Effect of Education Program regarding Antibiotic Stewardship on Nurse's Performance in Pediatric Intensive Care Units

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Abstract

Background: Antibiotic stewardship is the effort to measure and improve antibiotics prescribing by specialists and antibiotic usage by children. **Aim of the study:** This study aimed to assess effect of educational program on pediatric nurse's performance regarding to antibiotic stewardship. **Research design:** A quasi-experimental design was utilized in the study. **Setting:** The study was conducted in Pediatric Intensive Care Units (PICUs) at Benha University Hospital. **Sample:** A convenient sample included all available nurses (50) who working in the previously mentioned setting. **Tools of data collection: Tool (I)** A Structure Interviewing Questionnaire sheet to assess nurse's characteristic and their knowledge regarding antibiotic stewardship programs. **Tool (II)** An observational questionnaire Format to assess nurse's practice regarding to antibiotic stewardship programs. **Tool (III)** An observational questionnaire Format to assess nurse's attitude regarding antibiotic stewardship programs. **Results:** There was a positive correlation between pediatric nurse's knowledge, practice and attitude scores pre and post implementation of the educational program **Conclusion:** The educational program was effective in improving the level of pediatric Nurse's performance regarding to antibiotic stewardship. **Recommendations:** Enhancing nurse's performance regarding antibiotic stewardship programs through in service training program in PICUs. Further studies; repeating the study on large sample to generalize the results

Keywords: Antibiotic stewardship programs**,** Educational program, Intensive care units, Nurses performance, Pediatric.

Introduction

Antibiotic Resistance (AR) is a growing global public health threat that undermines the effectiveness of many life-saving medications. The overuse and misuse of Antibiotics in humans is a major driver of AR Children are particularly vulnerable to AR due to their developing immune systems, higher infection rates, and frequent exposure to antibiotics **(Murray et al., 2022).**

Antibiotic Stewardship (AS) is a comprehensive approach to promote the appropriate use of antibiotics by optimizing selection, dose, duration, and route of administration. Antibiotic Stewardship programs involve a multidisciplinary team that includes clinicians, pharmacists, microbiologists, infection preventionists, and other healthcare providers **(Saleem., 2023).**

The Centers for Disease Control and Prevention CDC developed the core elements of hospital ASPs which is a series of sustainable and reformative Team-based stewardship strategies that draw upon the

collective knowledge of the entire health care team to achieve goals of ASPs. It consists of leadership commitment, accountability, drug expertise, action, tracking, reporting, and education. The core elements are expected to improve antibiotic use, reduce adverse events, prevent the emergence of resistance, and lead to better outcomes for residents in the long-term care setting **(Pulcini et al., 2019).**

Pediatric ASPs principles are rooted in collaboration and cooperation to uniquely suite and meet the needs of children they serve and the environment within which they practice. It is the responsibility of every individual who prescribes, dispenses, and administers antibiotics to children **(Klatte, 2020).**

Antibiotic Stewardship Programs are primarily led by infectious disease physicians and pharmacists with specialized training. Recently several studies have shed light on nurses' perceptions of their potential contribution to stewardship efforts in acute care hospitals. Nurses view patient safety as an essential component of their work and have a general interest in embracing an antibiotic steward role **(Monsees et al., 2018).**

Nurses are the main communication link for healthcare messages of hospitalized children and also play a crucial role in preventing the emergence and spread antibiotic resistant bacteria through antibiotic stewardship programs. This requires them to possess correct knowledge and attitudes towards antibiotic use and resistance (**Jayaweerasingham et al., 2019).**

Bed side nurses possess a high degree of confidence with certain daily practices that is related to ASP functions such as assessing for an adverse drug reaction, obtaining cultures prior to antibiotic initiation, participating in family education and notifying physicians of dosing errors **(Monsees et al., 2019).**

Pediatric Intensive Care Units PICUs have a high prevalence of hospital acquired infections and an overall high risk of morbidity and mortality. Antibiotics are the most common medications prescribed in PICUs, with up to 50–100% of children receiving antibiotic drug prescription. This elevated consumption may be related to different causes as illness severity, the unjustified use of antibiotics for prophylaxis and in viral infections **(Kazzaz et al., 2020).**

Significance of the study

Antibiotic resistance (AR) is a major national and global health threat. Antibiotic misuse and overuse are major factors in drug-resistant pathogen development. In AR, antibiotics lose their effectiveness and infectious diseases become difficult to treat **(Centre for Disease Control and Prevention CDC, 2022).**

Children are of particular concern when evaluating the implications of antibiotic overuse and resistance. Fifty million prescriptions are written annually with 20% of all visits resulting in an antibiotic; 50% of those prescriptions are unnecessary. Up to 10% of children experience antibiotic-related side effects as diarrhea, rashes, allergic reactions, and anaphylaxis account for 50% of adverse medication-related emergency room visits, contributing to the soaring financial burden of this healthcare crisis, antibiotics may increase a child's risk for developing autoimmune disease, inflammatory bowel disease, asthma, and diabetes **(Gerber et al., 2021).**

This concern has accelerated the development of Antibiotic stewardship programs (ASPs) to improve clinical care and child safety. ASP is the organizational healthcare strategy program that promotes the appropriate use of antibiotic through the implementation

of evidence-based interventions **(Ju, et al., 2022**).

So, the implementation of antibiotic stewardship education program for nurses is essential to improve their performance in Pediatric Intensive Care Units (PICUs).

Aim of the Study

Aim of the present study was to evaluate effect of education program regarding antibiotic stewardship on nurses' performance in Pediatric Intensive Care Units (PICUs) through the following objectives:

1. Assessing pediatric Nurses' knowledge, practices and attitude regarding antibiotic stewardship.
2. Designing and implementing education program based on the nurses' actual needs.
3. Evaluating the effect of the educational program on nurses' knowledge practice and attitude regarding antibiotic stewardship.

Research Hypothesis

Nurses' performance regarding antibiotic stewardship in pediatric intensive care units would be improved after implementation of the education program.

Subjects And Method.

Research design

A quasi - experimental design was utilized to conduct the study.

Research Setting

The study was conducted in Pediatric Intensive Care Units (PICUs) at Benha University Hospital at Benha city affiliated to Ministry of Higher Education and Scientific Research. The Pediatric Intensive Care Units (PICUs) located in the fourth floor of internal medicine building. It contains two rooms each one of them had six beds, electro cardiograph machine, crash cart, and a defibrillator. Each bed is attached to a number of highly advanced and critical medical equipment such as a mechanical ventilator, ICU bed side monitor, intravenous infusion pump, oxygen cylinder, suction machine, and a nebulizer.

Research Subject

A convenient sample of all available pediatric nurses with total number (n= 50) through 6 months working at the previously mentioned setting regardless of their characteristics as age, gender, academic qualification, job title, years of experience and caring for critically ill children who receive antibiotics.

