Effect of PDCA Nursing Model Based on Artificial Intelligence Strategies on Nurses' Performance Regarding Care of Children with Henoch-Schonlein Purpura

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Abstract

Background: Successful implementation of AI into clinical practice requires a thorough understanding of the attitudes and behaviors of the nurses. **Aim:** To evaluate the effect of PDCA nursing model based on artificial intelligence strategies on nurses' performance regarding care of children with Henoch-Schonlein Purpura. **Subjects and Method: Design:** The present study was carried out utilizing a quasi-experimental research design. **Setting:** The present study was conducted at inpatient pediatric blood disease unit at Benha Specialized Pediatric Hospital in Benha City. **Subjects:** All available nurses, composed of 60 nurses working at the previously mentioned settings were included in the current study regardless of their personal characteristics. **Tools:** Four tools were used for data collection, **Tool I:** A structured interviewing questionnaire. **Tool II***:* An observational checklist to assess nurses' practice regarding care of children with Henoch-Schonlein Purpura **Tool III:** Nurses' attitudes toward artificial intelligence. **Tool IV***:* Nurses' opinion regarding the effectiveness of each stage of PDCA model. **Results:** The majority of the studied nurses had satisfactory level of knowledge and competent level regarding their total practice post PDCA model application. Also, the majority of them had positive attitude post PDCA model application. **Conclusion:** PDCA Nursing Model based on Artificial Intelligence strategies significantly improved nurses' performance in caring for children with Henoch-Schonlein Purpura. **Recommendation:** Developing strategies to improve nursing care for children with Henoch-Schonlein Purpura is needed to achieve high competent nurses' performance.

Keywords: Artificial Intelligence Strategies, Henoch-Schonlein Purpura , Nurses' performance, PDCA Nursing Model.

Introduction

Henoch-Schonlein Purpura (HSP) is the main systemic vasculitis in children, often affecting small blood vessels in the skin, digestive system, joints, kidneys, and other body organs. Erythema, skin spots, and raised purple lesions are commonly observed in children with Henoch-Schonlein Purpura **(Svastham Healthcare, 2023)**.

Henoch-Schönlein Purpura is most commonly found in school-age children, specifically between 3 and 14 years old, with a higher incidence in males than females. The illness is clearly affected by the different seasons and is most common in spring, autumn, and winter **(Qin et al., 2021)**.

Over the past few years, the occurrence of HSP in children has been continuously rising, due to factors such as environmental influences and daily social interactions. The yearly occurrence of HSP in children has been calculated to be up to 20 per 100,000, with severe instances being more common. The ratio of boys to girls in children is approximately 2:1 **(Wang et al., 2017)**.

The origins of HSP are complicated and involve multiple factors. The development of the disease is connected to genetic, immune, and various other factors. Children with relatives who have HSP, being around specific infections (like streptococcal or viral infections), and taking certain medications (such as antibiotics) might be more likely to get the illness **(Wang et al., 2022)**.

In children, HSP typically appears with a distinct skin rash known as palpable purpura. The purplish spots mainly occur on the lower limbs and buttocks, but may also affect the upper limbs and trunk. Additional typical symptoms include stiffness and inflammation in the joints, predominantly in the ankles and knees, as well as abdominal discomfort, which could be accompanied by intestinal bleeding in serious instances **(Gicchino et al., 2021)**.

HSP may result in different complications such as renal issues affecting kidney function, gastrointestinal problems like intense abdominal pain and bleeding, musculoskeletal disorders affecting joints and muscles, and skin-related complications such as vasculitis and ulcers that require important and efficient treatment **(Uppal & Singh, 2020)**.

Preventing HSP complications is essential to lessen their impact. Hands-on advice on lifestyle changes, like diet, exercise, and hygiene behaviors, can decrease the chances of complications in children with HSP. Moreover, the significance of consistent medical check-ups **(Gohari et al., 2020)**.

It is crucial to offer quality care for children with HSP to ensure their overall health and future well-being. Timely identification, proper treatment of symptoms, and keeping a close watch for possible complications like kidney issues are essential in halting disease advancement and enhancing patient outcomes. Nurses are essential in

providing complete and well-rounded care for children and their families **(Noake 2021)**.

Early identification of symptoms of HSP and prompt initiation of suitable interventions can help avoid complications. Moreover, nurses evaluate and track the advancement of children with HSP, recording symptoms and notifying the healthcare team of any worrisome observations. Nurses are essential in educating children and their families on how to manage and take care of themselves when dealing with HSP **(Cao et al., 2023)**.

Nurses must attend to the emotional and psychological needs of both the child and their family members. Nurses also support and defend the rights and needs of children with HSP, guaranteeing they receive suitable care and assistance. Nurses work together with doctors, other healthcare providers, and the child's family to create and carry out a personalized care plan **(Yaxing et al., 2019)**.

Artificial intelligence (AI) is a new technical field dedicated to researching and creating theories, methods, technologies, and application systems that imitate, enhance, and broaden human intelligence. Artificial intelligence explores the concept of intelligence in computer science to create machines that mimic human intelligence **(Zhao, 2022)**.

AI systems can assist in decision-making by giving recommendations based on evidence for managing HSP in children. This can assist nurses in creating individualized care plans that meet the specific needs of each child.

Additionally, AI applications can automate mundane tasks, enabling nurses to prioritize direct patient care and intricate decision-making. This effectiveness could result in improved use of nursing time and resources **(Mantas et al., 2023)**.

AI can aid in ongoing assessment of children's information, enabling nurses to detect slight alterations or patterns that may necessitate action. This proactive method can lead to improved outcomes for children. Artificial Intelligence systems can give nurses access to large volumes of current information, assisting them in keeping up to date with the newest research and guidelines on conditions like HSP **(Nie et al., 2023)**.

A highly effective AI strategy is the AI image generation strategy, which converts written text into artistic images of different styles. Pictures are utilized to promote self-examination, collective contemplation, and conversation about nursing subjects. Additionally, the chat bot GPT by Open AI is seen as a convenient tool for nurses to acquire information and gain experience in using Chat GPT **(Reed et al., 2023)**.

PDCA is derived from the first letters of Plan, Do, Check, Act in English, which represents the cycle of improvement. The PDCA cycle is a method for nurses to improve nursing quality, address issues, and make ongoing process enhancements. Introducing an AI-driven nursing model could help establish uniform care protocols, guaranteeing that all nurses adhere to evidence-based recommendations for treating children with HSP **(Chen et al., 2020)**.

The PDCA cycle management mode offers a straightforward and efficient method for addressing issues and overseeing transformations. This model enables nurses to provide thorough care, promote continuous professional growth, and assist nurses in continually improving their expertise **(Sun et al., 2021)**.

Significance of the study

The PDCA nursing model based on AI improved nurses' clinical decision-making, offered immediate alerts and reminders and promoted smooth communication and collaboration within the healthcare team. The efficiency of nursing performance was greatly enhanced by the AI-based model, resulting in quicker child care. Additionally, the AI-driven system demonstrated a significant reduction in medical and nursing mistakes, enhancing children safety and leading to improved outcomes for children care, including reduced readmissions and enhanced post-discharge care and follow-up **(Abouzaid et al., 2022)**.

