Research report:
Changing Peripheral Intravenous Catheter When Clinically Indicated: First Evidence-Based Practice Project in Makkah, Saudi Arabia

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ABSTRACT

Context: In the past, it was advised to replace peripheral intravenous catheters every 24 to 96 hours (about four days). Regular catheter removal under a time-based method was utilized for a considerable amount of time to prevent consequences. The Infusion Nurses Society advised against routinely replacing peripheral catheters and insisted they only be replaced when clinically indicated in the Infusion Therapy Standards of Practice 2016. These patients are exposed to invasive needle sticks, infection risks, and unnecessary financial burdens when peripherally inserted catheters are replaced without a clinical need. Additionally, healthcare personnel face an increased workload in such cases.

Aim: to assess the impact of removing peripheral intravenous catheters when clinically indicated compared to the current policy (routine replacement after 74-96 hours) on the complications and to appraise the financial implications.

Methods: This project was carried out in the Cardiac Ward, Cardiac Surgery Ward, and Neuroscience ward at King Abdullah Medical City, Makkah, Saudi Arabia, on two patient groups. For 78 patients, PIVs were routinely replaced every 96 hours. Subsequently, they transitioned to changing PIVs solely when clinically indicated, but for a different group of 75 patients. The average patient stay on this project was 6 to 8 days.

Results: Neither the clinically indicated replacement group nor the routine replacement group showed signs of infiltration, and there was no statistically significant difference between them. Phlebitis was absent in the routine replacement group, while 2.7% of the clinically indicated group developed this condition, again without a significant statistical difference. The mean PIVC indwelling time significantly differed between the groups: 3.12±0.33 days for routine replacement versus 6.6±2.09 days for clinically indicated replacement (p=0.000). Additionally, a cost analysis highlighted a potential yearly savings of 709,999.56 SAR post-implementation of the practice change, with 2022 costs of PIV insertions at 1,540,849.36 SAR under the hospital's former policy.

Conclusion: This study's findings indicate no statistically significant difference in the incidence of infiltration or phlebitis between the clinically indicated replacement group and the routine replacement group. However, the average PIVC indwelling time was longer in the clinically indicated group, which suggests that extending the interval for PIVC replacement does not increase the risk of complications. Additionally, a cost analysis revealed substantial yearly savings associated with the clinically indicated replacement strategy. By implementing this project's recommendations, nurse leaders can reduce costs, improve patient and employee satisfaction and safety, and assure adherence to best practices.

Keywords: Evidence-based practice, peripheral intravenous catheter

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1. Introduction

Vascular access is the most frequent invasive procedure for hospitalized patients, with an average of two vascular access devices per patient for most hospital admissions. Peripheral intravenous catheters facilitate easier, less minimally invasive venous access for infusion therapy while presenting a lower risk to the patient than other types of catheters *(Ansel et al., 2017).*

Despite their widespread use, peripheral intravenous catheter insertions are not impervious to failures, which include the potential for patient harm *(Rickard et al., 2015).* Phlebitis is associated with peripheral intravenous access with a combined percentage of 36%, while catheter-related bloodstream infection (CRBSI) is associated with a pooled incidence of less than 0.1 % *(Webster et al., 2019).*

In the past, it was advised to replace peripheral intravenous catheters every 24 to 96 hours (about four days) *(Ansel et al., 2017).* Regular catheter removal and re-siting under a time-based method were employed for a considerable

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amount of time to avoid consequences. The Infusion Nurses Society advised against routinely replacing peripheral catheters and insisted they only be replaced when clinically indicated in the 2016 Infusion Therapy Standards of Practice. This suggestion was based on the results of a systematic review, which recommended replacing the catheter only at the termination of therapy or in the case of inflammation, infiltration, or obstruction to reduce insertion procedures *(Webster et al., 2019).*

