Journal of Pediatric Nursing 70 (2023) 54–60

Contents lists available at ScienceDirect

Journal of Pediatric Nursing

journal homepage: www.pediatricnursing.org

Quality improvement: Antimicrobial stewardship in pediatric primary care

Christine Johnson, DNP, APRN, FNP-C, Alyssa Nordby, DNP, APRN, FNP-C, CDCES, Diane Brage Hudson, PhD, RN *, Leeza Struwe, PhD, MSN, RN, Ronelle Ruppert, DNP, APRN, FNP-C

College of Nursing, University of Nebraska Medical Center, United States of America

ARTICLE INFO

Article history:
Received 18 October 2021
Revised 1 February 2023
Accepted 3 February 2023

Keywords:
Quality improvement
Nurse led patient and parental education
Antimicrobial stewardship
Outpatient pediatric primary care

ABSTRACT

Background: Antimicrobial resistance is the resistance of microorganisms to antibacterial, antiviral, antiparasitic, and antifungal medication resulting in increased healthcare costs with extended hospital stays in the United States. The goals of this quality improvement project were to increase the understanding and importance of antimicrobial stewardship by nurses and health care staff and increase pediatric parents'/guardians' knowledge of the proper use of antibiotics and differences between viruses and bacterial infections.
Methods: A retrospective pre-post study was conducted in a midwestern clinic to determine if an antimicrobial stewardship teaching leaflet increased parent/guardian antimicrobial stewardship knowledge. The two interventions for patient education were a modified United States Center for Disease Control antimicrobial stewardship teaching leaflet and a poster regarding antimicrobial stewardship.
Results: Seventy-six parents/guardians participated in the pre-intervention survey, with 56 being included in the post-intervention survey. There was a significant increase in knowledge between the pre-intervention survey and the post-intervention survey with a large effect size, $p < .001$, $d = 0.86$. This effect was also seen when comparing parents/guardians with no college education, who had a mean knowledge increased change score of 0.62, to those parents/guardians with a college education, whose mean knowledge increase was 0.23, $p < .001$ with a large effect size of 0.81. Health care staff thought the antimicrobial stewardship teaching leaflets and posters were beneficial.
Practice implications: The use of an antimicrobial stewardship teaching leaflet and a patient education poster may be effective interventions for improving healthcare staff's and pediatric parents'/guardians' knowledge of antimicrobial stewardship.

Problem description

Antimicrobial resistance is the designation for the resistance of microorganisms to antibacterial, antiviral, antiparasitic, and antifungal medication (World Health Organization [WHO], 2017). Antimicrobial resistance arises due to what is known as a "superbug," formed when a microorganism is exposed to an antimicrobial agent and, in turn, changes. Antimicrobial resistance then continues naturally with time due to genetic changes in the microorganism (WHO, 2017). According to Bertollo et al. (2018), the growth of bacterial resistance to antimicrobial agents is activated by the selection of resistant organisms during antimicrobial-based treatments. The inappropriate use of antimicrobial drugs hastens the process of genetic change of these microorganisms. The United States (US) Center for Disease Control (CDC, 2019) states antimicrobial resistance has the potential to impact all Americans at every stage of life.

Antimicrobial resistance is a nationwide concern in the US as resistance results in increased healthcare costs with extended hospital stays and increasingly intense antimicrobial treatment. Sutthiruk et al. (2018) state inappropriate antimicrobial use is the foremost cause of antimicrobial resistance. In the US, 50% of antibiotics prescribed are unwarranted or unsuitable (Sutthiruk et al., 2018). To reduce antimicrobial resistance in the United States, structured programs have been implemented in healthcare settings called antimicrobial stewardship programs (Yadav et al., 2020). The US Joint Commission on Accreditation of Healthcare Organizations (Joint Commission, 2019) defines antimicrobial stewardship programs in an outpatient healthcare setting to have five components: an appointed antimicrobial stewardship leader; annual antimicrobial stewardship goals; implemented evidence-based practice guidelines related to those goals; clinical staff provided with educational resources related to those goals; and a system of collecting, analyzing, and reporting of data related to the goals. According to the CDC (2019), antimicrobial stewardship is imperative for pediatric populations, and antimicrobial stewardship programs have helped to decrease unnecessary

* Corresponding author.
E-mail address: DBrage@unmc.edu (D. Brage Hudson).

https://doi.org/10.1016/j.pedn.2023.02.002
0882-5963/

outpatient pediatric antibiotic prescribing by 16% from 2011 to 2017. As of January 1, 2020, The Joint Commission requires all participating ambulatory clinics to have a set antimicrobial stewardship program (Joint Commission, 2019). These programs provide education to healthcare providers and patients about antimicrobial resistance.

Antimicrobial resistance is a growing concern highlighted by the CDC in its latest "AR Threat Report" (CDC, 2019). Per this report, over 2.8 million infections in the United States yearly are antimicrobial resistant (CDC, 2019). More than 35,000 persons die each year in the United States because of antimicrobial-resistant infections. Antimicrobial resistance is a significant problem for patients because it may result in adverse outcomes of excess morbidity, heightened health care and individual out-of-pocket costs, and a higher incidence of adverse effects (Fitzgerald, 2019). Families, in turn, may be impacted by the burden of caregiving for these ill patients, the costs of helping to pay for treatment for a sick family member, and the emotional impact of the death of a loved one from an antimicrobial-resistant pathogen. The healthcare system is widely impacted by antimicrobial resistance due to the increasing cost of delivering care, negative adverse effects on patients who are being treated, and the rising need for new technologies to treat these infections (Fitzgerald, 2019).