The researchers noticed that children with Henoch-Schonlein Purpura faced a high likelihood of experiencing various complications. Therefore, the current research was conducted to assess how an AI-driven nursing framework enhancing nurses' understanding and performance in caring for children diagnosed with Henoch-Schonlein Purpura (HSP). By using cutting-edge technology, this new method aims to improve nurses' performance in caring of children with HSP and maximize child outcomes.

Aim of the study:

The current study aimed to evaluate the effect of PDCA nursing model based on artificial intelligence strategies on nurses' performance regarding care of children with Henoch-Schonlein Purpura.

Research hypotheses:

1. Nurses who participate in the PDCA nursing model based on artificial intelligence strategies are expected to have an improvement in their performance regarding care of children with Henoch-Schonlein Purpura.

2. There will be a positive correlation between nurses' total knowledge, total practice, and total attitude regarding care of children with Henoch-Schonlein Purpura.

Operational definitions:

Artificial intelligence:

The multidisciplinary field focuses on automating tasks requiring human intelligence.

PDCA model:

The PDCA model or quality cycle integrates Plan, Do, Check, and Act to help nurses improve quality, standardize operations, address issues, and minimize errors in nursing.

Henoch-Schonlein Purpura:

It is a condition that causes inflammation in the blood vessels due to the buildup of IgA, resulting in symptoms such as rash, joint pain, abdominal pain, and kidney problems.

Subjects and Method

Design:

The current study was carried out using quasi-experimental research design.

Setting:

The present study was conducted at the inpatient pediatric blood disease and oncology department, fourth floor which is located in a medical building and consists of 8 beds and one isolation room, at Benha Specialized Pediatric Hospital which affiliated to secretariat of specialized medical centers in Benha City.

Subject:

All available nurses, composed of 60 nurses, were included in the previously mentioned settings regardless of their personal characteristics. All working nurses participated.

Tools of data collection:

Four tools were used to obtain data relevant to the current study. These included the following tools:

Tool (I): A structured interview questionnaire

After reviewing scientific and relevant literature, the researchers created this tool. It was written in Arabic and comprised two sections:

Section (1): Nurses' characteristics: age, gender, academic qualifications, years of experience at the blood diseases unit, and previous attendance at training courses regarding the care of children suffering from Henoch-Schonlein Purpura.

Section (2): Characteristics and medical data of studied children: age, gender, educational level, manifestation of HSP, and past history of HSP relapse.

Section (3): It contained (26 questions) in the form of multiple choice and true/false questions. It included two parts as following:

Part (1) Nurses' knowledge regarding the care of children suffering from Henoch-Schonlein Purpura. It included (15 questions) definition of Henoch-Schonlein Purpura, etiology, pathophysiology, clinical manifestations, diagnostic criteria, early detection, the complications associated with HSP in children, preventing HSP complications, proactive management and evidence-based management strategies, prevention methods, prognosis and long-term out comes, supportive care for children with HSP, medical treatment for children with HSP, nursing care for children with HSP, and coordinate care within professional team to ensure a holistic approach.

Part (2) Nurses' knowledge regarding artificial intelligence. It included (11 questions); definition of AI in the nursing field, how AI works, importance of AI, advantages and disadvantage of AI, Types and components of AI, principles of AI, barriers of AI, applications of AI in the nursing field and problems of AI in the nursing field.

Scoring system:

The nurses were evaluated on their knowledge by comparing their answers to the model answer following the completion of the interview questionnaire. Correct responses receive a score of (1), while incorrect or unknown responses earn a score of (0). The overall score falls within the range of 0 to 26 (26

questions). The nurses' overall knowledge was divided into the following categories:

- A satisfactory level of knowledge was defined as being equal to or greater than 80%.
- Unsatisfactory level of knowledge was below 80%.

Tool (II): An observational checklist for nurses' practice

It was developed by researchers according to **Price et al., (2023); Richardson (2023); Veal et al., (2023),** to assess nurses' practice regarding care of children with HSP including 4 parts:

Part (1): Nursing care for children on admission (3 items); hand washing (9 steps), vital signs (24 steps); axillary temperature (11 steps), heart rate (7 steps), respiratory rate (6 steps), **initial child assessment and history taking (8 steps).**

Part (2): Immediate nursing care for children (3 items); Symptomatic treatment, pain management (5 steps), and emotional support (7 steps).

Part (3): Monitoring and follow-up care (2 items); address emerging concerns. (6 steps), and complications monitoring (5 steps).

Part (4): Education and support for children and their families (4 items); transition support (6 steps), emotional support (7 steps), empowerment and advocacy (5 steps), and health education for the care giver (9 steps).

Scoring system:

Each step was assessed based on whether it was executed correctly, receiving a score of 1 if done correctly, and a score of 0 if not done.

Total practice scores are transformed into percentages:
- ≥ 90% considered competent practice.
- <90% considered incompetent practice.

Tool III: Nurses' attitudes toward Artificial Intelligence

It based on **Schepman and Rodway's (2020)** work, was designed to measure overall attitudes toward AI using a five-point Likert Scale ranging from 1 to 5, with 1 representing "Strongly Disagree" and 5 representing "Strongly Agree".

Scoring System:

Determined by a threshold of 60%. The nurse's attitude is classified as negative if it is equal to or less than 60%, and as positive if it is 61% or greater.

Tool IV: Nurses' opinion regarding the effectiveness of each stage of PDCA model

It allows nurses to fully explain their own opinions regarding the effectiveness of each stage of PDCA model in the practical area.

Scoring system:

Nurse's opinion scored as (1) preferred PDCA nursing model based on artificial intelligence strategies in the practical area, (2) Not preferred PDCA nursing model based on artificial intelligence strategies in the practical area

Preparatory phase:

The researchers examined both domestic and global sources to address different aspects of the study and created appropriate methods for gathering data using books, research papers, journals, magazines, and online references. This timeframe

lasted from early July 2023 to late August 2023.

Tools validity and reliability:

A panel of three experts in the pediatric nursing field, two professor from Faculty of Nursing, Benha University and one professor from Faculty of Nursing, Beni suef University were reviewed the validity of the study tools, to address all study aspects and assess the items' clarity, application, and relevance. The modifications were done to ensure their relevance and accuracy. The internal consistency of the measures was calculated using Cronbach's alpha test. It was 0.87 for knowledge, 0.82 for practice, and 0.79 for attitude scale.

Ethical considerations:

Ethical considerations was accepted by the ethical research committee at the Faculty of Nursing, Benha University, on March 3, 2024, code no; REC-PN-P 52, before the beginning of the actual work. Additionally, written consent was gained from the nurses after the researchers explained the goal, significance, and length of the study to them. They obtained assures about the privacy of the information gathered. The nurses were informed of their right to participate in the study or not, as well as their right to withdraw from it at any moment.

Pilot study:

The study tools were tested on 10% of the subjects (6 nurses) in a period of (first 2 weeks from March 2024) to assess their effectiveness and determine the time needed to complete them. The study tools were not significantly changed based on the

findings of the pilot study. As a result, the nurses in the pilot study were included in the sample for the study.

Procedure for data collection:

The researchers conducted data collection in the study settings by rotating two days a week (Sunday and Tuesday) during the morning shift and utilizing the mentioned tools. Fieldwork lasted six months, starting from second 2 weeks of March 2024 and ending in 15 September 2024.