Adult admissions to acute care hospitals now account for 70% of all admissions, and IV therapy is needed for an average of 7 to 10 days (about one and a half weeks). These patients are put at risk for invasive needle sticks, infection risk, and financial costs when these necessary peripherally inserted catheters are replaced without a clinical need to do so, and their healthcare providers are put under more burden *(Rickard et al., 2015).* Clinically recommended PIVC removal policies are expected to save $300 million over five years and 1 million hours of medical staff time in the United States alone *(Tuffaha et al., 2014).* However, according to recent evidence-based research findings, the optimum practice for replacing PIV catheters is when clinically indicated *(Chang & Peng, 2018; Gorski et al., 2021).* Examples of clinical indicators are blockage, discomfort, redness, infiltration, swelling, leakage, phlebitis, and the end of treatment. Moreover, numerous studies demonstrated that in more than 4000 patients, the Short Peripheral Catheter Insertion (SPCs) that were replaced when clinically indicated had an equal or lower incidence of phlebitis, infiltration, and extravasation than those that were routinely removed *(Webster et al., 2019; Vendramim et al., 2020; Xu et al., 2017)*

2. Significance of the study

According to US Centers for Disease Control standards, peripheral intravenous catheters (PIVC) should be changed no more frequently than every 3–4 days. Routine replacement is believed to lower the incidence of phlebitis and bloodstream infections. According to the "Infusion Therapy Standards of Practice" published by the Infusion Nurses Society, a catheter should only be removed when absolutely indicated. If there are clinical indications to do so, the proposed intervention would replace a PIVC *(Gorski et al., 2021).*

Each "IV-start kit" costs 14.5 Saudi Riyals (SR), including an IV catheter, a 10-mL prefilled bottle of normal saline flush, an alcohol swab, a tourniquet, one dressing, one surgical glove, and 1 Q site connector. To measure the cost-effectiveness of replacing peripheral IV cannulas based on a clinical indication, we collected data on the cost of peripheral IV cannulas and other consumables associated with the IV cannulas during 2021.

The estimated cost amounted to SAR 1,540,849.36 a year. This cost included the total cost of the IV cannula kit used in King Abdullah Medical City inpatient wards. We estimated that if we changed the IV cannula when clinically indicated (Average 6.6 days) compared to the current policy (routine replacement after 3-4 days), we could also cut costs by half in Makkah hospitals. This initiative anticipated that the changes of peripheral IV cannulas based on clinical indication would last longer, experience fewer difficulties, and save a lot of money.

Current problem: In our hospital, scientific evidence does not substantiate the current practice of routinely replacing peripheral intravenous (PIV) catheters in hospitalized adults every 24-96 hours. This practice may lead to unnecessary costs, increased patient harm, and inefficiencies in staff time utilization.

3. Aim of the study

To assess the impact of removing peripheral intravenous catheters when clinically indicated compared to the current policy (routine replacement after 74-96 hours) on the complications and to appraise the financial implications.

3.1. PICO Question

How does replacing PIV catheter sites when clinically indicated compared to routine replacement of PIV catheter sites affect patient outcomes among hospitalized adults?
P: Patient with PIV catheter.
I: Replacing PIV catheter sites when clinically indicated.
C: Routine replacement of PIV catheter sites.
O: Patient' outcomes as phlebitis, infiltration, and cost.

4. Methods

4.1. Design

The John Hopkins Model of EBP was used as the framework to guide this pre-post evidence-based practice (EBP) project, which compared complication rates surrounding the removal of 96-hour timed SPCs with those removed according to clinical indicators over a period of three months.

4.2. Study setting

The study was conducted at King Abdullah Medical City (KAMC) in Makkah, Saudi Arabia. It occurred in the Cardiac Ward, Cardiac Surgery Ward, and Oncology Ward, with an incremental rollout from January 1, 2023, to April 1, 2023.