Tools of data collection

Data collected through used the following three tools:

Tool (I): A structured Interviewing Questionnaire (pre/post educational program):

It was designed by the researcher under supervision of supervisors after reviewing related and recent literature to assess nurses' knowledge regarding antibiotic stewardship. It was written in a simple Arabic language. It consisted of two parts:-

Part (1): Personal characteristics of the studied nurses Such as age, gender, educational level, job title, years of experience, place of work, and attendance of any training courses related to antibiotic stewardship, number of courses attended, application of what have been learned in the course and reasons of non-application.

Part (2): Nurses' knowledge questionnaire:-

This questionnaire was developed by the researcher and reviewed by the supervisors in order to evaluate the nurse's knowledge about antibiotic stewardship and consisted of as the following:

a) Nurses' general knowledge about antibiotic stewardship program which related to presence of official antibiotic stewardship program in the hospital, activation and application of the program in the hospital,

and participation of pediatric intensive care unit nurses in the program.

b) Nurses' knowledge about antibiotic stewardship program in the form of MCQ related to definition, reasons that led to applying the program, importance of applying the program in the hospital, obstacles that might prevent implementation of the program, members of antibiotic stewardship team, specializations of the team members within the antibiotic stewardship program, scheduling of team meetings, basic elements of the program, participation of nurses and their roles inside the program.

c) Nurses' knowledge about core elements in the form of Yes and No related to the extent of leadership commitment within the antibiotic stewardship program, additional procedures used to administer antibiotics, Ensuring the implementation of essential elements of the antibiotic stewardship program , methods used to educate team members within the antibiotic stewardship program, ways of monitoring bacterial resistance within the antibiotic stewardship program, procedures used for reporting antibiotic resistance within the antibiotic stewardship program.

Scoring system for nurse's knowledge:

The complete correct answer scored (2), incomplete correct answer scored (1) and incorrect and didn't know scored (0). The total score for all questions was (79) which represents 100 %.

The total score of nurses' knowledge was calculated and classified into three levels as the following:

- Poor knowledge < 60 % of total score
- Average knowledge 60 ≤ 80 % of total score
- Good knowledge 80 ≤ 100 % of total score

Tool (II): An observational questionnaire Format to assess Nurse's practices regarding antibiotic stewardship

It was designed by the researcher under supervision of supervisors after reviewing related and recent literature to assess nurses' practice regarding antibiotic stewardship and consists of 7 questions as the following, Nurses practice regarding taking allergy history, nurses practice regarding taking high quality microbiological sampling, improving administration of antibiotics in time, ensure optimum use of antibiotic doses, monitoring clinical progress and side effects or ineffectiveness of the antibiotic, cooperating with team members to transfer antibiotics from intravenous to oral, stopping giving the antibiotic.

Scoring system for nurses' practice

According to the nurses' actual practice, the correctly step done scored (1) grade and for each steps not done scored (0). The total score for all (38) items was 38 marks which represent 100 %. The total level of nurses' practice was categorized as the following:-

- **Competent** (≥ 85%) of total practice score.
- **Incompetent** (< 85%) of total practice score.

Tool (III): An observational questionnaire Format to assess nurses' attitude regarding antibiotic stewardship

It was designed by the researcher under supervision of supervisors after reviewing related and recent literature to assess nurses' attitude regarding antibiotic stewardship and it was consisted of (12) questions as the following:- thought that antibiotic stewardship program would raise awareness among pediatric health care providers, thought that

the antibiotic stewardship program could reduce infection and prevent its spread, thought that antibiotic stewardship program would stop antibiotic resistance, saw the antibiotic stewardship program as a way of improving the quality of healthcare for children.

Scoring system for nurses' attitude

The total scores of nurses attitude was categorized as the following; the agreed question scored (2) grade, sometimes scored (1), and disagree scored (0) .The total score for all (12) questions was 24 marks which represent 100%.

The total level of nurse's attitude was categorized as the following:-

- **Negative attitude** (< 60%)
- **Positive attitude** (60% ≤ 100%)

Preparatory phase

This phase included reviewing the past and current local and international related literature using articles, magazines, online access, and books to be aware of various aspects of the research problem. Tools of data collection was designed, and developed by the researcher, and it was translated into Arabic language.

Content validity and reliability

The revision of tools was done through a jury of three experts in the field of pediatric nursing from the Faculty of Nursing Benha University, to test the content validity of the instruments and to judge its clarity, comprehensiveness, relevance, simplicity and accuracy. All of their remarks were considered. Some items were rephrased to arrive at the final version of the tools. The tools were regarded as valid from the experts, point of view.

Reliability of the tools was tested by the researcher for testing the internal consistency by administrating the tools to the same subjects under similar conditions using Cronbach's Alpha coefficient test. This turned to be (0.731) for nurses knowledge, (0.849) for nurses practice and (0.723) for nurses attitude.

Ethical Consideration

All ethical issues were taken into consideration during all phases; Research approval was obtained from ethical committee of Benha faculty of nursing before starting the study. The researcher explained the aim, natural and expected outcome of the study to the studied nurses before their inclusion in the study. Nurses' participation was voluntary, and they were allowed to withdraw at any time from the study. Oral/ written acceptance was obtained from all nurses. All gathered data would be used for research purposes only. Confidentiality and results were secured.

Pilot study

A pilot study was carried out on 10% of the actual total sample size (5 nurses) to test the content feasibility, clarity, objectivity and applicability of the study tools, and to estimate time needed to fill each tool. The necessary modifications were done accordingly. No radical modification was suggested upon reviewing the study tools so, participants involved in the pilot study were included the study sample.

Field work

Collection of data for this study was carried out over a period of six months started from the beginning of October 2022 to the end of March 2023. The researcher was available two days/ week. Data was collected during the morning and evening times from the previously mentioned setting by using the previously mentioned tools.

At first the researcher interviewed the nurses individually, explained the aim of the study and took their approval to participate in the study prior data collection .The interview took about 20-30 minutes to fill the questionnaire sheet. The researcher assessd

nurse' knowledge about antibiotic stewardship program.

The tools were filled individually by the nurses for their knowledge and attitude then the researcher observed nurses practice during their actual nursing care. The average number of the interviewed was four to five nurses per day.

The researcher started to collect data through assessment, planning, implementation and evaluation phase as the following.

Assessment phase

At first each nurse was interviewed individually, at the beginning of the interview the researcher welcomed the nurses, explained the aim of the study, objective, tools, the study technique and outcomes of the study to obtain their approval to participate in the study prior data collection. An average of 3-5 nurses were interviewed per /day.