Assessment phase (Pre PDCA model application):

The researchers interviewed each nurse, introducing themselves and explaining the purpose and length of the study. Afterwards, every nurse was required to fill out the structured interview questionnaire (tool I) on their own, which typically lasted 15 to 25 minutes. Next, the researchers watched as nurses provided nursing care for children with Henoch-Schonlein Purpura (tool II); the process lasted approximately 20 to 30 minutes. Furthermore, the researchers evaluated the nurses' attitude toward artificial intelligence (tool III).

Planning phase:

The researchers developed the AI strategies included two strategies as following:

- **Chat GPT:** In the current study Chat GPT assist nurses working at the inpatient pediatric blood disease unit at Benha Specialized Pediatric Hospital to determine potential problems of children with HSP and guide them through the process from taking a medical history, setting nursing diagnoses and planning goals and interventions. Also, Chat GPT

facilitate to nurses to improve documentation, which help to better describe the current status of children with HSP, capture care processes and eventually improve children's outcomes. This represents an important opportunity to use novel generative artificial intelligence solutions that could help reduce nurses' workload and act as a supporting tool. Additionally, Chat GPT assist nurses in combining various types of inputs concerning nursing care for children with HSP and creating an output that can also include multiple types of outputs.

- **AI image-generation strategy:**
The approach of generating images using AI involves utilizing deep learning algorithms that are built upon existing data in order to produce new data like images or text. The use of artistic images for nurses has positive effects on nurses' communication, critical inquiry, dialogue, and depth of reflection that build clinical judgment for them. Additionally, AI image-generation techniques help nurses to create a multisensory, interactive experience and clinical judgment. The researchers applied AI image-generation strategy through three steps as following:

Step 1: Prompts and creation of AI-images.

The nurses were asked to provide written responses in several discussion prompts to help them reflect on their professional identity development in nursing, included:

1. Describe the nursing care provided for children with HSP.
2. Describe potential complication that can occur for children with HSP and its management

Nurses were asked to provide 5-8 sentences responses for each of these descriptive prompts. Mid journey of the program was used to create the AI-generated images.

Mid journey creates a series of photos in response to text inputs. Because the image-quality decreased when long paragraphs were copied verbatim, 5-10 keywords were chosen from the nurses' written responses to create the AI-generated images. Additionally, a bias was noted in the AI-system that whenever the word nurse was entered as a prompt in mid journey. More specifically, the image would consistently display a nurse.

Step 2: Reflection questions on the AI- generated images. The AI-generated images were then presented back to the nurses for individual reflection. Nurses were asked to write about their reactions and thoughts of the images individually. These responses were used for qualitative data analysis to answer the questions. The following four reflection questions were used:

1. What were your initial thoughts or reaction to creating AI-images of the nursing profession?
2. How did seeing these images make you feel and what was your reaction to them?
3. Do you believe these images reflect your words describing the nursing profession? Why or why not?

4. What did you learn from going through this process?

Step 3: Collaborative group reflection and member checking. Lastly, nurses were brought together with the researcher for a group collaborative reflection. Nurse's reflections and images were analyzed during the group meeting using basic interpretive qualitative research methods which seek to understand practices, experiences. During the group meeting, nurses were asked to examine written reflections and resulting images that were created by every member. Then, nurses were asked to reflect on and discuss the emerging themes. Having collaborative reflection in the group setting allowed nurses to re-evaluate their initial reactions and challenge their thinking as they heard from their peers.

The general objectives of the PDCA model application were to improve nurses' knowledge and practice regarding care of children with HSP.

Specific objectives:

At the end of the PDCA model application, the studied nurses were able to:

- Mention stages of the PDCA model.
- Illustrate the importance of PDCA model application in practical area.
- Define Henoch-Schonlein Purpura (HSP).
- Enumerate clinical manifestations of HSP.
- Illustrate etiology and pathophysiology of HSP.
- List the diagnostic criteria and early detection for HSP.

- Mention complications associated with HSP in children and its prevention.
- Discuss proactive management and evidence-based management strategies.
- List prognosis and long-term out comes.
- Illustrate supportive care for children with HSP.
- Discuss nursing care for children with HSP.
- Define artificial intelligence in the nursing field.
- Mention importance of AI and its advantages and disadvantage.
- List types and components of AI
- Explain principles and barriers of AI.
- Apply steps of hand washing and vital signs.
- Apply steps of immediate nursing care for children with HSP.
- Demonstrate steps of monitoring and follow-up care for children with HSP.

Implementation phase:

The theoretical part took four sessions, while the practical part took two sessions, totaling six sessions for completion. Additionally, a schedule was created for nurses with information about the titles, date, time, and length of each session.

Each theoretical and practical session lasted from 45 to 60 minutes in terms of time commitment. Every session started with a review of the last one and an outline of the goals for the current session, considering the appropriate level of Arabic language for the nurses' education. Each nurse was given the opportunity to ask

questions, to which the researchers responded clearly.

Small group discussions, brain storming, flip charts, role-playing, demonstration, and re-demonstration were all utilized as instructional approaches. Videos and a power point presentation were utilized as instructional aids.

Throughout the study period, a direct channel for communication was maintained between the researchers and nurses using mobile and personal meetings in the blood diseases department for any inquiries, missed information, and confirmation of knowledge and practice.

Contents of the sessions:

The Theoretical part:

The first theoretical sessions focused on:
- The general and specific objectives.
- Stages of PDCA model and its intended importance.
- Basics of PDCA model's application.

The second theoretical sessions focused on:
- Definition of Henoch-Schonlein Purpura (HSP).
- Clinical manifestations of HSP.
- Etiology and pathophysiology of HSP.
- The diagnostic criteria and early detection for HSP.
- Complications associated with HSP in children and its prevention.

The third theoretical sessions focused on:
- Proactive management and evidence-based management strategies.

- Prognosis and long-term out comes.
- Supportive care for children with HSP.
- Nursing care for children with HSP.

The fourth theoretical sessions focused on:
- Definition of artificial intelligence in the nursing field.
- Importance of AI and its advantages and disadvantage.
- Types and components of AI.
- Principles and barriers of AI.
- Problems of AI in the nursing field.

The Practical part:

The first practical sessions focused on:
- Steps of hand washing and vital signs.
- Apply steps of immediate nursing care for children with HSP.

The second practical sessions focused on:
- Demonstrate steps of monitoring and follow-up care for children with HSP.

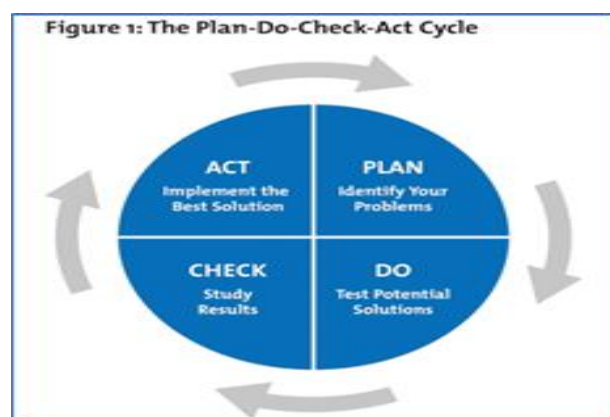**PDAC model application for nurses in the clinical area** through four stages of the model.