The impact of the problem of antimicrobial resistance is significant, with potentially every individual at risk as anyone may be at risk for infection from an antimicrobial-resistant pathogen. Those at the highest risk are immunocompromised patients, children, and elderly individuals. This quality improvement (QI) project comprised pediatric patients, ages 0–19, with parent/guardian participation because children are at increased risk for antimicrobial resistance. Poole (2018) reported that an estimated 15 million unnecessary courses of antibiotics are prescribed to pediatrics in outpatient settings yearly. Over 50% of children diagnosed with acute respiratory tract infections receive antibiotic prescriptions in the outpatient setting, but only 27% are estimated to be caused by bacteria (Mangione-Smith et al., 2015). In another study, Johnston et al. (2019) depicted an estimated 20.1% of hospitalizations in the United States were due to bacterial infections. These authors found that a minimum of 10.8% of these hospitalizations were due to multidrug-resistant pathogens (Johnston et al., 2019). According to Shrestha et al. (2018), the estimated cost of five antimicrobial-resistant pathogens (*S. aureus*, *E. coli*, *K. pneumoniae*, A. baumanii, and *P. aeruginosa*) in the United States was $2.9 billion.

Rationale

This QI project used the classic Kotter and Cohen's Model of Change in development and implementation (Kotter & Cohen, 2012). The eight steps of Kotter and Cohen's Model of Change are urgency, team selection, vision, and strategy, communicating the vision, empowerment, interim successes, ongoing persistence, and nourishment (Kotter & Cohen, 2012).

Urgency

The urgency for this QI project design was driven by educating nurses and physicians with a presentation on the growing concern of antimicrobial resistance. The urgency was also driven by the new Joint Commission standards as of January 1, 2020, regarding all ambulatory clinics that frequently prescribe antibiotics to have a set antimicrobial stewardship program in place (Joint Commission, 2019).

Team selection

Team selection for this QI project was driven by the knowledge that the pediatrician at the clinic is known for her advocacy of evidence-based practice. Other key stakeholders identified were the clinic manager and health care staff (physician, physician assistant, nurse practitioner, nurses, and medical assistant).

Vision and strategy

The clinic manager, nurses, and the physician attended a meeting during lunch to discuss the project's vision and strategy for proper antibiotic use for pediatric cough and congestion symptoms. All stakeholders involved in implementing the project were receptive to the project's aims. Nurses provided helpful suggestions to make the implementation realistic such as not having the front office staff oversee the distribution of the intervention but instead having the nurses determine which patients qualify. This luncheon was a helpful strategy for stakeholders to be involved in the 'vision and strategy' of the project.

Communicating the vision

During the next meeting with the clinic manager and health care staff, written and verbal education and orientation about the proposed QI project's intervention process was on September 3, 2020. For this meeting, the plan was to communicate the project vision and aims by providing stakeholders with visual algorithms for appropriate antibiotic prescribing of sinusitis, pharyngitis, upper respiratory infection or the common cold, and bronchiolitis, and antimicrobial stewardship teaching leaflets nurses reviewed with the patient's parent/guardian. Patient visit scenarios regarding when the antimicrobial stewardship teaching leaflets were to be provided to the parent/guardian were reviewed with stakeholders so they could visualize how the process would occur.

Specific aims

This QI project's purpose was to evaluate an antimicrobial stewardship program at a midwestern clinic in the US. The Doctor of Nursing Practice (DNP) students developed the antimicrobial stewardship program using the CDC guidelines for antimicrobial stewardship in outpatient health care settings. The DNP students learned during discussions with the clinic personnel that guidelines had yet to previously be developed and used for prescribing medications for coughs and congestion with pediatric patients. The goals of this QI project were to: (a) increase the understanding of antimicrobial resistance and the importance of antimicrobial stewardship by nurses and health care staff at the midwestern clinic and (b) increase pediatric parents'/guardians' knowledge of the proper use of antibiotics and the differences between viruses and bacterial infections.

The clinical questions were:

1. What are health care staff's perceptions of antimicrobial stewardship teaching leaflets, the poster developed by the CDC in the examination room, and algorithms for providing care to pediatric patients with various respiratory illnesses?
2. What is the effectiveness of the antimicrobial stewardship teaching leaflets for improving parents'/guardians' knowledge about respiratory illnesses and the appropriate usage of antibiotics?
3. What is the relationship between parents'/guardians' understanding of antimicrobial resistance and stewardship and their race/ethnicity, gender, /or educational level?
4. Discuss the perceptions of the health care staff regarding the feasibility of implementing the antimicrobial stewardship program and their occupation, educational level, and years in the position.

Methods

Context

The methodology included information regarding the design, participants, setting, instruments, the algorithm of methods for illnesses, and data collection measures. The study design for implementation was a pre-post design as this QI project sought to determine if a specific intervention (antimicrobial stewardship teaching leaflet) resulted in increased parent/guardian understanding through a measure of pre-assessment data compared to a post-educational assessment using a pre-post survey. A pre-post study design helped to understand the intervention's effectiveness while being feasible for project goals.

