost-effective. While there was an initial increase in cost due to testing for RSV, the cost savings outweighed the final cost of expenditure.

The retrospective audit completed by McCaleb., *et al.* [18] provided insight into the microbiology of children with long-term tracheostomies. While this is great information to have, the study only followed children in Arkansas at one institution. There may be variability in microbiology depending on the location of the patient. Also, the authors recognized that there was early acquisition of organisms but did not provide guidance on how to prevent or delay the acquisition of these aggressive bacteria.

Marra., *et al.* [16] showed how changes in infection control practice could lead to a significant decline in ventilator-acquired

pneumonia. One limitation to note is that this process was both time and resource-consuming. It also may not be possible in larger intensive care units, given the individualized focus on detail during the implementation phases.

A major limitation of the controlled trial completed by Marra, *et al.* [17] was that it was fairly obvious in the control group that hand hygiene observations were taking place. In theory, this should have increased the number of people completing hand hygiene, which would have made it difficult to assess whether the independent variable has any true clinical significance. Instead of highlighting this issue, the authors concluded that the intervention had no significant effect on compliance.

The research completed by Stelfox, *et al.* [30] was interesting because there are few studies completed that look at the negative aspects of isolation practices. The researchers highlighted that patient care and satisfaction tend to be negatively impacted when isolation practices are implemented. This is important information to keep in mind during the development of new infection control guidelines. A limitation of the study was that the authors did not provide recommendations or guidance on how to improve this identified issue.

The research completed by Roberts, *et al.* [25] was significant as it was a well-designed study that showed that simple infection control techniques, such as handwashing, can have a statistically significant impact on the reduction of transmitted respiratory illnesses. The authors also noted that it is more difficult to prevent the transmission of illnesses in older children as they tend to share germs more frequently than younger children (share cups, silverware, toys in their mouths, etc.). The authors suggested that future research could look at the use of teaching infection control interventions with older children and see if there is a reduction of transmitted infections in this population.

The limitations of the survey completed by Zhou, *et al.* [33] were fairly significant. As mentioned in the synthesis of evidence, the study was limited because there were factors that could not be assessed through a simple survey. For example, the request for a written policy by centers does not mean that the policy is being utilized, that the policy is working, or provides any other performance standards of that specific center.

The study completed by Montecalvo, *et al.* [19] was a well-designed prospective cohort study that was completed to determine

if infection control practices could be used to reduce the transmission of vancomycin-resistant enterococci. This was a large study with 443 participants, which allowed the researchers the opportunity to thoroughly test if enhanced infection control measures provided benefit to the patient. One limitation that will need further exploration would be to assess how sustainable these interventions will be over time.

Cohen, *et al.* [6] assessed the quantity and quality of care received by pediatric patients that were in isolation or not in isolation during admission. There were several limitations to this study. First, the size of the sample does not provide the necessary power to detect small changes in time. Also, the observations were only made during morning rounds, so there is a possibility that care throughout the day was different. Finally, the data for the study was only collected during the first 48 hours of a patient's admission.

The 12-year surveillance study completed by Piza, *et al.* [23] was a well-designed approach to monitoring the effects of infection control precautions on ICU patients. There was a large patient population that was included in the survey, and the impact of infection control was considered statistically significant ($p = <.05$). One limitation was a need for follow-up studies as there are many factors associated with non-compliance to infection control; however, none of those factors were specifically identified.

Madge, *et al.* [15] completed a prospective controlled study to determine the best practice to prevent the spread of RSV. While the results were statistically significant, the authors did not discuss other factors that may have contributed to the decline in spread (cohorting, aggressive hand hygiene, etc.). Regardless of the limitations, the study is well designed and provides guidelines for implementation in other centers.

Finally, the policy statements from the American Academy of Pediatrics provided a specific set of guidelines and recommendations for pediatric offices [1-3]. These policy statements are based on expert opinion from sound clinical evidence. These guidelines provided a solid foundation for the development of pediatric pulmonology infection control guidelines.

Implications for practice and further investigations

Studies completed by Griffiths, *et al.* [12] Marra, *et al.* [16] Montecalvo, *et al.* [19] and Piza, *et al.* [23] suggest that there is evidence that infection control can be used successfully to care for patients and to prevent the spread of nosocomial and other infec-

tions. Successful use of infection control practices in a variety of different settings may suggest that research can be applied to a pediatric pulmonology setting as well. Studies completed by Cooper, *et al.* [7], Griffiths, *et al.* [12], Marra, *et al.* [16], Montecalvo, *et al.* [19], and Piza, *et al.* [23] highlighted the effectiveness of implementing infection control practices but also emphasized the need for further research. All reviewed studies addressed the research question in an indirect fashion by discussing the pros and cons of infection control implementation. This information was synthesized and used to develop infection control guidelines that can be used in a pediatric pulmonology clinic. Medical professionals need to educate themselves on the pros and cons of infection control and evaluate current practice to see if it is optimized to provide best care for patients.

Data analysis

A multi-step approach was used to analyze the data for the systematic review of literature. The first step was to summarize the data. A spreadsheet was created highlighting essential information to analyze such as author, title of study, year, intervention, comparison, and results. The spreadsheet was useful in both organizing the information and assessing quality and heterogeneity [22]. Next, an iterative process with a constant comparative method was used to identify common themes among the reviewed literature. This was useful to help identify common practices and recommendations found throughout the published research. Finally, the data collected was summarized and used to develop comprehensive pediatric pulmonology infection control guidelines. Once the guidelines were completed, they were reviewed by the management team of the Division of Pediatric Pulmonology and the Infection Control Department. Recommendations from both teams were welcomed, and changes were made as needed.