Figure (1): Components of PDCA Model

PDCA Model courtesy of The W. Edwards Deming Institute®. Available at: https://www. Mindtools .com/as2l5i1 /pdca-plan-do-check-act.

The application of PDCA model proceeded through four stages [planning stage, Do stage (execution stage), Check stage (feedback stage) and Act stage (improvement stage)].

The initial stage is the planning stage, also known as the P stage.

To create a particular planning scheme, this stage consisted of five specific steps:

1. Find out the nurses' needs and their quality defects in caring for children with HSP and analyze the causes of the defects and all influencing factors.
2. Identify the core problems.
3. Assess the resources needs and existing resources in the clinical area.
4. Find best solution using available resources.
5. Develop specific improvement strategies, define the anticipated objectives, and outline comprehensive implementation strategies.

The Do stage, also known as stage D, is the second phase of the process.

During this phase, the objective is to implement the plan created during the planning stage, ensuring that all tasks are executed in a structured manner as per the plan.

This stage was included into five specific steps:

1. A detailed work plan was developed for nurses.
2. Determine time to take action.

3. Periodic training sessions were conducted to enhance their expertise in the field.
4. Be aware of unpredicted problems.
5. Provide the most appropriate and standardized care for children with HSP.

Stage C, the third stage, is known as the Check stage, which functions as a feedback stage.

During this phase, the researchers assess and provide input on the effect of the implementation process, to track the advancement, validate the initial strategy, and identify any deviations from the plan as well as indicating any short comings. This stage was included into three specific steps:

1. Avoid recurring mistakes.
2. Apply continuous improvement.
3. Eliminate problematic parts.

The fourth phase is known as the Act stage, which is the stage of improvement.

During this phase, it is important to analyze the issues encountered in the previous stage, recognize or dismiss them, highlight areas for further improvement, and address any shortcomings to enhance effectiveness.

This stage was included into two specific steps: Apply and precede the initial plan and new standard baseline.

Evaluation phase:

The nurses' knowledge, practice and attitude were immediately evaluated after the application of PDCA model. The same pretest collection tools were used to conduct the post-tests.

Data analysis:

The data was first classified, arranged, analyzed, and then entered into SPSS

version 21 for tabulation. Descriptive statistics such as mean, standard deviation, frequency, and percentages were utilized. Chi-square is employed for testing the study's hypothesis. Pearson correlation coefficients were employed to analyze correlations and determine the level of significance. A significance level of p-value < 0.001 was regarded as highly statistically significant.

Results

Table (1): Outlines that half (51.7%) of nurses were in the age group 35-<40 years with mean age 35.38±3.84 years. In relation to gender, the majority (91.7%) of studied nurses were females. And more than half (53.3%) of them had technical institute of nursing certificate. Meanwhile, half (51.7%) of them had 6- <10 years of experience at the blood diseases unit with mean 6.95±2.53 years of experience. Also, none of them had training courses related to caring of children suffering from Henoch-Schonlein Purpura.

Table (2): Shows that less than two thirds (60%) of studied children were in the age group 3- <6 years with mean age 5.91±2.90 years and more than half (55.0 %) of them were females. In relation to educational level less than two thirds (60.0% & 62%) of children with HSP were in preschool stage and had past history of relapse**,** respectively.

Figure (1): Explains that (100%, 95%, 70%, 63.3%, 30% & 20%) of studied children complain from skin involvement: rash, palpable purpura, abdominal pain, vomiting, arthralgia, hematuria and orchitis respectively.

Table (3): Reveals that the majority (88.3% & 91.7%) of the studied nurses had incorrect or didn't know answers regarding diagnostic criteria of HSP and proactive management and evidence-based management strategies respectively at the pre PDCA model implementation. Which improved to the majority (96.7% & 90.0%) of them had correct answers regarding diagnostic criteria of HSP and proactive management and evidence-based management strategies respectively at post PDCA model implementation, Moreover, there was a highly statistically significant difference (p <0.000) in their knowledge pre and post PDCA model implementation.

Table (4): Mentions that the majority (95.0% & 96.7%) of the studied nurses had incorrect or don't know answers regarding definition of AI in the nursing field and how AI works respectively at the pre PDCA model implementation. Which improved to the majority (96.7% & 91.7%) of them had correct answers regarding definition of AI in the nursing field and how AI works respectively at post PDCA model implementation. Moreover, there was a highly statistically significant difference (p <0.000) in their knowledge pre and post PDCA model implementation.

Figure (2): Clarifies that the majority (85%) of studied nurses had unsatisfactory level of total knowledge at pre PDCA model implementation. Which improved to, the majority (90%) of them had satisfactory level of total knowledge post PDCA model implementation.

Table (5): Illustrates that, the majority (91.7% & 93.3%) of the studied nurses have an incompetent level of practice regarding addressing emerging concerns and transition support respectively at the pre PDCA model implementation. Which improved to majority (83.3% & 86.7%) of nurses have competent level of practice regarding address emerging concerns and transition support respectively, at the post PDCA model implementation. Moreover, there was a highly statistically significant difference (p <0.000) in pre and post PDCA model implementation.

Figure (3): Shows that the majority (93.3%) of studied nurses had incompetent level of total practice regarding care of children suffering from Henoch-Schonlein Purpura pre PDCA model implementation. In contrast, the majority (88.3%) of them had competent level of total practice post PDCA model implementation.

Table (6): Mentions that mean score of the studied nurses regarding benefits of using artificial intelligence in nursing in the pre-program (16.73±2.12) which improved to be (24.45±1.80), in the post implementation. Moreover, there was a highly statistically significant difference (p <0.000) in pre and post implementation of PDCA nursing model based on artificial intelligence strategies.

Figure (4): Demonstrates that the majority (90%) of studied nurses had a negative level of attitude regarding care of children suffering Henoch-Schonlein Purpura pre PDCA model implementation. In contrast, the majority (81.7%) of them had positive level of attitude post PDCA model implementation.

Figure (5): Shows that the majority (90%) of studied nurses preferred PDCA nursing model based on artificial intelligence strategies.

Table (7): Reflects that there was a statistically significant positive correlation between studied nurses' total knowledge, total practice and total attitude pre and post PDCA model implementation (P <0.000).