Inclusion criteria were English-speaking parents/guardians of pediatric patients ages 1 to 19 years seeking care for cough and congestion

symptoms at the clinic. Parents/guardians were given the pre-survey, the antimicrobial stewardship teaching leaflet, and the post-survey on behalf of the pediatric patient.

The proposed sample for this QI project was based on a statistical power analysis performed for sample size estimation. For the second aim of difference of knowledge score in a two-tailed test, an effect of 0.5, was used in the a priori power calculation, the mean difference within persons, alpha = 0.05 and power = 0.80, the analysis was completed with G*Power 3.1 (Faul et al., 2007). The projected sample size needed with this effect size is $N = 34$.

Nurses determined which patients and parents/guardians qualified for receiving the pre-survey, antimicrobial stewardship teaching leaflet, and post-survey. The health care provider (physician, physician assistant, or nurse practitioner) diagnosed and treated patients based on the provided algorithms for four common respiratory illnesses identified by the CDC. Implementation dates for patients, parents/guardians, and health care staff were October 13, 2020, to February 16, 2021.

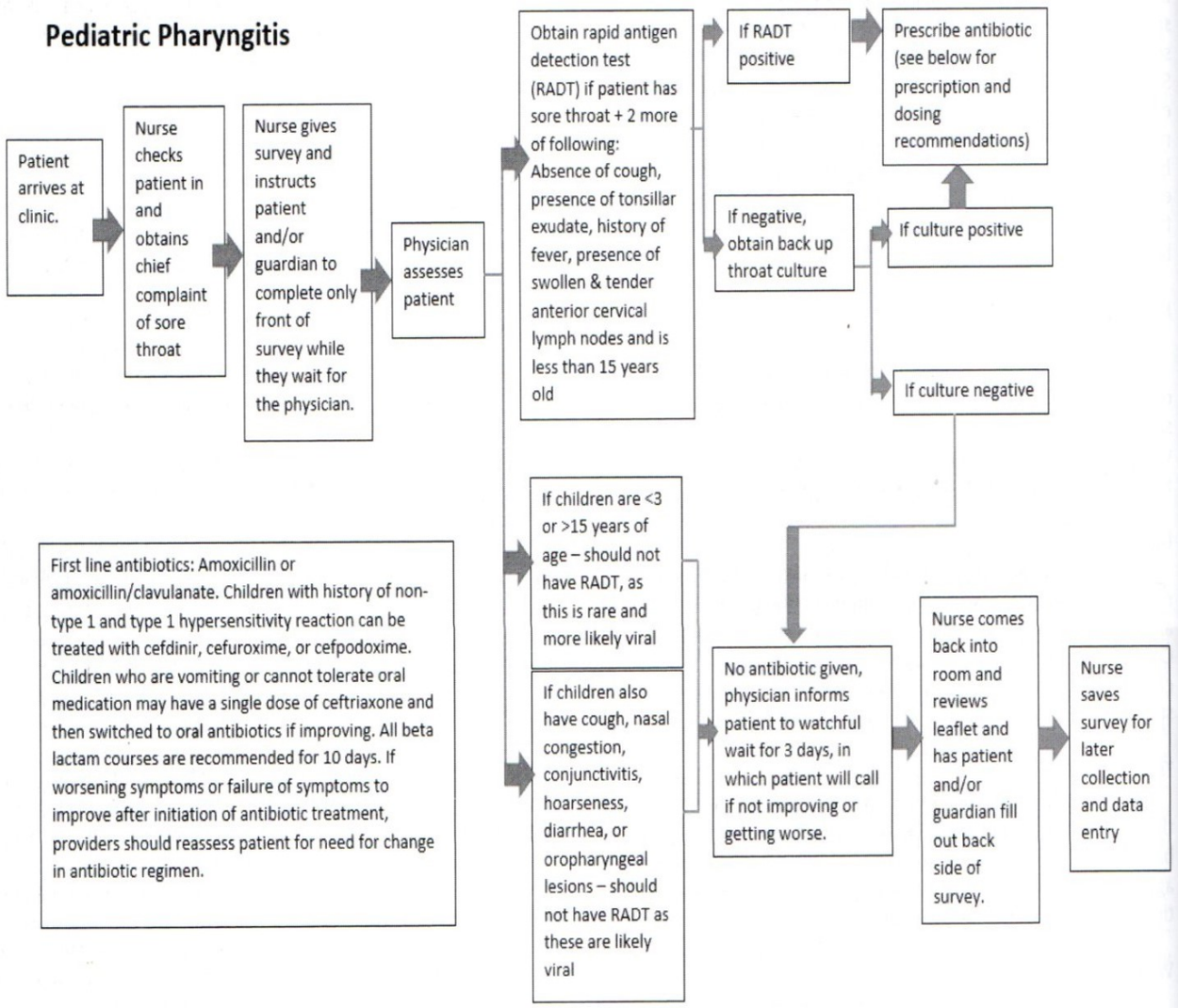
The QI project was implemented at a midwestern clinic in the United States. The clinic is a rural primary care facility that serves patients of all ages, ethnicities, backgrounds, income levels, and health statuses. Healthcare providers at this clinic are interested in preventative care for children and adolescents. The clinic has three examination rooms specifically for pediatric patients.