4.3. Study subjects

There were two patient groups. For 78 patients, PIVS was routinely replaced every 96 hours. Subsequently, they transitioned to changing PIVS solely when clinically indicated, but for a different group of 75 patients. The average patient stay on this project was 6 to 8 days.
Sample Size: Epi-info program was used to find sample size using the following information:
- Population size = 255 patients.
- Expected frequency = 50%.
- Acceptable error = 10%.
- Confidence coefficient = 95%.
- The minimal sample size is 153. Thus, the sample size was 79 for the Routine replacement group and 79 for the clinically indicated replacement group.

Inclusion criteria
- Length of stay greater than two days.
- Able to make independent decisions related to care, and capable of self-consent.

- PIV catheters are placed according to the PIV policy, with the utilization of a PIV CHG securement dressing and no pre-existing catheter-related bloodstream infection (CR-BSI), phlebitis, or central line-associated bloodstream infection (CLABSI).

Exclusion Criteria

- Patients who required central vascular access no longer needed a peripheral IV.
- Patients with a length of stay (LOS) of four days or less were removed from this pilot.
- Patients with SPCs placed in the emergency room or outside the hospital were also excluded because hospital policy requires peripheral IV removal within 24 hours of placement.
- Infusion of corrosive drugs.
- History of thrombotic diseases.
- Lower extremity catheterization.
- Scratches and burns on the local part of the catheter.
- Patients with BSI or under immunosuppressive therapy.
- Patients receiving parenteral nutrition infusion through PIVC.
- Patients with indwelling catheters for more than 72 hours at study entry; and severe infection or hepatocellular failure and renal failure.

4.4. Tools of data collection

4.4.1. Patient Assessment Record

Data was collected through patient assessment record. It included three parts: Part one focused on gathering personal data for each patient. This section included comprehensive information such as the patient's age and gender, their medical diagnosis, whether they were using anticoagulant medications, the date and hour of the intravenous device insertion, the specific site of insertion, the length of time the catheter was in place, and the reason for its replacement. This detailed data collection ensured that all relevant demographic and clinical factors were considered.

Part two: Visual Infusion Phlebitis score (VIP scale). This part was adopted from *Andrew Jackson (1998)*. It was used to determine the appropriate assessment and discontinuation of peripheral intravenous catheters based on the presence and severity of symptoms. It consisted of 6 items. The response to these items was scored at (0-5), ranging from no sign of phlebitis to advanced-stage thrombophlebitis.

Part three: Cost and infiltration Cost: Initially, the cost of IV cannulas and other associated consumables used by two wards during 2021 was collected. This number was used as a baseline. Then, the cost before and after replacing the cannulas when clinically indicated was compared. Infiltration included whitening and edema with or without pain at the insertion site. The response was either yes or no.

A panel of three experts in cardiac and Medical-Surgical Nursing reviewed the tool for content validity, and modifications were made accordingly. The tool was tested for reliability using Cronbuch's alpha test; it was 0.75 for Part (II).

4.5. Procedures

4.5.1. Search Strategy

A literature search using the Cochrane Library, OVID, and CINAHL and the keywords PIVs, replacement, clinically indicated, routine, infiltration, occlusion, and phlebitis. The evidence-based practice team critically appraised the evidence and created an evidence synthesis table to guide recommendations.

4.5.2. Critical Appraisal of the Evidence

Six studies were identified, appraised, and synthesized for the project (Table 1). Convincing evidence concluded that, compared to routine replacement, replacing PIV sites when clinically indicated resulted in no greater rates of PIV complications, including phlebitis, infiltration, catheter-related bloodstream infections, occlusion, accidental removal, infusion failure, or in-hospital mortality. In addition to not being harmful, changing PIV sites when clinically indicated resulted in decreased costs and reduced resource utilization.