Table (1): Distribution of the studied nurses regarding their characteristics (n= 60)

Items	No.	%
Age/ years		
25- <30	4	6.7
30- <35	18	30.0
35- <40	**31**	**51.7**
≥ 40	7	11.6
Mean ± SD　　　35.38±3.84 years		
Gender		
Male	5	8.3
Female	**55**	**91.7**
Academic qualifications		
Secondary school of nursing	7	11.7
Technical institute of nursing	**32**	**53.3**
Bachelor in nursing science	16	26.7
Post graduate studies	5	8.3
Years of experience at the blood diseases unit		
< 3 years	4	6.7
3- <6	18	30.0
6- <10	**31**	**51.7**
≥ 10	7	11.6
Mean ± SD　　6.95±2.53 years		
Previous attendance at training courses regarding the care of children suffering from Henoch-Schonlein Purpura		
Yes	0	0.0
No	**60**	**100.0**

Table (2): Characteristics and medical data of studied children (n =60)

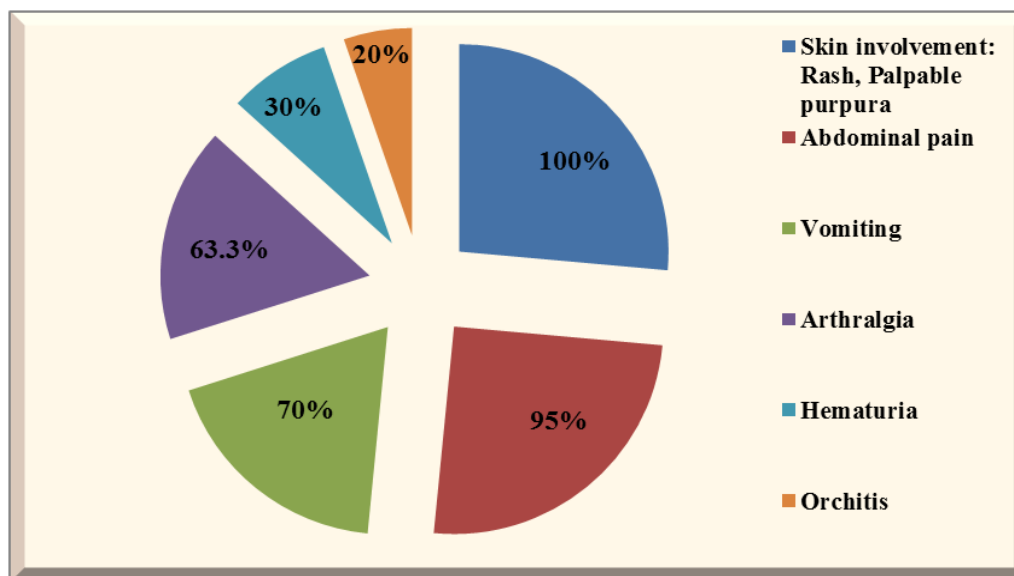| Items	No.	%
Age/ years		
▪ 3- <6	**36**	**60.0**
▪ 6 <10	15	25.0
▪ 10- <13	9	15.0
Mean ± SD　　5.91±2.90 years		
Gender		
▪ Male	27	45.0
▪ Female	**33**	**55.0**
Educational level		
▪ Preschool stage	**36**	**60.0**
▪ School stage	17	28.4
▪ Preparatory stage	7	11.6
Past history of HSP relapse		
▪ Yes	**37**	**62.0**
▪ No	23	38.0

Figure (1): Distribution of studied children regarding their manifestation of Henoch-Schonlein Purpura (n =60)

Table (3): Distribution of the studied nurses' knowledge regarding care of children suffering from Henoch-Schonlein Purpura pre and post implementation of PDCA nursing model based on artificial intelligence strategies (n =60)

Items	Pre implementation (n =60)				Post implementation (n =60)				X^2 FET	P value
	Correct answer		Incorrect or don't know answers		Correct answer		Incorrect or don't know answers			
	No.	%	No.	%	No.	%	No.	%		
Definition of HSP	8	13.3	52	86.7	56	93.3	4	6.7	77.14	0.000**
Etiology of HSP	9	15.0	51	85.0	54	90.0	6	10.0	67.66	0.000**
Pathophysiology of HSP	10	16.7	50	83.3	53	88.3	9	15.0	64.60	0.000**
Clinical manifestations of HSP	12	20.0	48	80.0	56	93.3	4	6.7	65.70	0.000**
Diagnostic criteria of HSP	7	11.7	53	**88.3**	58	**96.7**	2	3.3	87.30	0.000**
Early detection of HSP	12	20.0	48	80.0	50	83.3	10	16.7	48.18	0.000**
Complications associated with HSP in children	10	16.7	50	83.3	56	93.3	4	6.7	71.24	0.000**
Preventing HSP complications	6	10.0	54	90.0	52	86.7	8	13.3	70.61	0.000**
Proactive management and evidence-based	5	8.3	55	**91.7**	54	**90.0**	6	10.0	80.05	0.000**

management strategies									
Prevention methods	13	21.7	47	78.3	57	95.0	3	5.0	66.37	0.000**
Prognosis and long-term out comes	11	18.3	49	81.7	56	93.3	4	6.7	68.43	0.000**
Supportive care for children with HSP	13	21.7	47	78.3	57	95.0	3	5.0	66.37	0.000**
Medical treatment for children with HSP	10	16.7	50	83.3	51	85.0	9	15.0	56.04	0.000**
Nursing care for children with HSP	13	21.7	47	78.3	56	93.3	4	6.7	63.05	0.000**
Coordinate care within professional team to ensure a holistic approach.	9	15.0	51	85.0	56	90.0	6	10.0	67.66	0.000**

** A highly statistically significant difference (P <0.001)   ---   Fisher exact test "FET"

Table (4): Distribution of the studied nurses' knowledge regarding artificial intelligence pre and post implementation of PDCA nursing model based on artificial intelligence strategies (n =60)

Items	Pre implementation (n =60)				Post implementation (n =60)				X^2 FET	P value
	Correct answer		Incorrect or don't know answers		Correct answer		Incorrect or don't know answers			
	No.	%	No.	%	No.	%	No.	%		
Definition of AI in the nursing field	3	5.0	57	**95.0**	**58**	**96.7**	2	3.3	100.86	0.000**
How AI works	2	3.3	58	**96.7**	**55**	**91.7**	5	8.3	93.86	0.000**
Importance of AI	7	11.7	53	88.3	58	96.7	2	3.3	87.30	0.000**
Advantages of AI	6	10.0	54	90.0	55	91.7	5	8.3	80.05	0.000**
Disadvantages of AI	11	18.3	49	81.7	56	93.3	4	6.7	68.43	0.000**
Types of AI	2	3.3	58	96.7	54	90.0	6	10.0	90.53	0.000**
Components of AI	1	1.7	59	98.3	52	86.7	8	13.3	87.89	0.000**
Principles of AI	6	10.0	54	90.0	51	85.0	9	15.0	67.66	0.000**
Barriers of AI	10	16.7	50	83.3	53	88.3	7	11.7	61.78	0.000**
Applications of AI in the nursing field	4	6.7	56	93.3	54	90.0	6	10.0	83.42	0.000**
Problems of AI in the nursing field	9	15.0	51	85.0	49	81.7	11	18.3	53.39	0.000**

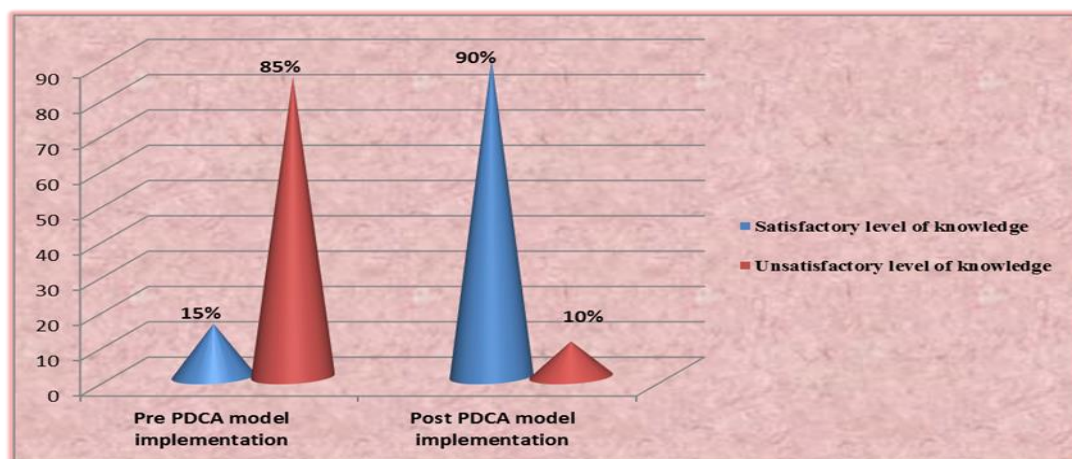** A highly statistically significant difference (P <0.001)   ---   Fisher exact test "FET"