Intervention

Two interventions were used for parent/guardian education in this project. One intervention was the modified CDC antimicrobial stewardship teaching leaflet (see Appendix A). This trifold antimicrobial stewardship teaching leaflet was given to every parent/guardian who answered "yes" to the question, "Are you seeking antibiotics today for illness?" The second parent/guardian education intervention used in this QI project was the CDC poster regarding antimicrobial stewardship. This poster was placed in the clinic's three pediatric patient examination rooms for the duration of project implementation.

Algorithm of project methods for illnesses

Four illnesses were chosen per the CDC recommendations. These illnesses were acute sinusitis, pharyngitis, common cold or nonspecific upper respiratory illness, and bronchiolitis. The patient arrived at the clinic, was registered at the front office, and asked to sit in the lobby. The nurse took the patient and the parent/guardian to an examination room. While in the examination room, the nurse assessed the patient and obtained the patient's chief complaint. If the patient's complaint involved cough, congestion, sore throat, or sinus drainage, the nurse provided the parent/guardian with the pre-survey on the front side of the paper to complete while waiting for the health care provider. The parent/guardian was asked to place the survey on the desk in the examination room when finished. The healthcare provider then assessed the patient in the examination room. If the health care provider prescribed an antibiotic for the patient after following the algorithms, the nurse did not give the antimicrobial stewardship teaching leaflet or post-survey to the parent/guardian. If the health care provider did not prescribe an antibiotic, the nurse gave and reviewed the antimicrobial stewardship teaching leaflet to the parent/guardian (with education regarding pamphlet information presented at this time), followed by asking them to complete the post-survey before leaving.



Study of the intervention

The modified CDC antimicrobial stewardship teaching leaflet is a one-page (front and back) trifold antimicrobial stewardship teaching leaflet explaining appropriate antibiotic use (see Appendix A). These antimicrobial stewardship teaching leaflets were given during the patient visit, highlighted in the "Intervention" section above. Another intervention was CDC educational posters regarding antimicrobial stewardship to prevent antimicrobial resistance. These posters were placed in the pediatric examination rooms in the clinic for parents/guardians to review.

Ethical considerations

To ensure all ethical considerations were reviewed before implementation, the midwestern university's institutional review board sought approval to conduct this QI project, which determined that the project was approved with no review as needed. The clinic does not require institutional review board approval. The parent/guardian educational component was part of the usual care in the clinic. The nurse verbally obtained the survey consent, and all information in the survey was separate from the care and medical record of the patient.

Measures

Two instruments used for data collection purposes were the pre-post parent/guardian survey and the feasibility survey provided to the health care staff. The parent/guardian survey was developed from the literature review described in the algorithm of the project methods for selected illnesses. The survey was reviewed by the clinical staff, who are content experts. The survey was not pilot tested. The nurse provided the pre-survey to the parent/guardian before the health care provider assessed the patient. The nurse provided the pre-survey to any parent/guardian whose child was seen for a chief complaint of cough, congestion, or sore throat. The nurse provided the post-survey to the patient or parent/guardian if the health care provider did not prescribe an antibiotic.

The feasibility survey was provided to the healthcare staff after the project implementation. This survey assessed opinions of the healthcare staff on the ease, usefulness, and feasibility of the project. This survey consisted of six questions and was coded using a 5-point Likert scale where 1 = Strongly agree and 5 = Strongly disagree. The questionnaire had a space on the bottom for additional comments for the healthcare staff to complete.

The demographic information collected from the parent/guardian pre-post surveys included the patient's age, race/ethnicity, sex, and the parent's/guardian's level of education to determine if these factors were related to antimicrobial stewardship understanding. This demographic information was chosen, so no key patient identifiers were reported. Demographic information collected for employees at the clinic who completed the health care provider survey were occupation, education level, and years in their current role or position.

There were three primary outcome variables and one outcome comparison for this QI project; the first outcome variable was whether the parent/guardian thought that they knew when an antibiotic was needed following the intervention of the antimicrobial stewardship teaching leaflet review. The second primary outcome variable was whether the parent/guardian thought they knew the difference between a virus and bacteria following the antimicrobial stewardship teaching leaflet review intervention. The third primary outcome variable was whether the parent/guardian thought an antibiotic was necessary for cough and congestion symptoms. These survey questions were coded using a 5-point Likert scale where 1 = Strongly agree and 5 = Strongly disagree. The outcome comparison was regarding if the greater than high school education of the parent/guardian correlated to the understanding of antimicrobial prescribing.

Analysis

The pre-post survey data were collected from the clinic nurse by the DNP students, and the DNP students completed data entry with the assistance of the statistician. The survey data were kept in a locked file cabinet in the DNP student's office. Demographic variables included were patient age, gender, race and ethnicity, and parent/guardian's highest completed level of education. For analysis purposes, race and education were dichotomized as Caucasian and non-Caucasian, and college education or no college education. After the two negatively worded questions were reverse coded, the six questions of the parent survey were summed and then divided by six to get a mean score for the survey. The change score from pre to post was calculated by subtracting the pre-score from the post-score so that a positive number would be interpreted as an increase in knowledge. An a priori significance level of 0.05 was set for all inferential testing.

To ensure responses were from the defined population only, baseline clinical variables included age and whether the parent/guardian was seeking an antibiotic for cough and congestion. Patient age was entered as a continuous code ranging from 0 to 228 months, in which patients older than 19 years were excluded. Whether the parent/guardian was seeking antibiotics for cough and congestion was entered as a dichotomous yes or no.