Data collected in this phase before implementing the educational program. The questionnaire sheets were distributed to all nurses individually to assess nurse's performance (knowledge, practice and attitude), to determine nurses needs regarding antibiotic stewardship using previous study tools. The time needed for filling all data collection tools were 20-30 minutes, the average time needed to answer personal data and knowledge questions 10-15 minutes and time needed to answer practice steps are 10-15 minutes .The period of assessment phase (pre-test) took 2 months (from the beginning of October 2022 to the end of November 2023)

Planning phase

This Phase included analysis of the assessment phase and based on baseline data obtained from pre- test finding, identification of the actual needs of the studied nurses and reviewing relevant literature, the educational program was designed by the researcher using simple Arabic language. Different teaching methods (modified lecture, brain storming, demonstration, re-demonstration, group discussion and suitable teaching media (power point, Booklet and pictures) used as a guide in order to facilitate nurses' understanding.

Program Construction

- **Statement of objectives**

General objectives

The educational program aimed to improve nurses' performance regarding antibiotic stewardship program based on fulfilling their needs of knowledge, practice and attitude in Pediatric Intensive Care Units.

Specific objectives:

At the end of this educational program each nurse should be able to

- Enumerate the objectives of the educational program and its expected outcomes for children.
- Distinguish between different terminologies related to antibiotic stewardship program.
- Explain general notes about antibiotics, types, forms, and mechanism of action.
- Discuss the reasons that led to the establishment of a hospital antibiotic stewardship program.
- Illustrate the importance of applying the antibiotic stewardship program within the hospital.
- Identify the obstacles that prevent the implementation of antibiotic stewardship program.
- Recognize the antibiotic stewardship program team members and their specialization.
- Enumerate core elements of the antibiotic stewardship program.
- Categorize challenges (difficulties) faced by nurses to participate in the program.
- Discuss ways to involve nurses be a member of the antibiotic stewardship program.

- Applying the nurses' role within the program.

Implementation phase

The educational program regarding antibiotic stewardship was developed based on the actual need of assessment and implemented for nurses. The implementation phase was achieved through 10 sessions at a period of 8 weeks (1-2 session /week). The studied nurses were divided into 8 groups each group consisted of 4-5 nurses, (6) sessions for theoretical part each session consumed 45-60 minutes, (3) sessions for practical and (1) session for attitude consumed 60 minutes. Each session started by summary of the previous session and objectives of the current session. Each session included 10 minutes for discussion and feedback. These sessions were repeated to each group of nurses. Motivation and reinforcement were used during sessions to encourage nurses' participation in the study. Different methods of teaching were used such as; discussion, lecture, and brain storming for each group. Media utilized were educational program guided by an educational booklet and power point and posters which were constructed by the researcher after reviewing the related literatures about antibiotic stewardship.

Knowledge sessions

The purpose of Knowledge sessions is to enhance nurses' knowledge about antibiotic steward ship programs. **The first session** focused on objectives of the educational program and its expected outcomes, different terminologies related to antibiotic and antibiotic stewardship program, general notes about antibiotics. **The second session** focused on, discussing the reasons that led to the establishment of a hospital antibiotic stewardship program, explanation the importance of applying the antibiotic stewardship program within the hospital, identifying the obstacles that prevent the implementation of antibiotic stewardship program. **The third session** focused on

recognizing the antibiotic stewardship program team members and their specialization., enumeration the core elements of antibiotic stewardship program. **The fourth session** focused on recognizing responsibilities of leadership commitment, illustration the accountability and responsibility of the program, enumeration the additional procedures followed to administer antibiotics. **The fifth session** focused on distinguishing between different types of education within the antibiotic stewardship program, discussing general policy for monitoring bacterial resistance, realizing procedures for reporting antibiotic resistance within the antibiotic stewardship program. **The sixth session** focused on recognizing relation between antibiotic stewardship program and corona virus, mention challenges (difficulties) faced by nurses to participate in the program, discussing ways to involve nurses in antibiotic stewardship program.

Practices sessions

The purpose of practices sessions is to improve reported practice of nurses, **the first session** focused on compiling with other team member's duties and responsibilities of nurses, assessing antibiotic allergy history, following infection control steps in dealing microbiological samples, **The second session** focused on improving the timely administration of antibiotics, demonstrate handling of optimum antibiotic doses, monitor clinical progress and side effects or ineffectiveness of the antibiotic, **The third session** focused on, cooperating with team members to transfer antibiotics from intravenous to oral, applying measures of stopping antibiotic medication.

Attitude session

The purpose of attitude session is to improve reported attitude of nurses, **the**

session focused on raise awareness among pediatric health care providers, stopping antibiotic resistance, reducing infection and prevents its spread**,** reducing side effects of antibiotics, increasing the effectiveness of the drug in eliminating bacteria and limiting their growth, increasing children's chances of receiving appropriate treatment and completing the treatment plan, ensuring the safety and security of children and reduce their stay in the hospital, reducing the cost of treatment, improving the children status and reducing complications.

Evaluation phase

After the implementation of the educational program the post-test was administered to assess the effect of the program on nurses' knowledge, attitude and practices using the same tools of pretest related to antibiotic stewardship. This was done immediately after the implementation of program and took about 8 weeks (from the beginning of February2023 to the end of March 2023).

Statistical analysis

The collected data organized, tabulated and statistically analyzed using Statistical Package for Social Science (SPSS) version 25 for windows, running on IBM compatible computer. Descriptive statistics were applied (e.g. frequency, percentages, mean and standard deviation). Qualitative variables were compared using qui square test (x2) as the test of significance, and paired (t) test was used to compare between quantitative variables. Correlation coefficient test (r) was used to test the correlation between studied variables. Reliability of the study tools was done using Cronbach's Alpha. A significant level value was considered when $p < 0.05$ and a highly significant level value was considered when $p < 0.01$. No statistical significance difference was considered when $p > 0.05$.

Results

Table (1): Shows that, less than half (46%) of the studied nurses aged between 25-<30 years with mean age 28.84% SD is ± 11.34 years, Also, more than one third (36%) of them have 5-<10 years of experience in PICU with mean ± SD is 7.92 ± 4.90 years, Moreover, the minority (16%) of them attended training courses on antibiotic stewardship. In addition, all of them couldn't apply what has been learned. Less than three quarters (62.5%) of them due to work pressure.

Figure (1): Shows that, less than half (48.0%) of the studied nurses had technical institute of nursing. Also, less than half (42.0% of them had bachelor degree of nursing. While, the minority (4.0% and 6.0%) of them had nursing diploma and postgraduate studies, respectively.

Figure (2): Shows that, less than three quarters (74%) of the studied nurses are females, while more than one quarter (26%) is male.

Figure (3): Shows that, more than three quarters (76%) of the studied nurses are staff nurses, while less than one quarter (24%) is unit supervisor.

Figure (4): Shows that, half (50.0%) of the studied nurses had poor level of total knowledge about the antibiotic stewardship program pre-implementation of educational program, in contrast, more than three quarters (76.0%) of them had good level of total knowledge post implementation of educational program.

Figure (5): Shows that, the majority (86.0%) of the studied nurses was incompetent regarding antibiotic stewardship program pre implementation of educational program; in contrast, the majority (82.0%) of them was competent regarding antibiotic stewardship

program post implementation of educational program.