Figure (2): Distribution of total level of studied nurses' knowledge regarding care of children suffering from Henoch-Schonlein Purpura pre and post implementation of PDCA nursing model based on artificial intelligence strategies (n =60)

Table (5): Distribution of total level of the studied nurses' practice regarding care of children suffering from Henoch-Schonlein Purpura pre and post implementation of PDCA nursing model based on artificial intelligence strategies (n =60)

Procedure	Pre implementation (n =60)				Post implementation (n =60)				X2 FET	P value
	Competent practice ≥90%		Incompetent practice < 90 %		Competent practice ≥90%		Incompetent practice < 90 %			
	No.	%	No.	%	No.	%	No.	%		
Part: I Nursing care for children on admission										
1-Hand washing	12	20.0	48	80.0	58	96.7	2	3.3	72.54	0.000**
2-Vital signs;										
2.1 Axillary temperature	22	36.7	38	63.3	57	95.0	3	5.0	45.38	0.000**
2.2 Heart rate	20	33.3	40	66.7	54	90.0	6	10.0	40.75	0.000**
2.3 Respiratory rate	18	30.0	42	70.0	57	95.0	3	5.0	54.08	0.000**
3. Initial child assessment and history taking	6	10.0	54	90.0	50	83.3	10	16.7	64.82	0.000**
Part: II Immediate nursing care for children										
1-Symptomatic treatment	13	21.7	47	78.3	56	93.3	4	6.7	63.05	0.000**
2-Pain management	11	18.3	49	81.7	51	85.0	9	15.0	53.39	0.000**
3-Emotional support	6	10.0	54	90.0	46	76.7	14	23.3	54.29	0.000**
Part: III Monitoring and Follow-Up Care										

1-Address emerging concerns	5	8.3	55	**91.7**	50	**83.3**	10	16.7	67.97	0.000**
2-Complications Monitoring	6	10.0	54	90.0	55	91.7	5	8.3	80.05	0.000**
Part IV: Education and support for children and their families										
1-Transition support	4	6.7	56	**93.3**	52	**86.7**	8	13.3	77.14	0.000**
2-Emotional support	12	20.0	48	80.0	53	88.3	7	11.7	56.42	0.000**
3-Empowerment and advocacy	8	13.3	52	86.7	47	78.3	13	21.7	51.05	0.000**
4-Health education for the care giver	12	20.0	48	80.0	51	85.0	9	15.0	50.82	0.000**

** A highly statistically significant difference (P <0.001)   -   Fisher exact test "FET"
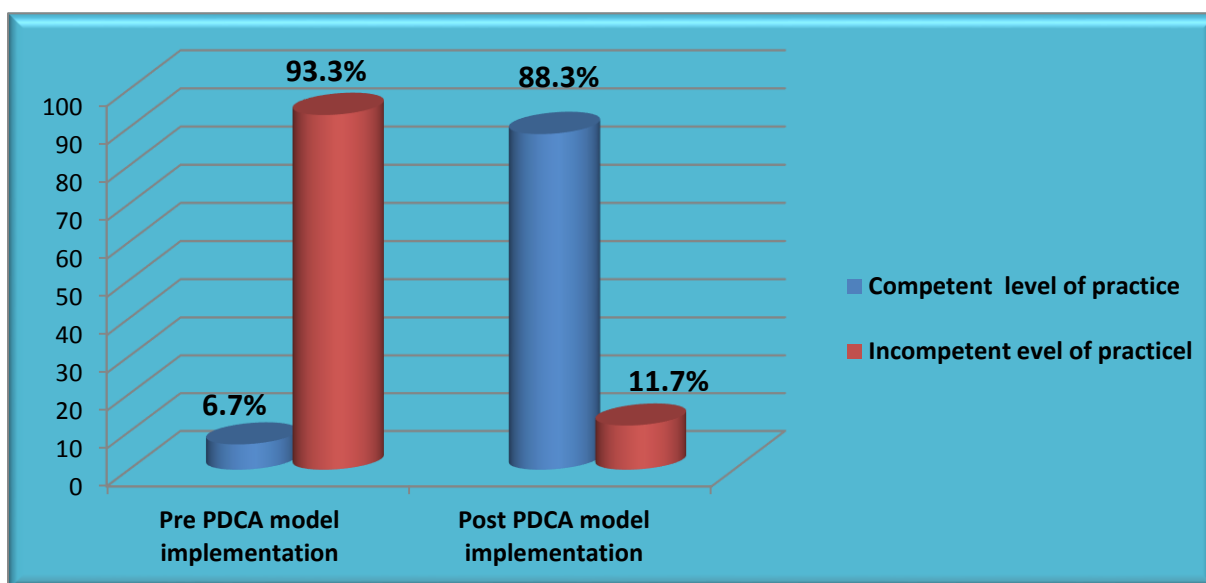

Figure (3): Distribution of total level of studied nurses' practice regarding care of children suffering from Henoch-Schonlein Purpura pre and post implementation of PDCA nursing model based on artificial intelligence strategies (n =60)

Table (6): Mean score of the studied nurses' attitudes towards artificial intelligence pre and post implementation of PDCA nursing model based on artificial intelligence strategies (n =60)

Items	Pre implementation ((n =60 Mean ± SD	Post implementation ((n =60 Mean ± SD	Paired t test	P value
1-Benefits of using artificial intelligence in nursing				
1.1-Artificially intelligent systems can benefit human health	2.12±.743	4.10±.510	9.49	0.000**
1.2-I am impressed by what artificial intelligence can do	2.85±.512	4.15±. 515	14.99	0.000**
1.3-Artificial intelligence can have positive impacts on people's wellbeing	2.95±. 501	4.06±.634	12.51	0.000**
1.4-Artificial intelligence can provide new opportunities for nursing professionals	2.60±.741	4.25±.594	12.09	0.000**
1.5-Possibilities for use of artificial intelligence in nursing care exciting	2.80±.798	4.06±.516	10.47	0.000**
1.6-There are many beneficial applications of artificial intelligence in nursing	2.61±.922	4.01±.676	12.79	0.000**
Total score	**16.73±2.12**	**24.45±1.80**	17.06	0.000**
2-Dangers of artificial intelligence				
2.1-I think that using artificial intelligence in healthcare is dangerous	2.93±1.02	4.08±.743	11.15	0.000**
2.2-Use of artificial intelligence in nursing is unethical	2.48±.982	3.96±.581	13.46	0.000**
2.3-I think artificially intelligent systems make many errors	2.58±1.02	3.86±.700	9.38	0.000**
2.4-I feel uncomfortable when I think about future uses of artificial intelligence in nursing	2.45±.891	3.19±.719	14.35	0.000**
2.5- I find artificial intelligence sinister	2.40±1.01	3.76±.767	10.01	0.000**
2.6-Nurses/medical technicians will suffer if artificial intelligence is used more and more	2.50±.892	3.90±.705	15.10	0.000**
2.7-Artificial intelligence is used to spy on people	2.48±1.08	3.80±.819	10.03	0.000**
2.8-Artificial intelligence might take control of people	2.61±.825	3.90±.796	14.38	0.000**
Total score	**20.45±5.02**	**31.20±3.85**	17.42	0.000**