The descriptive data analysis of the health care staff's perceptions of and recommendations for the antimicrobial stewardship teaching leaflets, the poster developed by the CDC in the examination room, and algorithms for providing care to pediatric patients with various respiratory illnesses were conducted by the DNP students and their project advisor. Frequencies were reported for these perceptions and recommendations according to the healthcare staff members' roles.

Results

Quantitative results

A total of 76 parents/guardians participated in the pre-intervention survey. Eighteen parents/guardians were not seeking antibiotics and were thus excluded from the intervention. Fifty-eight parents/guardians were seeking antibiotics, and these individuals were therefore provided the antimicrobial stewardship teaching leaflet and the post-intervention survey. Fifty-six parents/guardians returned the survey completed. Of the 56 parents/guardians, 25 (45%) were male, 23 (41%) were female, and eight (14%) preferred not to disclose. Thirty-three (59%) patients were Caucasian, and 23 (41%) were not Caucasian. Thirty-two (56%) parents/guardians had no college education (no high school to some college), 23 (42%) had a college education (associate degree or higher), and one (2%) did not disclose.

Aim 2 sought to find if the antimicrobial stewardship teaching leaflet improved the knowledge of those parents/guardians' seeking antibiotics for their children's respiratory illnesses to focus on the first, second, and third outcome variables. Using a paired *t*-test, there was a significant 0.46 point difference on the 5-point scale, showing an increase in knowledge between the pre-intervention survey and the post-intervention survey with a large effect size, $p < .001$, $d = 0.86$. See Table 1.

Aim three sought to find the relationship between the knowledge of the parents/guardians of pediatric patients regarding antimicrobial stewardship and their sex, race, and education level to assess the fourth outcome variable. When testing the difference in knowledge gain between men and women, a non-significant independent *t*-test showed a mean increased change score for males was 0.39 and for females of 0.56, $p = .30$, $d = 0.31$. When assessed individually with paired *t*-tests, both males, $p < .001$, $d = 0.74$, and females, $p < .001$, $d = 1.02$, had significant improvements in knowledge gain, see Table 1.

In Aim three, comparing parents/guardians with no college education, who had a mean knowledge increased change score of 0.62 to

Table 1
Pre to Post intervention knowledge scores with paired and independent *t*-tests.

Survey Questions	Time	N	Range	Minimum	Maximum	Mean	SD	*t*	*p*-value	*d*
I understand when an antibiotic is needed.	Pre	56	3.00	2.00	5.00	3.95	0.95	−6.02	<0.001	0.81
	Post	56	2.00	3.00	5.00	4.52	0.54			
I know the difference between viral and bacterial symptoms.	Pre	56	4.00	1.00	5.00	3.53	1.17	−6.52	<0.001	0.87
	Post	56	3.00	2.00	5.00	4.34	0.77			
An antibiotic is necessary for cough and congestion symptoms. (reverse coded)	Pre	56	4.00	1.00	5.00	3.09	1.34	−1.69	0.10	0.23
	Post	56	4.00	1.00	5.00	3.30	1.40			
Getting an antibiotic can shorten the duration of a cold. (reverse coded)	Pre	56	4.00	1.00	5.00	2.95	1.30	−1.80	0.04	0.24
	Post	56	4.00	1.00	5.00	3.14	1.47			
Inappropriate antibiotic use can lead to resistance.	Pre	56	2.00	3.00	5.00	3.91	0.83	−6.29	<0.001	0.84
	Post	56	2.00	3.00	5.00	4.45	0.57			
There are other treatments for low-grade fever other than antibiotics.	Pre	56	3.00	2.00	5.00	3.98	0.81	−3.52	<0.001	0.47
	Post	56	4.00	1.00	5.00	4.41	0.73			

Survey scores	Time	N	Range	Minimum	Maximum	Mean	SD	*t*	*p*-value	*d*
Group mean score	Pre	56	2.83	2.17	5.00	3.57	0.81	6.47	<0.001	0.86
	Post	56	2.17	2.83	5.00	4.03	0.66			
Males mean score	Pre	25	2.83	2.17	5.00	3.55	0.91	3.70	<0.001	0.74
	Post	25	2.17	2.83	5.00	3.95	0.72			
Female mean score	Pre	23	2.67	2.33	5.00	3.51	0.60	4.89	<0.001	1.02
	Post	23	1.67	3.33	5.00	4.07	0.60			
College educated mean score	Pre	23	2.00	3.00	5.00	4.20	0.67	2.53	0.01	0.53
	Post	23	1.83	3.17	5.00	4.43	0.67			
Non-college educated mean score	Pre	32	2.67	2.17	4.83	3.13	0.60	6.39	<0.001	1.13
	Post	32	2.17	2.83	5.00	3.74	0.51			
Caucasian mean score	Pre	33	2.83	2.17	5.00	3.83	0.70	4.10	<0.001	0.71
	Post	33	1.83	3.17	5.00	4.21	0.80			
Non-Caucasian mean score	Pre	23	2.83	2.17	5.00	3.19	0.67	5.29	<0.001	1.10
	Post	23	2.17	2.83	5.00	3.76	0.52			
Group mean change score	Change	56	2.33	−0.33	2.00	0.46	0.46			
Males mean change score	Change	25	2.33	−0.33	2.00	0.39	0.53	−1.06	0.30	0.31
Female mean change score	Change	23	2.17	−0.33	1.83	0.56	0.55			
College educated change score	Change	23	1.33	−0.33	1.00	0.23	0.44	2.80	0.01	0.77
Non-college educated change score	Change	32	2.17	−0.17	2.00	0.62	0.55			
Caucasian change score	Change	33	2.33	−0.33	2.00	0.38	0.54	−1.31	0.20	0.36
Non-Caucasian change score	Change	23	2.17	−0.33	1.83	0.57	0.52			

SD = standard deviation, *d* = Cohen's *d* effect size

those parents/guardians with a college education, whose mean knowledge increased was 0.23, an independent *t*-test was significantly different between these groups, $p = .01$ with a large effect size of 0.77 showing the non-college educated increase was much greater, see Table 1.