4.5.3. Integration of the Evidence with Clinical Expertise and Patient Preferences

Following an evaluation and synthesis of the current evidence, three inpatient departments were granted to implement PIVs replaced where clinically indicated. Approval was taken from IRB and the Nursing Administration. The cardiac, cardiac surgery, and oncology wards were chosen for an incremental rollout for the project's implementation from 2023/1/1 to 1/4/2023. The piloted departments were chosen from different areas to reflect the other departments in KAMC. The Evidence-Based Practice (EBP) team scheduled a meeting with all head nurses in these departments and explained the project process.

All questions related to the project were answered. The EBP team discussed the project implementation with the nursing staff at the selected department. Initially, nurses adhered to the hospital policy, routinely replacing PIVs every 96 hours for 78 patients. Subsequently, they transitioned to changing PIVs solely when clinically indicated, but for a different group of 75 patients. Every time nurses withdrew a PIV, data collection forms were filled out. This form involved the patient's age and gender, diagnosis, anticoagulant medicine use, the date and hour of insertion of the intravenous device, the inserting site, and the cause for replacement. Phlebitis was checked during PIVC indwelling up.

4.5.4. The Incremental Rollout Procedure

The incremental rollout helped identify any inconsistencies that may emerge during the full implementation. The objective of the Incremental rollout is to assess the impact of removing peripheral intravenous catheters when clinically indicated compared to the current policy (routine replacement after 74-96 hours) on complications and to appraise the fiscal consequences.

After getting official permission from KAMC IRB, the data was collected using a questionnaire from the patients.

Two weeks before the study, intensive training on PIVC placement and maintenance was provided to the nurses to train their skills for catheter placement and maintenance, catheter removal, and complication evaluation.

Table (1): Summary of literature findings of clinically indicated replacement compared to routine change of peripheral intravenous catheters.

Author and Date	Evidence Type	Sample, Sample Size, Setting	Observable Measures	Evidence Level, Quality	Findings
Li et al. (2022)	Multisite randomized controlled trial	3050 participants from three hospitals in China	Phlebitis, infiltration, occlusion, displacement, local infection, and diagnosed catheter-related bloodstream infection	I A	The risk of phlebitis, phlebitis per 1000 catheter days, occlusion, dislodgement, all bloodstream infections, local infection, and mortality between the two groups were not significantly different. The risk of infiltration was increased in the clinically indicated group (HR 1.29). There was no catheter-related bloodstream infection reported in either group. Patients' first peripheral intravenous catheter dwelling time and cumulative indwelling time of all peripheral intravenous catheters in the clinically indicated group were significantly longer than the routine replacement group. There was no statistical significant difference in survival times from phlebitis between the two groups.
Webster et al. (2019).	Systematic review and meta-analysis	Nine included studies with 7412 participants	Catheter-related bloodstream infection (CRBSI), thrombophlebitis bloodstream infection (BSI), costs, infiltration, and pain	I A	We found no clear difference in catheter-related bloodstream infection rates, phlebitis, bloodstream infection from any cause, local infection, mortality, or pain. Healthcare organizations may consider a policy whereby catheters are changed only if there is a clinical indication to do so (e.g. if there are signs of infection, blockage, or infiltration). This would provide significant cost savings, spare patients the unnecessary pain of routine re-sites in the absence of clinical indications, and reduce the time busy clinicians spend on this intervention.
Morrison and Holt (2015).	Systematic review	13 studies	infection, phlebitis	I A	The current practice of replacing peripheral intravenous catheters every 72–96 hours (about four days) does not decrease the incidence of phlebitis or infection compared to replacing catheters when clinically indicated in the adult population. By translating this research into current practice, healthcare costs and nursing care time will decrease, and unnecessary invasive procedures will be eliminated, thereby increasing patient safety and satisfaction.
Olivier et al. (2021)	Retrospective review of 473 medical records, 737 peripheral IV sites	-	infection rates, nurse satisfaction, and costs	II A	The average PIV dwell time was seven days, with a 3% phlebitis rate. Findings showed no catheter-related bloodstream infections and 2(0.27%) skin tears. One year after the practice change, cost savings of $17,100 in PIV supplies occurred. Nurse satisfaction with the new dressing was 94.2%, with a 17-month sustainment of satisfaction.
Vendramim, et al. (2020)	Randomized, non-blinded, controlled, non-inferiority trial.	1319 patients	Phlebitis. Phlebitis severity, catheter indwelling time	I A	Clinically indicated peripheral intravenous catheter replacement was not inferior to routine (96 hours) replacement regarding phlebitis occurrence and was associated with significantly less phlebitis per 1000 days (about two and a half years).
Xu et al. (2017).	Cluster-randomized trial	1198 patients (553 patients in the experimental group and 645 patients in the control group).	Phlebitis, catheter occlusion, infiltration, and accidental removal	I A	There were no catheter-related bloodstream infections or local infections in the two groups. Both groups showed no statistically significant differences in the incidence of phlebitis, catheter occlusion, infiltration, and accidental removal.