Figure (6): Shows that, more than three quarters (76.0%) of the studied nurses had negative attitude regarding antibiotic stewardship program pre-implementation of educational program, in contrast, the majority (84.0%) of them had positive attitude regarding antibiotic stewardship program post implementation of educational program.

Table (2): Shows that, there was a highly statistically significant relation between total nurses' knowledge at pre-intervention and knowing that there is an official program for giving antibiotics in the hospital, knowing that the antibiotic stewardship program is activated and applied in the hospital and participation in the antibiotic administration program at (P= < 0.001). Also, there was statistically significant relation between total nurses' knowledge and their academic qualification and attendance of training courses on antibiotic stewardship at (P= < 0.05). While, there was no statistically significant relation between total nurses' knowledge and their age, gender, job title and number of years of experience at (P= > 0.05). Also, this table shows that, there was statistically significant relation between total nurses' knowledge at post-intervention and their academic qualification, knowing that there is an official program for giving antibiotics in the hospital and participation in the antibiotic administration program at (P= < 0.05). While, there was no statistically significant relation between total nurses' knowledge and their age, gender, job title, number of years of experience, attendance of training courses on antibiotic stewardship and knowing that the antibiotic management program activated and applied in the hospital at (P= > 0.05).

Table (3): Shows that, there was a statistically significant relation between total nurses' practice at pre-intervention and their academic qualification, attendance of training courses on antibiotic stewardship, knowing that there is an official program for giving antibiotics in the hospital, knowing that the antibiotic management program activated and applied in the hospital and participation in the antibiotic administration program at (P= < 0.05). While, there was no statistically significant relation between total nurses' practice and their age, gender, job title and number of years of experience at (P= > 0.05). Also, this table shows that, there was statistically significant relation between total nurses' practice at post-intervention and their academic qualification at (P= < 0.05). While, there was no statistically significant relation between total nurses' practice and their age, gender, job title, number of years of experience, attendance of training courses on antibiotic stewardship, knowing that there is an official program for giving antibiotics in the hospital, knowing that the antibiotic management program activated and applied in the hospital and participation in the antibiotic administration program at (P= > 0.05).

Table (4): Shows that, there was a statistically significant relation between total nurses' attitude at pre-intervention and their age, academic qualification, number of years of experience, attendance of training courses on antibiotic stewardship, knowing that there is an official program for giving antibiotics in the hospital, knowing that the antibiotic management program activated and applied in the hospital and participation in the antibiotic administration program at (P= < 0.05). While, there was no statistically significant relation between total nurses' attitude and their gender and job title at (P= > 0.05). Also, this table shows that, there was a highly statistically significant relation between total nurses' attitude at post-intervention and their academic qualification at (P= < 0.01). While, there was

no statistically significant relation between total nurses' attitude and their age, gender, job title, number of years of experience,

attendance of training courses on antibiotic stewardship, knowing that there is an official program for giving antibiotics in the hospital, knowing that the antibiotic management program activated and applied in the hospital and participation in the antibiotic administration program at (P= > 0.05).

Table (5): shows that, there was a highly statistically positive correlation between total nurses' knowledge, total practice and total attitude towards the antibiotic stewardship program pre-implementation of educational program at (r= 0.390, r=0.409 and r=0.438, respectively). Also, there was a highly statistically positive correlation between total nurses' knowledge, total practice and total attitude towards the antibiotic stewardship program post-implementation of educational program at (r= 0.524, r=0.533 and r=0.530, respectively.

Table (1): Distribution of the studied nurses according to their personal characteristics (n=50)

Personal characteristics	No.	%
- Age (years)		
< 20	3	6.0
20-<25	8	16.0
25-<30	23	46.0
30-<35	9	18.0
35 – 45	7	14.0
Mean ± SD **28.84 ± 11.34**		
- Years of experience in PICU		
<1 year	4	8.0
1-<5 years.	8	16.0
5-<10 years.	18	36.0
10-<15 years	16	32.0
≥ 15 years.	4	8.0
Mean ± SD **7.92 ± 4.90**		
- Attending training courses on antibiotic stewardship		
Yes	8	16.0
No	42	84.0
- Number of courses attended (n=8).		
One	**8**	**100.0**
More than one course	0	0.0
- Application of learned course in your daily work (n=8)		
Yes	0	0.0
No	**8**	**100.0**
- Reasons of no application (n=8)		
Non-implementation of the program inside the hospital	2	25.0
Poor capabilities of the hospital	1	12.5
Work pressures	**5**	**62.5**

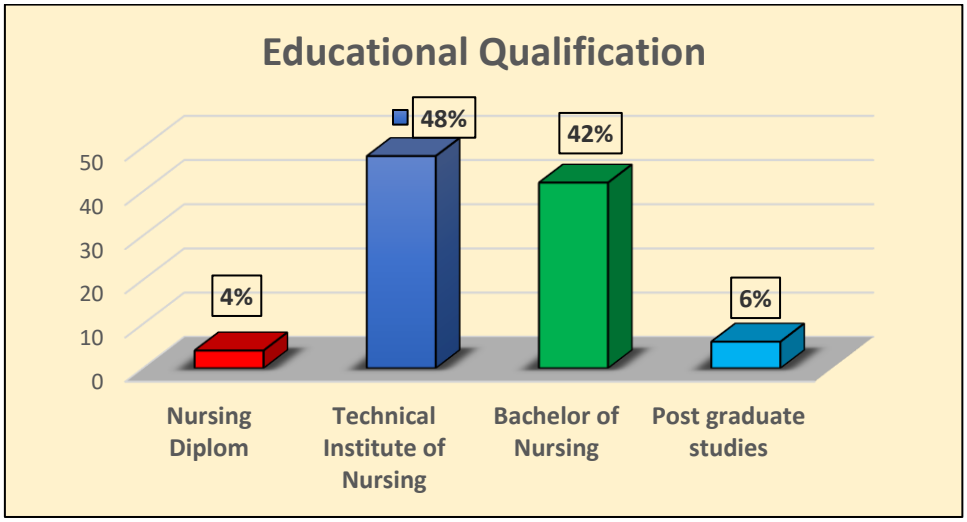

Figure (1): Percentage distribution of the studied nurses according to their educational qualification