Caucasian parents/guardians and non-Caucasian parents/guardians showed a significant increase in knowledge, 0.57 for the non-Caucasian parents/guardians, $p < .001$, $d = 1.10$ and 0.38 for the Caucasian parents/guardians $p < .001$, d = 0.71. This increase in knowledge was not different between the parents/guardians, $p = .20$, with a small effect size of 0.36, see Table 1.

The age of the 56 children brought into the clinic by their parent/guardian ranged from 2 months to 17 years of age, with a mean age of 46 months (3 years, 10 months) with a standard deviation of 51 months. The median age was 24 months (2 years) of age. There was a statistically significant Pearson's correlation between the child's age in months and the change score in knowledge for the parent/guardian, $r(56) = 0.277$, $p = .04$, meaning that as the child's age in months increased, the parent/guardian's knowledge gain increased. No differences were found in the children's ages by gender, race, or parent/guardian education.

Descriptive results

The healthcare staff was surveyed after the patient data collection. All participating healthcare staff members completed the survey. The staff was: one physician, two nurse practitioners, one physician assistant, two registered nurses, and one medical assistant. The educational level of the health care staff included one doctoral level, three master's level, two bachelor's level, and one high school level education. The years of experience of the health care staff surveyed ranged from 9 months to 27 years. The list of staff survey questions is provided in Table 2.

We sought to determine the healthcare staff's perceptions of the feasibility of the antimicrobial stewardship teaching leaflets by surveying the healthcare staff using a 5-point Likert scale where 1 was strongly agree, and 5 was strongly disagree. Health care staff completed the feasibility survey after the intervention, and the results showed the antimicrobial stewardship teaching leaflets and CDC posters were positively perceived with all questions resulting in a mean between 1.00 and 2.00 and a total mean score of 1.71. See Table 2.

Discussion

Summary

The results of the QI project demonstrated the antimicrobial stewardship teaching leaflet improved the parent/guardian's knowledge of appropriate antimicrobial use for pediatric respiratory illnesses. There was a significant increase in antimicrobial knowledge for both males and females, college education and non-college-educated, and Caucasian and non-Caucasian parents/guardians. While each group had a significant increase in knowledge, when compared to each other, one gender did not increase knowledge more than the other, nor did one race increase knowledge more. Only non-college-educated parents/guardians had a significant knowledge increase compared to the college-educated parents/guardians.

The feasibility survey completed by the health care staff concluded that the antimicrobial stewardship teaching leaflets, CDC posters, and prescribing algorithms were easy to understand, effective in teaching the parent/guardian, and they received enough training before

Table 2
Staff Survey Questions.

	N	Range	Minimum	Maximum	Mean	SD
The leaflets were easy for my patients to understand.	7	2	1	3	1.57	0.79
Patients seemed to have positive feedback regarding the leaflets.	7	2	1	3	2.00	0.58
I found the leaflets to be helpful in educating my patients.	7	2	1	3	1.57	0.79
I found the posters to be helpful in educating my patients.	7	2	1	3	1.86	0.90
The leaflets helped my patients better differentiate between a bacterial and viral infection.	7	2	1	3	1.71	0.76
I had adequate training from the DNP group regarding the project implementation.	7	2	1	3	1.57	0.79
I would like to continue using the leaflets for patient education in the future.	7	2	1	3	1.71	0.76
Survey Total	7	13	7	20	12.00	4.24
Survey Mean	7	1.86	1.00	2.86	1.71	0.61

SD = standard deviation

initiation. The medical assistant, who had a high school degree and worked at the clinic for less than one year answered uncertain or not applicable to most of the questions. Her role in the project did not directly involve educating the parent/guardian and therefore did not pertain to her.

Interpretation

Based on project findings, there were probable associations between interventions and study outcomes. A statistically significant difference in pre- versus post-survey findings suggesting that the intervention of the antimicrobial stewardship teaching leaflets and posters resulted in an associated increase in parent/guardian knowledge regarding antimicrobial usage was found. In a similar study by Hernández-Díaz et al. (2019), a questionnaire regarding pediatric antibiotic use for respiratory infections was employed. It was found to improve parent/guardian knowledge levels surrounding proper antibiotic prescribing. Al-Shawi et al. (2018) had similar findings regarding socioeconomic status affecting antimicrobial usage.

Another finding of this QI project was that socioeconomic factors such as parental education impacted the understanding of antimicrobial stewardship, which may have influenced the incidence of visits seeking antibiotic prescriptions. In the study by Hernández-Díaz et al. (2019) where it was found that parents/guardians with lower education levels sought medical care for their child with an antibiotic more frequently than those with higher education levels.