Various training methods were used, including multimedia teaching, decomposed workflow teaching, and using pictures to compare nonstandard procedures and standard procedures. At least two training sessions were held on each ward to ensure that all nurses who engaged in this study were trained in (and became proficient in) PIVC placement, maintenance, and complication evaluation, and an additional training session was given to any nurses who missed a session. Registered nurses performed the PIVC catheterization.

The following steps were applied:

- Patients who met the criteria for inclusion and exclusion signed a form of informed consent.
- Transparent standard PIVC. The use of a catheter flusher and film dressing. The site of insertion was the arm or back of the hand. Following catheterization, the extension tube was placed in a "U" form with the help of the clear film dressing for tension-free fixation. Medical adhesive tape was used to secure the extension tube's end without applying pressure. The nursing staff recorded the information after the catheterization was complete and noted it.
- For maintenance, a Transparent film dressing was replaced if it became sloppy or moist. A prefilled catheter flush syringe with Excelsior saline was used for flushing. Positive-pressure flushing was utilized to reduce blood reflux into the VAD lumen, while pulsatile flushing was used for flushing. The A-C-L (Assess-Clear-Lock) maintenance requirements were applied.
- Catheter removal: The catheter was eliminated when a replacement was clinically indicated. If the following conditions happened, the catheter was removed from the clinically indicated intervention group.

Symptoms of complications, both with and without infusion through the catheter, such as the presence of any degree of pain or tenderness with or without palpation, and color changes, are not the only things to look for (erythema or blanching), edema, induration, leaking of fluid, or purulent discharge from the insertion, variations in skin temperature (hot or cold), location, as well as other dysfunctions (such as resistance when lack of a blood return, flushing).

The EBP team filled out a demographic data form for each patient. The patient's age and gender, as well as diagnosis, anticoagulant medicine use, the date and hour of insertion of the intravenous device, the inserting site, the length of time the catheter was in place, and the cause for replacement, were all included on this form. Patients were checked for phlebitis during PIVC indwelling up to 48 hours after catheter removal. The research assistants were responsible for daily inspections to verify that data collection was complete, but they were not involved in catheter indwelling or removal decisions. During the data-gathering procedure, members of the core research team occasionally visited the wards to examine and supervise the data collection activities and to answer any staff concerns.

Routine replacement group: This group followed standard care, with catheter replacement every 72nd hour per hospital policy, regardless of complications.

Clinically indicated replacement group: Catheters were replaced based on clinical indications or reported complications. In both groups, nurses monitored for complications each shift and documented their observations. Dressing and valve connector changes occurred as needed, such as in soiling, looseness, or visible blood in the line.

Data Collection and Management: After obtaining official approval from the King Abdullah Medical City (KAMC) Institutional Review Board (IRB), the Evidence-Based Practice (EBP) team commenced the data collection process. The team thoroughly explained the study's purpose and the survey details to potential participants. Verbal consent was then sought from those who wished to participate, ensuring their involvement was voluntary and informed. Participation in the study was entirely voluntary. Participants were informed that they could withdraw from the study without any consequences, and measures were taken to maintain anonymity. Participants were assured that their personal information and responses would be kept confidential, with data being collected and managed in a manner that protected their privacy.