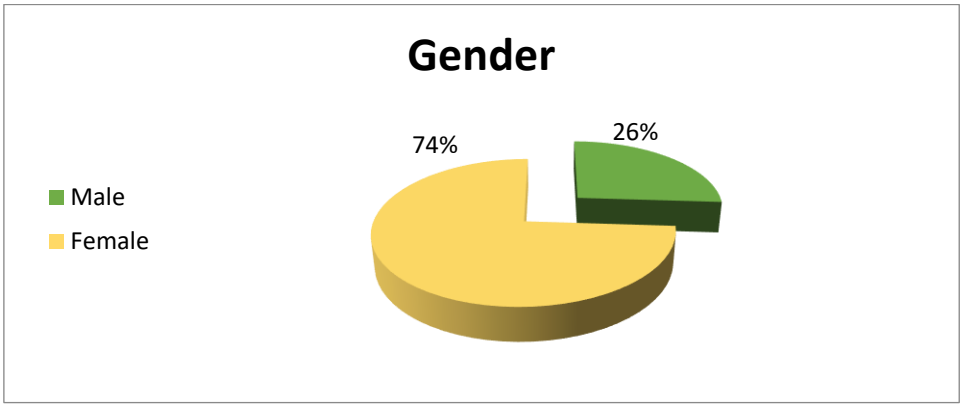

Figure (2): Percentage distribution of the studied nurses according to their gender (n=50)

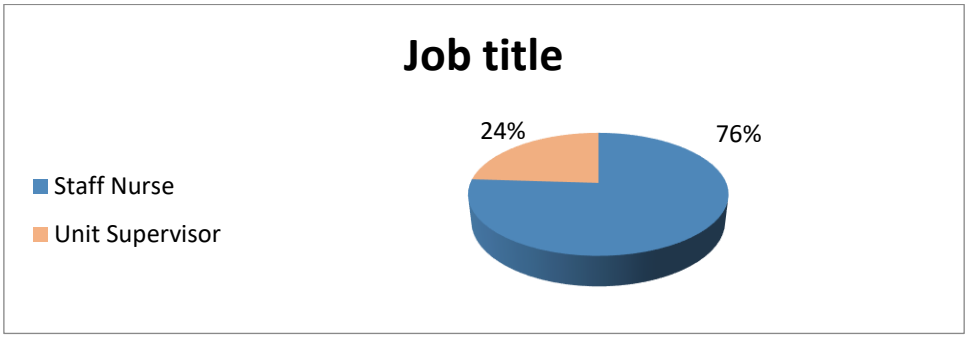

Figure (3): Percentage distribution of the studied nurses according to their job title (n=50)

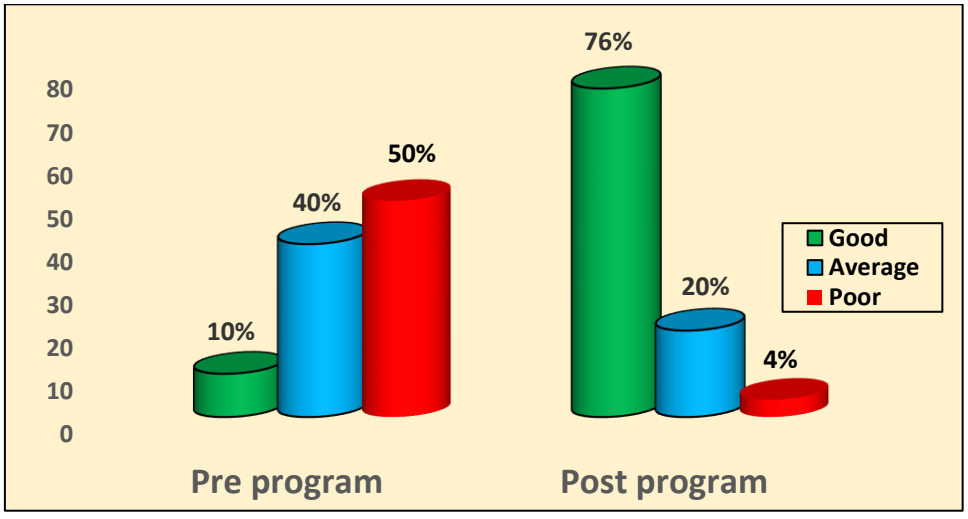

Figure (4): Percentage distribution of total nurses' knowledge about antibiotic stewardship program at pre and post implementation of education program (n=50).

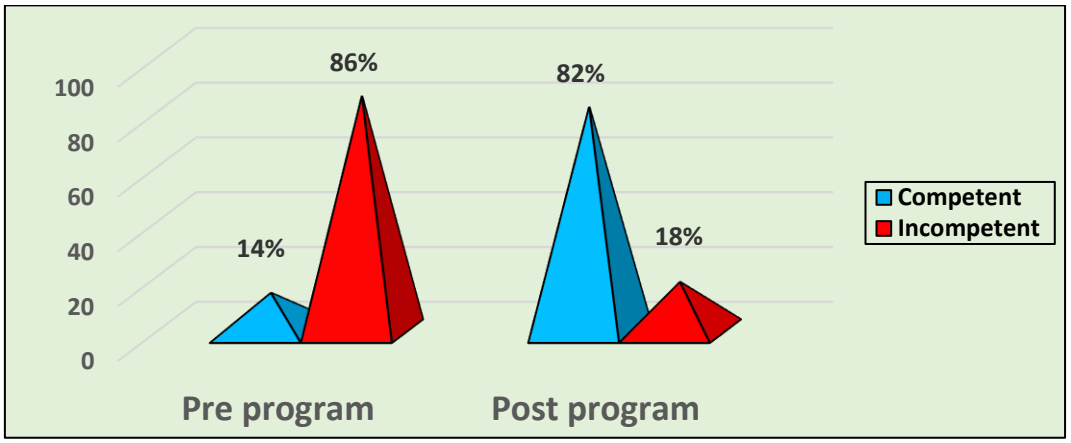

Figure (5): Percentage distribution of total nurses' practice regarding antibiotic stewardship program at pre and post implementation of education program (n=50).

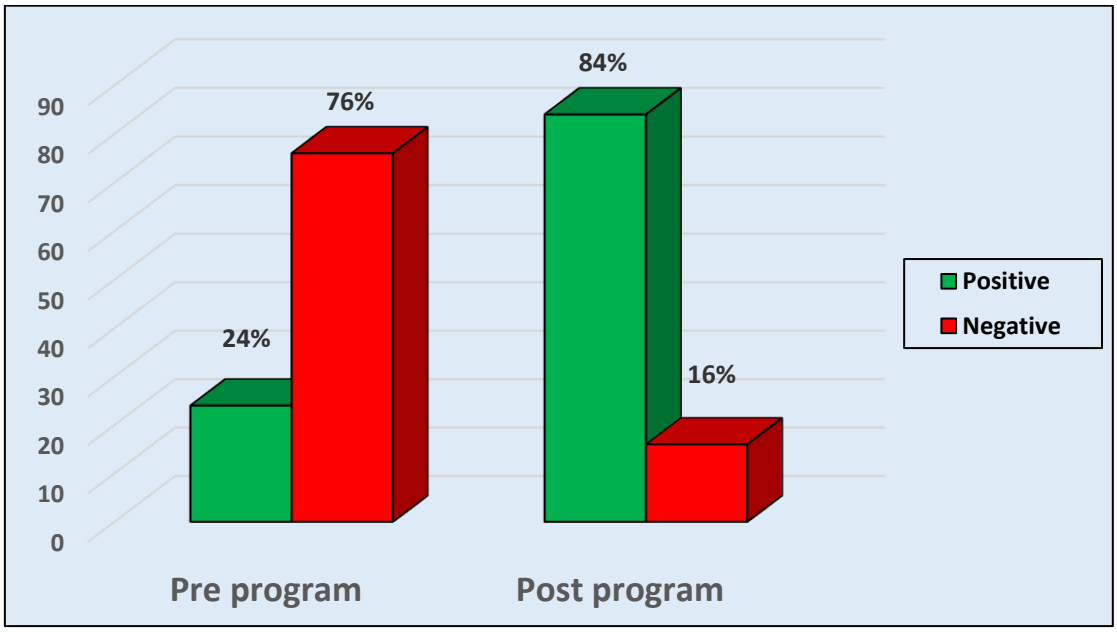

Figure (6): Percentage distribution of total nurse's attitude towards the antibiotic stewardship program pre / post implementation of education program (n=50)

Table (2): Relation between personal characteristics of the studied nurses and their total knowledge pre and post implementation of education program (n=50).