We sought to determine the healthcare staff's perceptions of the antimicrobial stewardship teaching leaflets, the CDC poster in the examination rooms, and algorithms for providing care to pediatric patients with respiratory illnesses. From answers provided by the health care staff, perceptions of the antimicrobial stewardship teaching leaflets, the CDC poster, and the algorithm were positive. The health care staff thought the antimicrobial stewardship teaching leaflets, and CDC posters were easy for the parent/guardian to understand, the parent/guardians were receptive to the teaching materials, and materials helped educate the parent/guardian on proper antibiotic use and the difference between bacterial and viral infections. Most of the healthcare staff agreed they received enough training from the DNP students and were interested in continuing to use the educational materials in the future.

We sought to discuss the perceptions of the healthcare staff regarding the feasibility of implementing the antimicrobial stewardship program and their occupation, educational level, and years in the position. From the answers provided, the bachelor's, master's, and doctoral education levels health care staff worked in their current position for the past 1 to 27 years. They were agreeable the antimicrobial stewardship teaching leaflets and CDC poster was effective in teaching the parent/guardian about proper antibiotic use and the difference between bacterial and viral infections. These healthcare staff members thought they had received enough training from the DNP students and were interested in continuing to use the education materials.

Limitations

A limitation in implementing this QI project was that the clinic health care staff determined which patients and parents/guardians were and were not appropriate for inclusion which may have altered the sample profile due to access. The sample might be biased because only some parents/guardians who initially completed the pre-survey completed the post-survey. We cannot distinguish between the effects of the intervention and the impact of other factors that may change over time because a single-group pre-post design, was used for this QI project. Another limitation of this QI project was that the parent/guardian education materials and questions were in English. The clinic serves a diverse population of patients, with many Spanish-speaking individuals. Due to COVID-19, there were limited patients and their parents/guardians for study inclusion due to the clinic limiting sick pediatric visits without prior COVID-19 screening.

Nursing implications

Future nursing implications should include assessing parent/guardian's health literacy. For those identified as being at risk for lower health literacy, nurses can provide pamphlets that are easy to understand to improve their knowledge about illnesses and the appropriate use of antibiotics per evidence-based practice. Nurses should strive to be familiar with CDC updates. Nurses can request from their employers to use CDC posters as signage for parents/guardians to view while waiting for their appointments. Antimicrobial stewardship programs should become a routine part of parent/guardian education for long-term success. Materials needed would include additional pamphlets and posters to be updated and distributed. Data surrounding antimicrobial prescribing through an electronic health record and parent/guardian satisfaction surveys would need to be reviewed for continued implementation.

This study was linked with organization-based initiatives as the primary care clinic where implementation occurred is working towards obtaining Joint Commission Accreditation. As mentioned previously, The Joint Commission requires all participating ambulatory clinics to have a set antimicrobial stewardship program (Joint Commission, 2019). Having a formal antimicrobial stewardship program would be beneficial in obtaining Joint Commission certification. Currently, this clinic is recognized by the National Committee for Quality Assurance (NCQA) as a Patient-Centered Medical Home.

Future study implications

Future studies may include qualitative interviews with parents/guardians, patients, and healthcare staff about antimicrobial stewardship. A longitudinal study may be beneficial to determine if continued use of the intervention will lead to improved antimicrobial usage. Future research could also include a retrospective review on whether the number of patient visits requesting antibiotic treatment for pediatric

cough and congestion decreased after the parent/guardian education intervention. This QI project reviewed the age of the parent/guardian about antimicrobial prescribing, which could be an area of future research in conjunction with the current interventions. This QI project could be replicated in school settings with students and parents/guardians regarding antimicrobial resistance. Future opportunities may include implementation in another location such as a metropolitan outpatient clinic or adults. This QI project used Kotter and Cohen's Model for Change due to its well-known effectiveness for initiating change; future studies could examine incorporating a new innovative model, such as the Prosci Methodology, to further assess the effectiveness of the teaching leaflets and CDC poster. Other research opportunities could be another condition of concern, such as earache, sore throat, fever, or dysuria in both pediatric and adult populations.

Conclusions

This QI project can have a significant impact on improving parents'/guardians' understanding of proper antibiotic use. Thus, it will help ease the burden of unnecessary medical costs from unnecessary clinic visits and antibiotic prescriptions. The short-term outcomes from this project's implementation were an increased understanding of antimicrobial resistance and the importance of antimicrobial stewardship by the health care staff at the clinic, increased knowledge of parent/guardians regarding the proper use of antibiotics and the differences between viruses and bacterial infections, and increased parent/guardian satisfaction concerning parent/guardian education. These short-term outcomes may lead to decreased inappropriate antibiotic prescriptions and reduced office visits of patients or parents/guardians seeking antibiotics for possible viruses. In the long term, implementing the proposed interventions may lead to decreased medical costs related to unnecessary office visits and antibiotics and reduced development of antimicrobial resistance and hospitalizations. According to Goff and Kullar (2020), while antimicrobial stewardship programs do not directly produce revenue, the return on investment is considerable when the number of infections decreases. Karanika et al. (2016) stated that implementing antimicrobial stewardship programs was associated with a decrease in antimicrobial cost by more than one-third.

Funding

There was no funding for this quality improvement project.