cont.: Table (6): Mean score of the studied nurses' attitudes towards artificial intelligence pre and post implementation of PDCA nursing model based on artificial intelligence strategies (n =60)

| Items	Pre implementation (n =60) Mean ± SD	Post implementation (n =60) Mean ± SD	Paired T test	P value
3-Practical advantages of artificial intelligence				
3.1- For routine tasks, I would rather use an artificially intelligent system than a human	3.26±.709	4.10±.510	10.99	0.000**
3.2- Nursing profession will benefit from a wider use of artificial intelligence in the future	3.06±.606	4.30±.590	14.75	0.000**
3.3- An artificially intelligent agent can do many routine jobs better than a human nurse/technician	3.11±.640	4.25±.592	10.75	0.000**
3.4- Artificially intelligent systems are more efficient than nurses/medical technicians	3.25±.704	4.56±.620	15.08	0.000**
Total score	**12.70±1.85**	**17.20±1.61**	**18.34**	0.000**
4-Willingness to use artificial intelligence in nursing practice				
4.1- I would like to use artificial intelligence in my job	3.43±.620	4.50±.624	12.51	0.000**
4.2- I am interested in using artificially intelligent systems for my daily nursing tasks	3.58±.497	4.71±.523	17.44	0.000**
Total score	**7.01±.770**	**9.21±.825**	18.58	0.000**
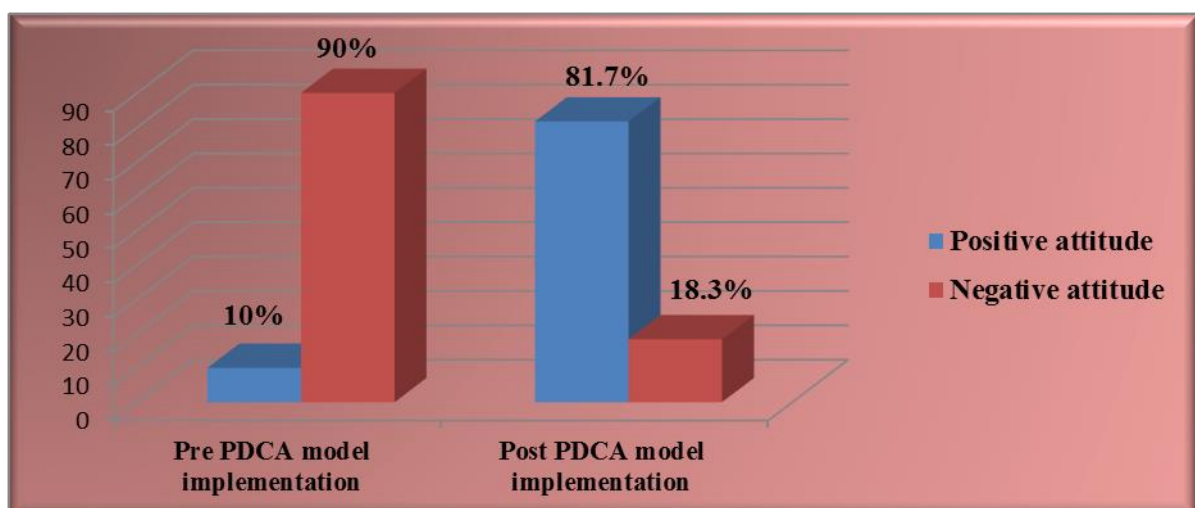
Figure (4): Distribution of total level of studied nurses' attitude towards artificial intelligence pre and post implementation of PDCA nursing model based on artificial intelligence strategies (n =60)
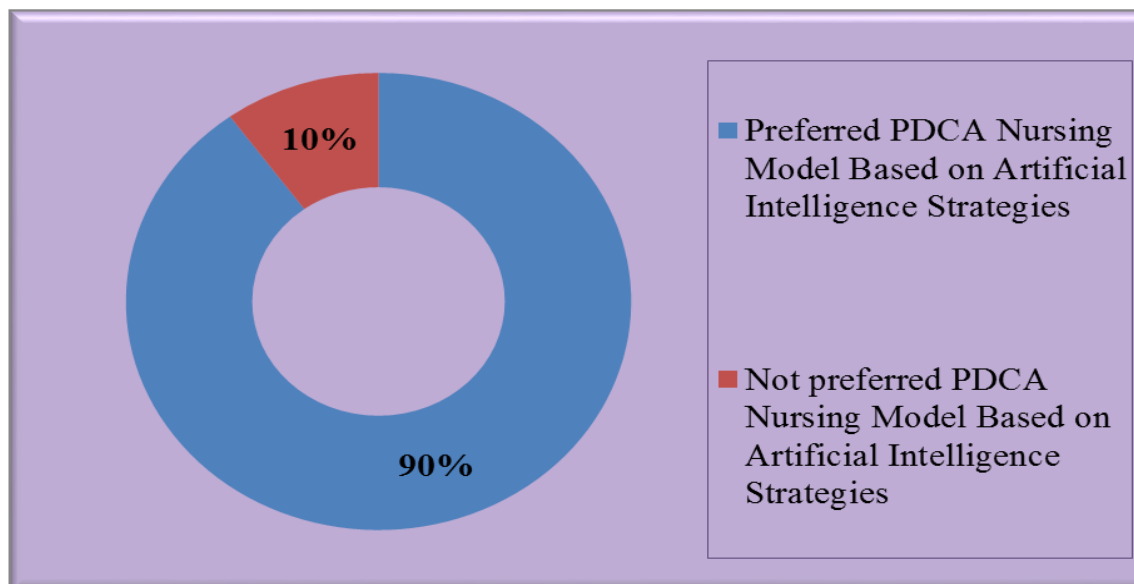
Figure (5): Distribution of total level of studied nurses' opinion regarding the effectiveness of each stage of PDCA Nursing Model Based on Artificial Intelligence Strategies (n =60)

Table (7): Correlation between studied nurses' total knowledge, total practice and total attitude score pre and post PDCA model implementation (n =60)

Total scores	Pearson correlation coefficient			
	Pre- PDCA model implementation		Post- PDCA model implementation	
	r	P-value	r	P-value
Knowledge - practice	0.814	0.000**	0.948	0.000**
Knowledge - attitude	0.793	0.000**	0.856	0.000**
Attitude - practice	0.631	0.000**	0.792	0.000**

Discussion

Henoch-Schönlein purpura (HSP) is characterized by a non-blanching rash, which commonly affects the lower limbs of children aged 3-15 years. It is the most common vasculitis in children. Also, HSP often develops after an upper respiratory tract infection and is more likely to present in autumn, winter and spring. Some cases may progress to serious complications, including renal involvement. So, nurses are often the first to assess children to recognize HSP early. Admission of a child into hospital is considered a stressful event for the parents and child; so, the nurse can help by ensuring prompt admission to hospital and offering support and reassurance to the family **(Wilkinson, 2019)**.