Personal characteristics	Total knowledge Pre program phase						x^2 (p)	Post program phase						x^2 (p)
	Good (n =5)		Average (n =20)		Poor (n=25)			Good (n=38)		Average (n=10)		Poor (n=2)		
	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%	
Age (years)														
< 20	0	0.0	0	0.0	3	12.0	11.71	2	5.3	1	10.0	0	0.0	4.867
20-<25	0	0.0	5	5.0	3	12.0	(0.165)	6	15.8	2	20.0	0	0.0	(0.772)
25-<30	1	20.0	9	45.0	13	52.0		16	42.1	5	50.0	2	100	
30-<35	3	60.0	3	15.0	3	12.0		7	18.4	2	20.0	0	0.0	
35 – 45	1	20.0	3	15.0	3	12.0		7	18.4	0	0.0	0	0.0	
Gender														
Male.	2	40.0	5	25.0	6	24.0	0.572	9	23.7	3	30.0	1	50.0	0.788
Female	3	60.0	15	75.0	19	76.0	(0.751)	29	76.3	7	70.0	1	50.0	(0.674)
Academic qualification														
Nursing Diploma	0	0.0	0	0.0	2	8.0		0	0.0	1	10.0	1	50.0	
Technical Institute of Nursing	0	0.0	8	40.0	16	64.0	15.71	17	44.7	6	60.0	1	50.0	8.261
Bachelor of Nursing	3	60.0	11	55.0	7	28.0	(0.015*)	18	47.4	3	30.0	0	0.0	(0.041*)
Post graduate studies	2	40.0	1	5.0	0	0.0		3	7.9	0	0.0	0	0.0	
Job title														
Staff Nurse	2	40.0	16	80.0	20	80.0	3.947	28	73.7	9	90.0	1	50.0	1.928
Unit Supervisor	3	60.0	4	20.0	5	20.0	(0.139)	10	26.3	1	10.0	1	50.0	(0.381)
Number of years of experience														
<1 year	0	0.0	2	10.0	2	8.0	7.844	2	5.3	2	20.0	0	0.0	6.243
1-<5 years.	0	0.0	3	15.0	5	20.0	(0.449	5	13.2	2	20.0	1	50.0	(0.620)
5-<10 years.	1	20.0	6	30.0	11	44.		14	36.8	3	30.0	1	50.0	
10-<15 years	4	80.0	7	35.0	5	20.0		13	34.2	3	30.0	0	0.0	
≥ 15 years.	0	0.0	2	10.0	2	8.0		4	10.5	0	0.0	0	0.0	
Attending training courses on antibiotic stewardship														
Yes	2	40.0	5	25.0	1	4.0	6.027	6	15.8	2	20.0	0	0.0	4.501
No	3	60.0	15	75.0	24	96.0	(0.049*)	32	84.2	8	80.0	2	100	(0.221)
Knowing that there is an official program for giving antibiotics in the hospital														
Yes	4	80.0	6	30.0	2	8.0	21.72	8	21.1	4	40.0	0	0.0	7.900
No	1	20.0	14	70.0	9	36.0	(.001**)	19	50.0	4	40.0	1	50.0	(0.015*)
Don't know	0	0.0	0	0.0	14	56.0		11	28.9	2	20.0	1	50.0	
Knowing that the antibiotic management program activated and applied in the hospital?														
Yes	4	80.0	8	40.0	0	0.0	17.41	8	21.1	4	40.0	0	0.0	4.833
No	1	20.0	11	55.0	23	92.0	(.002**)	29	76.3	5	50.0	1	50.0	(0.119)
Don't know	0	0.0	1	5.0	2	8.0		1	2.6	1	10.0	1	50.0	
Participating in the antibiotic administration program														
Yes	5	100	9	45.0	0	0.0	14.66	14	36.8	0	0.0	0	0.0	12.77
No	0	0.0	11	55.0	25	100	(.001**)	24	63.2	10	100	2	100	(0.010*)

Table (3): Relation between personal characteristics of the studied nurses and their total practice pre and post implementation of education program (n=50).

Items		Levels of total practice at pre program phase				X2	P-Value	Levels of total practice at post program phase				X2	P-Value
		Competent (n=7)		Incompetent (n=43)				Competent (n=41)		Incompetent (n=9)			
		No.	%	No.	%			No.	%	No.	%		
Age (year)	< 20	0	0.0	3	7.0	3.113	0.539	1	2.4	2	22.2	6.603	0.158
	20-<25	1	14.3	7	16.2			6	14.6	2	22.2		
	25-<30	5	71.4	18	41.9			21	51.2	2	22.2		
	30-<35	0	0.0	9	20.9			7	17.1	2	22.2		
	35 – 45	1	14.3	6	14.0			6	14.6	1	11.1		
Gender	Male	3	42.9	10	23.3	0.357	0.254	11	26.8	2	22.2	1.000	0.571
	Female	4	57.1	33	76.7			30	73.2	7	77.8		
Academic qualification	Nursing Diploma	0	0.0	2	4.7	10.41	0.011*	1	2.4	1	11.1	8.825	0.032*
	Technical Institute of Nursing	0	0.0	24	55.8			19	46.3	5	55.6		
	Bachelor of Nursing	4	57.1	17	39.5			20	48.8	1	11.1		
	Post graduate studies	3	42.9	0	0.0			1	2.4	2	22.2		
Job title	Staff Nurse	5	71.4	33	76.7	1.000	0.542	30	73.2	8	88.9	0.425	0.299
	Unit Supervisor	2	28.6	10	23.3			11	26.8	1	11.1		
Number of years of experience	<1	2	28.6	2	4.7	6.684	0.154	3	7.3	1	11.1	0.881	0.927
	1-<5	2	28.6	6	14.0			6	14.6	2	22.2		
	5-<10	2	28.6	16	37.2			15	36.6	3	33.3		
	10-<15	1	14.2	15	34.9			14	34.1	2	22.2		
	≥ 15	0	0.0	4	9.2			3	7.3	1	11.1		
Attending training courses on antibiotic stewardship	Yes	6	85.7	2	4.7	8.271	0.037*	8	19.5	0	0.0	2.454	0.117
	No	1	14.3	41	95.3			33	80.5	9	100.0		
An official antibiotic management program in the hospital	Yes	5	71.4	7	16.2	9.005	0.031*	10	24.4	2	22.2	0.276	0.871
	No	2	28.6	22	51.2			19	46.3	5	55.6		
	Don't know	0	0.0	14	3.6			12	29.3	2	22.2		
Antibiotic management program activated and applied in the hospital?	Yes	5	71.4	7	16.3	11.41	0.015*	10	24.4	2	22.2	0.510	0.775
	No	2	28.6	33	76.7			29	70.7	6	66.7		
	Don't know	0	0.0	3	7.0			2	4.9	1	11.1		
Participating in antibiotic administration program	Yes	7	100	7	16.2	12.63	0.010*	11	26.8	3	33.3	0.697	0.490
	No	0	0.0	36	83.8			30	73.2	6	66.7		