5. Results

Regarding the demographic information, Table 2 displays the distribution of the Routine replacement group and clinically indicated replacement group that have been clinically indicated. A statistically insignificant difference was identified between both groups in terms of age, diagnosis, and gender.

The table also reveals that the routine replacement group had the highest percentage of patients with cardiovascular disease (56.4%) and with cancer (53.3%). There was also no statistically significant difference between the percentage of male patients in the standard replacement group (62.8%) and the percentage of male patients in the clinically indicated replacement group (62.7%).

Table 3 shows no statistically significant difference between the two groups regarding the percentage of patients who had a catheter inserted in their forearm: 38.5% of patients in the routine replacement group and 56% of patients in the clinically indicated replacement group. 22 catheter gauge was found to be the highest percentages of the catheter gauge for both groups (73.1% and 76% respectively), with no statistically significant difference between both groups.

Most of the catheters were used intermittently in both groups (89.7% and 90.7%, respectively), not statistically different from one another. According to hospital policy, catheters were removed from patients in the routine replacement group in 93.6% of the cases. 38.7% of the catheters in the group of replacements that were clinically indicated were found to have been removed due to occlusion. It was found that the PIVC indwelling time for 85.8% of the patients in the group receiving routine replacement ranged from one to three days compared with none of the patients in the clinically indicated group. Within the set of clinically indicated replacements, it was found that 77.3% had PIVC indwelling time ranging from five to seven days, with highly statistically significant differences between the two groups.

According to table 4, neither the clinically indicated replacement group nor the routine replacement group had any signs of infiltration, and there was no statistically significant difference between the two groups. Phlebitis was not present in the routine replacement group, whereas 2.7% of patients in the clinically indicated replacement group developed the condition with no statistically significant difference between the two groups.

Table 5 reveals that the mean percentage of PIVC indwelling time of the routine replacement group was 3.12± 0.33 compared with the mean percentage of PIVC indwelling time of the clinically indicated replacement group 6.6±2.09 with a highly statistically significant difference between them p=0.000.

Figure 1 represents the estimated cost reduction after the implementation of the practice change. It was found that the cost of insertion of PIVs according to hospital policy from 3-4 days in 2022 was 1,540.849.36 SAR. The estimated cost amounted to a year, and the cost reduction will be 709,999.56 yearly.

Table (2): Comparison of the clinically recommended replacement and routine replacement groups concerning the demographic data (n= 153)

Characteristics	Routine replacement group (n=78)		Clinically indicated replacement group (n=75)		$\chi 2$	p
	n	%	n	%		
Age						
<18	0	0.0	1	1.3	5.86	0.11
18-<40	15	19.2	6	8.0		
40-<60	32	41.0	29	38.7		
≥60	31	39.7	39	52.0		
Current diagnosis						
Cardiovascular disorder	44	56.4	34	45.3	3.89	0.27
Respiratory disorder	0.0	0.0	1	1.3		
Neurological disorder	1	1.3	0	0.0		
Medical oncology	33	42.3	40	53.3		
Gender						
Male	49	62.8	47	62.7	0.00	0.98
Female	29	37.2	28	37.3		

Table (3): Peripheral intravenous catheter characteristics (n= 153).