Summary of major findings

The goal of this project was to develop infection control guidelines for the Division of Pediatric Pulmonology located at Midwestern Hospital. The pediatric pulmonology clinic did not have infection control guidelines specific to the types of patients being seen in the clinic. The review of the literature showed the benefits of infection control and provided the necessary data to support a change in infection control practice at Midwestern Hospital.

The most difficult part of completing the systematic review of literature was the limited literature published about pediatric pulmonology infection control. This meant that broader search terms had to be used to find relevant research. The lack of specific re-

search meant that a significant amount of time had to be spent reviewing other types of published literature.

The project was successful as the systematic review of literature was used to create a comprehensive infection control guidelines. Additionally, the unanimous adaptation of the infection control guidelines by the Division of Pediatric Pulmonology was an additional success. The development and adaptation of comprehensive infection control guidelines will hopefully not only protect the pediatric pulmonary clinic staff but its most vulnerable patients as well.

Limitations

The major limitation of completing a systematic review of literature to develop pediatric infection control guidelines was the limited published research available. The inability to ethically create a randomized controlled trial limits the available literature to weaker levels of evidence. Another limitation in completing the systematic review was the initial search parameters did not provide ample articles for final review so a second review of literature with expanded search parameters was necessary. Also, not all of the reviewed literature was pediatric specific. Due to limited available published pediatric research, research using adult patients was used for this project. Finally, another limitation is in the implementation process. As previously mentioned, there are a number of students and resident physicians who see patients in the Division of Pediatric Pulmonology. The frequent influx of new students and residents can make implementation of the infection control guidelines difficult as it will be necessary to make sure all the students and resident physicians are aware of, understand, and implement the guidelines.

Next steps

Moving forward, more studies need to be completed to address current infection control practices to help develop and/or update comprehensive infection control guidelines for pediatric pulmonology clinics. Further review of literature was completed as there were gaps in the original review. The second review was necessary to help find enough high-quality information to create new pediatric infection control guidelines. The second literature review focused on infection control for patients with tracheostomies and an extensive review of pediatric infection control policy statements from the American Academy of Pediatrics. Completing a second review of literature provided the necessary information to properly address the PICO question.

Pediatric pulmonology infection control guidelines

Definitions

Standard Precautions

- Standard precautions are a set of infection control practices used to prevent transmission of diseases that can be acquired by contact with blood, body fluids, non-intact skin, and mucous membranes.
- Standard Precautions are used when providing care to all individuals, whether or not they appear infectious or symptomatic.
- Contact Precautions
- Contact precautions are used for infections, diseases, or germs that are spread by touching a patient or items in a patient's room.
- Contact precautions include gown and gloves.
- Droplet Precautions
- Droplet precautions are used for diseases that are spread through droplets caused by coughing or sneezing.
- Droplet precautions include gown, gloves, and mask.
- Airborne Precautions
- Airborne precautions are used for patients with known or suspected pathogens that are known to be transmitted by the airborne route.
- Airborne precautions include gown, gloves, and N95 or higher respirator.

Standard precautions

The use of standard precautions will be used for the care of all patients. Standard precautions include

- Hand Hygiene (washing with plain or antibacterial soap and water before and after seeing a patient. Soap can be replaced with alcohol hand gel if hands are not visibly soiled)
- The use of gloves when touching blood, body fluids, non-intact skin, mucous membranes, and contaminated items
- The use of gloves during activities involving vascular access
- The use of surgical mask or goggles/face shield if there is a reasonable chance that a splash or spray of blood or body fluids may occur to the eyes, mouth, or nose.
- The use of a gown if skin or clothing is likely to be exposed to blood or body fluids.
- Proper use of safety devices and disposal of all needles and sharps
- Cleaning of room with hospital approved sanitizer and allowed to dry for 1-3 minutes.

- Cleaning of all shared medical equipment (pulse oximeter, thermometer, demonstration equipment) with hospital approved sanitizer and allowed to dry for 1-3 minutes.

In addition to standard precaution, all patients with a temperature of 38 degrees Celsius or higher will be placed in droplet precautions.

Care for cystic fibrosis patients

- Standard precautions on all patients (as listed above)
- All patients automatically in contact isolation (gown and gloves)
- Avoid the reuse of exam rooms until 30 minutes have passed since last patient in room and room has been cleaned
- Dedicated stethoscopes in each room
- Patient in contact precautions are not to congregate in public places including: waiting areas, playrooms, or hallways. Patients must be immediately placed in a room.

Care for Pediatric Home Vent (Tracheostomy) Patients

- Standard precautions on all patients (as listed above)
- All patients automatically in contact isolation and droplet isolation (gown, gloves, and mask)
- Avoid the reuse of exam rooms until 30 minutes have passed since last patient in room and room has been cleaned
- Dedicated stethoscopes in each room
- Patient in contact and droplet precautions are not to congregate in public places including: waiting areas, playrooms, or hallways. Patients must be immediately placed in a room.

Special populations

- **Airborne precautions**
 - All patients with a diagnosis of measles, varicella, or tuberculosis will be in airborne precautions in addition to standard precautions.
- **Droplet precautions**
 - All patients with a diagnosis of invasive Haemophilus influenzae, invasive Neisseria meningitidis, diphtheria, Mycoplasma pneumonia, pertussis, streptococcal pharyngitis (in children less than 5 years old), adenovirus, influenza, mumps, Parvovirus B19 or rubella will be in droplet precautions in addition to standard precautions. All patients with a temperature higher than 38 degrees Celsius will be in droplet precautions.

- **Contact Precautions**
 - All patients with a diagnosis of *Clostridium difficile*, cutaneous diphtheria, herpes simplex virus, impetigo, major non-contained abscess, pediculosis, scabies, staphylococcal furunculosis or viral/hemorrhagic conjunctivitis will be in contact precautions in addition to standard precautions.

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