CRediT authorship contribution statement

Christine Johnson: Conceptualization, Methodology, Software, Resources, Data curation, Visualization, Writing - original draft, Writing - review & editing. **Alyssa Nordby:** Conceptualization, Investigation, Resources, Visualization, Methodology, Writing - original draft, Writing - review & editing. **Diane Brage-Hudson:** Validation, Writing – review & editing, Supervision. **Leeza Struwe:** Validation, Formal analysis, Data curation. **Ronelle Ruppert:** Conceptualization, Methodology, Resources, Data curation, Investigation, Resources, Visualization, Writing - original draft, Writing - review & editing.

Conflicts of interest

We have no known conflicts of interest to disclose.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pedn.2023.02.002.

References

Al-Shawi, M. M., Darwish, M. A., Abdel Wahab, M. M., & Al-Shamlan, N. A. (2018). Misconceptions of parents about antibiotic use in upper respiratory tract infections: A survey in primary schools of the eastern province, KSA. *Journal of Family & Community Medicine*, *25*(1), 5–12. https://doi.org/10.4103/jfcm.JFCM_46_17.

Bertollo, L. G., Lutkemeyer, D. S., & Levin, A. S. (2018). Are antimicrobial stewardship programs effective strategies for preventing antibiotic resistance? A systematic review. *American Journal of Infection Control*, *46*(7), 824–836. https://doi.org/10.1016/j.ajic.2018.01.002.

Centers for Disease Control and Prevention (2019, November 13). Antibiotic resistance threats in the United States: 2019. https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf.

Faul, F., Erdfelder, E., Lang, A. -G., & Buchner, A. (2007). GPower 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/BF03193146.

Fitzgerald, M. A. (2019, December). Applying principles of empiric antimicrobial therapy. *Fitzgerald Health Education Associates*, *19*(12), 1–24. https://cdn.coverstand.com/61029/641698/9926632f772aab748e048488fb5775f60f19ea08.pdf.

Goff, D. A., & Kullar, R. (2020). Can the perfect handshake hold the key to success and sustainability of antimicrobial stewardship programs? *Clinical Infectious Diseases*, *70*(11), 2333–2335. https://doi.org/10.1093/cid/ciz699.

Hernández-Díaz, I., Ayala-Meléndez, A., González-González, E., Rosario-Calderón, L., Figueroa-Ríos, D., Melin, K., & Hernández-Muñoz, J. J. (2019). Knowledge and beliefs, behaviors, and adherence among Latino parents or legal guardians related to antibiotic use for upper respiratory tract infections in children under 6 years of age. *Journal of the American Pharmacists Association: JAPhA*, *59*(4), 506–513. https://doi.org/10.1016/j.japh.2019.03.004.

Johnston, K. J., Thorpe, K. E., Jacob, J. T., & Murphy, D. J. (2019). The incremental cost of infections associated with multidrug-resistant organisms in the inpatient hospital setting- a national estimate. *Health Services Research*, *54*(4), 782–792. https://doi-org.library1.unmc.edu/10.1111/1475-6773.13135.

Karanika, S., Paudel, S., Grigoras, C., Kalbasi, A., & Mylonakis, E. (2016). Systematic review and meta-analysis of clinical and economic outcomes from the implementation of hospital-based antimicrobial stewardship programs. *Antimicrobial Agents and Chemotherapy*, *60*(8), 4840–4852. https://doi.org/10.1128/AAC.00825-16.

Kotter, J. P., & Cohen, D. S. (2012). *The heart of change: Real-life stories of how people change their organizations*. Boston, MA: Harvard Business School Press.

Mangione-Smith, R., Zhou, C., Robinson, J. D., Taylor, J. A., Elliott, M. N., & Heritage, J. (2015). Communication practices and antibiotic use for acute respiratory tract infections in children. *Annals of Family Medicine*, *13*(3), 221–227. https://doi.org/10.1370/afm.1785.

Poole, N. M. (2018). Judicious antibiotic prescribing in ambulatory pediatrics: Communication is key. *Current Problems in Pediatric and Adolescent Health Care*, *48*(11), 306–317. https://doi.org/10.1016/j.cppeds.2018.09.004.

Shrestha, P., Cooper, B. S., Coast, J., Oppong, R., Do Thi Thuy, N., Phodha, T., ... Lubell, Y. (2018). Enumerating the economic cost of antimicrobial resistance per antibiotic consumed to inform the evaluation of interventions affecting their use. *Antimicrobial Resistance and Infection Control*, *7*, 98. https://doi.org/10.1186/s13756-018-0384-3.

Sutthiruk, N., Considine, J., Hutchinson, A., Driscoll, A., Malathum, K., & Botti, M. (2018). Thai clinicians' attitudes toward antimicrobial stewardship programs. *American Journal of Infection Control*, *46*(4), 425–430. https://doi.org/10.1016/j.ajic.2017.09.022.

Joint Commission, The. (2019). *R3 Report: Antimicrobial stewardship in ambulatory health care (Issue 23). https://www.jointcommission.org/-/media/tjc/documents/standards/r3-reports/r3_23_antimicrobial_stewardship_amb_6_14_19_final2.pdf.*

World Health Organization (2017, July). What is antimicrobial resistance? https://www.who.int/features/qa/75/en/.

Yadav, K., Stahmer, A., Mistry, R. D., & May, L. (2020). An implementation science approach to antibiotic stewardship in emergency departments and urgent care centers. *Academic Emergency Medicine*, *27*(1), 31–42. https://doi.org/10.1111/acem.13873.