Table (4): Relation between personal characteristics of the studied nurses and their total attitude pre and post implementation of education program (n=50).

Items		Levels of total attitude at pre program phase				X2	P-Value	Levels of total attitude at post program phase				X2	P-Value
		Positive (n=12)		Negative (n=38)				Positive (n=42)		Negative (n=8)			
		No.	%	No.	%			No.	%	No.	%		
Age (year)	< 20	0	0.0	3	7.9	10.56	0.032*	3	7.1	0	0.0	5.219	0.266
	20-<25	0	0.0	8	21.1			5	11.9	3	37.5		
	25-<30	9	75.0	14	36.8			21	50.0	2	25.0		
	30-<35	0	0.0	9	23.7			8	19.0	1	12.5		
	35 - 45	3	25.0	4	10.5			5	11.9	2	25.0		
Gender	Male	3	25.0	10	26.3	1.000	0.624	13	31.0	0	0.0	3.346	0.067
	Female	9	75.0	28	73.7			29	69.0	8	100.0		
Academic qualification	Nursing Diploma	0	0.0	2	5.3	8.408	0.042*	0	0.0	2	25.0	11.55	0.009**
	Technical Institute of Nursing	5	41.7	19				18	42.9	6	75.0		
	Bachelor of Nursing	4	33.3	17	44.7			21	50.0	0	0.0		
	Post graduate studies	3	25.0	0	0.0			3	7.1	0	0.0		
Job title	Staff Nurse	9	75.0	29	76.3	1.000	0.602	32	76.2	6	75.0	1.000	0.627
	Unit Supervisor	3	25.0	9	23.7			10	23.8	2	25.0		
Number of years of experience	<1	1	8.3	3	7.9	8.158	0.047*	4	9.5	0	0.0	4.220	0.377
	1-<5	0	0.0	8	21.1			5	11.9	3	37.5		
	5-<10	8	66.7	10	26.3			16	38.1	2	25.0		
	10-<15	3	25.0	13	34.2			14	33.3	2	25.0		
	≥ 15	0	0.0	4	10.5			3	7.1	1	12.5		
Attending training courses on antibiotic stewardship	Yes	7	58.3	1	2.6	9.336	0.037*	7	16.7	1	12.5	1.000	0.622
	No	5	41.7	37	97.4			35	83.3	7	87.5		
An official antibiotic management program in the hospital	Yes	9	75.0	3	7.9	8.955	0.040*	9	21.4	3	37.5	1.548	0.461
	No	1	8.3	23	60.5			20	47.6	4	50.0		
	Don't know	2	16.7	12	31.6			13	31.0	1	12.5		
Antibiotic management program activated and applied in the hospital?	Yes	10	83.4	2	5.3	8.566	0.045*	10	23.8	2	25.0	1.938	0.379
	No	1	8.3	34	89.5			30		5	62.5		
	Don't know	1	8.3	2	5.3			2	4.8	1	12.5		
Participating in antibiotic administration program	Yes	10	83.3	4	10.5	9.001	0.035*	10	23.8	4	50.0	2.286	0.131
	No	2	16.7	34	89.5			32	76.2	4	50.0		

Table (5): Correlation between total nurses' knowledge, total practice and total attitude towards the antibiotic stewardship program pre and post implementation of education program (n=50).

Variables		Total nurses' practice		Total nurses' Attitude	
		Pre program	Post program	Pre program	Post program
Total nurses' knowledge	r	0.390	0.524	0.409	0.533
	p	0.005**	.000**	0.001**	.000**
Total nurses' Attitude	r	0.438	0.530		
	p	0.001**	.000**		

Discussion

In relation to personal characteristics of the studied nurses, the current study revealed that, less than half of the studied nurses aged between 25≤ 30 years with mean age were 28.84 ± 11.34. This result was in agreement with **Lalithabai et al., (2022)** in their recent study entitled "Knowledge, attitude and beliefs of nurses regarding antibiotic use and prevention of antibiotic resistance" and reported that about one third of the studied nurses their age group was between 25 to < 30 years with mean ± SD age was 28.371 ± 5.69 years .

Regarding total nurses' knowledge about antibiotic stewardship program at pre and post implementation of education program**,** the present study revealed that, half of the studied nurses had poor level of total knowledge about the antibiotic stewardship program pre-implementation of educational program, in contrast, more than three quarters of them had good level of total knowledge post implementation of educational program, from the researcher point of view, this result preprogram implementation might be related to that, minority of the studied nurses were attending training courses on antibiotic stewardship.

This study was agreed with **(Kilpatrick et al., 2023)** in their recent study titled "Nurses' knowledge and implementation of antimicrobial stewardship and infection prevention strategies in acute pediatric settings" who stated that most of the studied nurses had satisfactory knowledge level regarding antibiotic stewardship post program

implementation than pretest. Also, this result was in agreement with **(Mittal et al., 2023)** who mentioned that more than two thirds of the studied nurses had good knowledge post educational program regarding antimicrobial stewardship.

Concerning Percentage distribution of total nurses' practice regarding antibiotic stewardship program at pre and post implementation of education program, the current study found that, the majority of the studied nurses were incompetent regarding antibiotic stewardship program pre implementation of educational program, in contrast, the majority of them were competent regarding antibiotic stewardship program post implementation of educational program, in the researcher point of view, this might be related to, effect of educational program of the current study on improvement of the studied nurses practice regarding antibiotic stewardship program implementation.

This result was similar to **Schmid et al., (2022)** in their recent study titled "Interprofessional collaboration between ICU physicians, staff nurses, and hospital

pharmacists optimizes antimicrobial stewardship and improves quality of care and economic outcome" and mentioned that about two thirds of the studied nurses had poor practice level regarding antimicrobial stewardship. Also, this finding was agreed with **Fayed et al., (2022)** who stated that most studied nurses had proficient level of practices after applying the educational program as compared to before implementation.