Regarding characteristics of studied children, this result shown that; less than two thirds of studied children were in the age group 3- <6 years with mean age 5.91±2.90 years and more

than half of them were females. These results were on the same line with **Sung et al., (2018)** who study characteristics of children with Henoch-Schönlein Purpura in Korea. And found that; the peak age of Henoch-Schönlein Purpura occurrence was 5 years old and male to-female ratio was 1:1.1.

On assessing manifestation of Henoch-Schönlein Purpura; the present study demonstrated that, vast majority of studied children complain from skin involvement: rash, palpable purpura. This finding congruent with study done by **Gonzalez-Gay et al., (2017)**, to assess incidence and clinical spectrum of Henoch-Schönlein purpura and observed that; skin involvement is present in all children with Henoch-Schönlein Purpura, and it is characterized by a rash of symmetric erythematous papules of the buttocks and lower extremities, which progresses to palpable purpura.

Moreover; this study finding observed that, majority, more than half, and one third of studied children complain from abdominal pain, arthralgia and hematuria respectively. This finding congruent with **Ekinci, et al., (2019)**, who study clinical manifestations and outcomes of children with Henoch Schönlein Purpura in Turkey and observed that; more than half, and one third of children complain from abdominal pain, arthralgia / arthritis , and renal involvement respectively.

The finding of the current study has revealed that, the majority of the studied nurses had incorrect or don't know answers regarding diagnostic criteria of HSP and proactive management and evidence-based management strategies respectively at the pre PDCA model implementation. This could be due to the fact that all nurses did not attend any training courses related to caring of children suffering from Henoch-Schonlein Purpura. Which improved to majority of them had correct answers regarding diagnostic criteria of HSP and proactive management and evidence-based management strategies respectively at post PDCA model implementation, Moreover, there was a highly statistically significant difference (p <0.000) pre and post PDCA model implementation. The finding of this study was congruent with **Huan et al., (2022)** who apply PDCA process in day operation ward and the assess influence on safety and nursing quality and mentioned that the total knowledge score were higher in the study than control group regarding nursing care quality in operating room, equipment management, equipment preparation, nurses' cooperation skills, disinfection and isolation quality.

Also, this study results mentioned that, the majority of the studied nurses had incorrect or don't know answers regarding definition of AI in the nursing field and how AI works respectively at the pre PDCA model implementation. Which improved to majority of them had correct answers regarding definition of AI in the nursing field and how AI works respectively at post PDCA model implementation, Moreover, there was a highly statistically significant difference (p <0.000) pre and post PDCA model implementation. This

result corresponded with the findings of **Elderiny et al., (2024)**, who conduct study to assess knowledge and perception of intensive care nurses regarding applications of artificial intelligence and clarified that more than two thirds of nurses had unsatisfactory level of knowledge about artificial intelligence.

On the same line, this study finding clarified that the majority of studied nurses had unsatisfactory level of total knowledge at pre PDCA model implementation. Which improved to, the majority of them had satisfactory level of total knowledge post PDCA model implementation. This improvement indicated that the PDCA model based on artificial intelligence strategies considered a successful method to increase nurses' knowledge. This study finding was supported by **Bader et al., (2022)** who conducted study about PDCA Cycle: A mean for improving nurses' performance regarding medication administration and showed that the less than one fifth of nurses had satisfactory knowledge regarding medication administration at pre implementation PDCA cycle. While at post and follow up implementation PDCA cycle the total satisfactory knowledge were highly improved respectively.

On investigating nurses' practice regarding care of children suffering from Henoch-Schonlein Purpura, the present study showed that, the majority of studied nurses had incompetent level of total practice regarding care of children suffering from Henoch-Schonlein Purpura pre PDCA model implementation. From the researcher point of view, this might due to the lack of AI based training and education performed for nurses. In contrast, majority of them had competent level of total practice post PDCA model implementation. This might be because the PDCA model based on artificial intelligence strategies made refreshment in nurses' knowledge which in turn led to an improvement their practice level. This finding was supported by **Chen et al., (2020)** who conduct study about application of the PDCA cycle for standardized nursing management in a COVID-19 intensive care unit, and found that the virus contamination awareness, professional skills, awareness of duties and responsibilities, and quality and nursing performance were remarkably improved 2 weeks after the implementation of the PDCA cycle.

More over this study results were supported by **Liu et al., (2022)** who conduct study about application of the PDCA cycle for standardized nursing management in sepsis bundles, and reported that, the implementation of PDCA cycle management improve the compliance of clinical staff to the bundle treatment of sepsis, improve the treatment efficiency of sepsis, and improve the quality of care.

Regarding studied nurses' attitude, the current study finding demonstrated that, the majority of studied nurses had negative level of attitude regarding care of children suffering Henoch-Schonlein Purpura pre PDCA model implementation. In contrast, the majority of them had positive level of attitude post PDCA model implementation. This result aligns with the findings of **Mohamed et al.,**

(2023a) conducted study to assess effect of the artificial intelligence enhancement program on head nurses' managerial competencies and reported that there were significant differences in head nurses' attitudes toward technologies artificial intelligence between pre- and post-intervention, pre- and follow-up, and post- and follow-up (p.000). Indicating that the program had a significant impact on the attitudes of head nurses.

Additionally, this study finding also supported by **Mohamed, et al., (2023b)** who study the effect of educational program on nurses' knowledge and attitude regarding artificial intelligence and found that the total mean score of nurses' attitudes improved immediately post program than preprogram phase with statistically significant differences.

On discovering nurses' opinion regarding the effectiveness of each stage of PDCA nursing model based on artificial intelligence strategies. The present study showed that, the majority of studied nurses preferred PDCA nursing model based on artificial intelligence strategies. These results were supported by **Zhao, (2022)** who conduct study to assess, effect of artificial intelligence-based electronic health PDCA nursing model for treatment of children with mycoplasma pneumonia and showed that the total nurses' satisfaction was higher in the experimental group using PDCA nursing mode than the nurses in control group and the difference was statistically significant.

Additionally this study result reflected that, there was a statistically significant positive correlation between studied nurses' total knowledge, total practice and total attitude pre and post PDCA model implementation (P <0.000). This result goes in line with **Ranbhise et al., (2023)** who conduct a correlational study on knowledge and attitude regarding artificial intelligence in health care among nursing students and indicated that there was a strongly positive correlation between knowledge and attitude which was statistically significant at p <0.05 level, regarding artificial intelligence in healthcare.

Conclusion

Based on the findings of the current study, it could be concluded that level of nurses' performance improved regarding the care of children with HSP, which emphasize that PDCA model application based on AI strategies was effective.

Recommendations

1. Conducting a periodical AI based educational program for the nurses who are working at the blood disease departments is mandatory to improve nurses' performance and quality of nursing care.

2. Further research is needed to explore the long-term impact of PDCA model based on AI and overcome potential implementation barriers.

3. Explore the potential of applying the AI-based nursing model to other pediatric conditions beyond HSP.

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