Concerning percentage distribution of total nurses' attitude towards the antibiotic stewardship program pre and post implementation of education program, the present study represented that, more than three quarters of the studied nurses had negative attitude regarding antibiotic stewardship program pre-implementation of educational program, in contrast, the majority of them had positive attitude regarding antibiotic stewardship program post implementation of educational program, this reflect the positive effect of the current study educational program on converting the studied nurses attitude from negative to positive attitude regarding antibiotic stewardship program. This improvement indicated that the educational program was a successful method to improve nurses' attitude.

This finding was similar to **Hamdy et al., (2019)** who reported that more than half of the studied nurses had negative attitude regarding antimicrobial stewardship preprogram which improved post program to majority of them had positive attitude regarding antimicrobial stewardship. Also, this result was agreed with **Kjærsgaard et al., (2019)** who carried out a study entitled "Antibiotic stewardship based on education: Minor impact on knowledge, perception and attitude" and mentioned that there was an improvement in nurses' attitude regarding antibiotic stewardship which was more than one third of them had negative attitude pre educational program which improved to become most of them had positive attitude regarding antibiotic stewardship post educational program.

Regarding relationship between personal characteristics of the studied nurses and their total knowledge pre and post implementation of education program, the current study found that, there was a highly statistically significant relation between total nurses' knowledge at pre-intervention and knowing that there is an official program for giving antibiotics in the hospital, knowing that the antibiotic stewardship program activated and applied in the hospital and participation in the antibiotic stewardship program. Also, there was statistically significant relation between total nurses' knowledge and their academic qualification and attendance of training courses on antibiotic stewardship. While, there was no statistically significant relation between total nurses' knowledge and their age, gender, job title and number of years of experience.

Also, this finding was agreed with **Elsayed et al., (2019)** who stated that there was no statistically significant relation between total knowledge level of the studied nurses and their age, gender, job title in hospital, number and years of experiences post program implementation. Moreover, this result was supported by **Fitzpatrick et al., (2021)** who mentioned that there was a statistically significant difference between the studied nurses' total knowledge post educational program implementation and there educational level and participation in antimicrobial stewardship in their hospital.

Concerning relationship between personal characteristics of the studied nurses and their total practice pre and post implementation of education program, the

present study represented that, there was a statistically significant relation between total nurses' practice at pre-intervention and their academic qualification, attendance of training courses on antibiotic stewardship, knowing that there is an official program for giving antibiotics in the hospital, knowing that the antibiotic management program activated and applied in the hospital and participation in the antibiotic stewardship program. While, there was no statistically significant relation between total nurses' practice and their age, gender, job title and number of years of experience.

This finding was similar to **Chater et al., (2023)** who found that there was a statistically significant difference between the studied nurses' practice and their educational level, training courses, knowing about and participation in antimicrobial stewardship program in their hospitals. Also, this study was agreed with **Patel et al., (2022)** in their resent study titled "Examining Nurse Engagement in Antimicrobial Stewardship at Long-Term Care Facilities" and reported that there was no statistically significant difference between total practices of the studied nurses and their age, gender, work title and years experiences.

Contrariwise, this finding was dissimilar to **Fayed et al., (2022)** who revealed that there was no statistically significant relation between the studied nurses' practice and their educational level.

Regarding relationship between personal characteristics of the studied nurses and their total attitude pre and post implementation of education program, the current study reported that, there was a statistically significant relation between total nurses' attitude at pre-intervention and their age, academic qualification, number of years of experience, attendance of training courses on antibiotic stewardship, knowing that there is an official program for giving antibiotics in the hospital, knowing that the antibiotic stewardship program activated and applied in the hospital and participation in the antibiotic stewardship program. While, there was no statistically significant relation between total nurses' attitude and their gender and job title.

In addition, there was a highly statistically significant relation between total nurses' attitude at post-intervention and their academic qualification. While, there was no statistically significant relation between total nurses' attitude and their age, gender, job title, number of years of experience, attendance of training courses on antibiotic stewardship, knowing that there is an official program for giving antibiotics in the hospital, knowing that the antibiotic stewardship program activated and applied in the hospital and participation in the antibiotic stewardship program.

This study was in agreement with **Kumar et al., (2019)** who mentioned that there was no statistically significant relation between the studied nurses' total attitude and their gender and job title. Contrariwise, this result was in disagreement with **Lalithabai et al., (2022)** who stated that there was no statistically significant difference between total attitude of the studied nurses and there age, educational qualifications, years of experiences, training courses regarding antibiotic use, presence of antibiotic stewardship program in hospital and engagement in implementation of antibiotic management program.

Conclusion

The performance of pediatric nurses regarding to antibiotic stewardship was improved and the program was effective. There were statistically significant differences between the level of knowledge, practice and attitude of pediatric nurses after implementing the program. There was positive correlation between total knowledge, practice and

attitude of pediatric nurses regarding to antibiotic stewardship.

Recommendations

1. Enhancing nurse's performance regarding antibiotic stewardship programs through in-service training program in PICUs.
2. Providing simple illustrative educational booklets, posters about antibiotic stewardship programs for all health team members in hospitals and outpatient clinics .
3. Further studies; repeating the study on large sample to generalize the results.

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تأثير برنامج تعليمي تجاه إدارة المضادات الحيوية علي أداء الممرضات في وحدات الرعاية المركزة للأطفال

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برامج إدارة المضادات الحيوية عبارة عن مجموعة من الإجراءات المنسقة لتعزيز الاستخدام المناسب والامثل للمضادات الحيوية بهدف تحسن حالة المرضي من الأطفال ومعافاتهم مع تقليل فرص تحول البكتيريا إلى بكتيريا مقاومة للمضادات الحيوية. هدفت الدراسة إلى تقييم تأثير البرنامج التعليمي على أداء ممرضين الأطفال فيما يتعلق بإدارة المضادات الحيوية. تم استخدام التصميم شبه التجريبي (قبل الإختبار / بعد الإختبار) لإجراء هذه الدراسة, وقد أجريت الدراسة في وحدات العناية المركزة للأطفال في مستشفى بنها الجامعي علي عينة ملائمة شملت جميع الممرضين المتواجدين وعددهم 50 ممرض وممرضه. أظهرت نتائج هذه الدراسه وجود علاقة إيجابية بين معلومات وممارسات واتجاهات ممرضين الأطفال قبل وبعد تنفيذ البرنامج التعليمي, واستنتجت هذه الدراسه أن البرنامج التعليمي كان فعالا في تحسين مستوى أداء ممرضين الأطفال مع وجود دلاله إحصائية عالية بين معلومات وممارسات واتجاهات الممرضين قبل وبعد تنفيذ البرنامج, وقد أوصت الدراسه بتحسين أداء الممرضين من خلال برامج التدريب أثناء العمل في وحدات العناية المركزة للأطفال.