Characteristics	Routine replacement group (n=78)		Clinically indicated replacement group (n=75)		$\chi 2$	p
	n	%	n	%		
Insertion site						
Forearm	30	38.5	42	56.0	7.47	0.24
The back of the hand	26	33.3	24	32.0		
Wrist	22	28.2	9	12.0		
Catheter gauge						
18	2	2.6	5	6.7	3.65	0.30
20	14	17.9	7	9.3		
22	57	73.1	57	76.0		
24	5	6.4	6	8.0		
Catheter mode of use						
Intermittent	70	89.7	68	90.7	0.03	0.84
Continuous	8	10.3	7	9.3		
Reason for removal						
Discharge home	1	1.3	28	37.3	135.2	0.000
Drainage/leaking	1	1.3	14	18.7		
Occlusion/ blockage	2	2.7	29	38.7		
Phlebitis	0	0.0	2	2.7		
Removed by patient	1	1.3	2	2.7		
Routinely changed	73	93.6	0	0.0		
Indwelling time (days)						
1-3	67	85.8	0	0.0	153.0	0.000
4	11	14.1	0	0.0		
5-7	0	0.0	58	77.3		
8-13	0	0.0	17	22.6		

Table (4): Comparison between the routine replacement and clinically indicated replacement groups about complications (n= 153).

Complications	Routine replacement group (n=78)		Clinically indicated replacement group (n=75)		χ2	p
	n	%	n	%		
Phlebitis						
Score 0	78	100.0	73	97.3	**2.108**	**0.147**
Score 1	0	0.0	2	2.7		
Infiltration						
Yes	0	0.0	0	0.0		
no	77	100.0	75	100.0		

Table (5): Comparison between the routine and clinically indicated replacement group about indwelling time PIVC.

	Routine replacement group Mean±SD	Clinically indicated replacement group Mean±SD	t-value	p-value
Indwelling time of PIVC	3.12± 0.33	6.6±2.09	14.6	0.000

6. Discussion

Short peripheral catheters (SPCs) are hospitals' most frequently used medical devices. Many hospital policies state that SPCs be replaced at 96 hours, which can be unnecessary and costly *(Maier, 2019)*. The aim is to assess the impact of removing peripheral intravenous catheters when clinically indicated compared to the current policy (routine replacement after 74-96 hours) on the complications and to appraise the financial implications.

Our findings indicate that in the Routine replacement group, where PIVCs were removed based on clinical indication; these catheters remained intact for longer durations and exhibited fewer complications compared to the group where PIVCs were routinely replaced. This outcome underscores the clinical efficacy of removing catheters when they are clinically indicated and hints at potential cost savings for healthcare facilities. By allowing catheters to remain in place for longer periods when they are still functional and without complications, healthcare institutions may reduce the frequency of catheter replacements and the associated costs.

This finding aligns with a study by *Maier (2019),* which reported similar observations that peripheral catheters replaced according to clinical indication tended to last longer and experienced fewer complications than those routinely replaced. It emphasizes the importance of a patient-centered approach to catheter management, prioritizing clinical need over arbitrary time-based replacement.

According to studies, replacing PIVCs only when clinically indicated, such as in cases of inflammation, infiltration, or occlusion, was not associated with an increased risk of phlebitis or infections *(Vendramim et al., 2020; Lin et al., 2021).* The findings of the current project reveal a notable absence of evidence of infiltration in both groups, with only two patients in the clinically indicated replacement group experiencing phlebitis. These results suggest that routine replacement of intravenous catheters may not necessarily lead to a significant reduction in complications, such as infiltration and phlebitis.

Instead, our data align with the conclusions drawn from a recent systematic review by Webster et al. in 2019, which reported no discernible difference in complication rates between clinically indicated removal and routine replacement. This finding suggests that nurses consider adopting a more selective approach to catheter replacement, guided by clinical indications rather than a rigid routine, to reduce the risk of complications without compromising patient care *(Webster et al., 2019).*

Additionally, *Li et al. (2022)* found that the incidence of phlebitis per patient was not significantly higher in the clinically indicated group compared to the routine replacement group after conducting a multisite randomized controlled trial about routine replacement versus replacement as clinically indicated of peripheral intravenous catheters *(Li et al., 2022).*

In comparison, *Xu et al. (2017)* discovered that the intervention group showed no signs of phlebitis, and

infiltration was only partially responsible for removing a few peripheral catheters. Conversely, *Lu et al. (2022*) noted that the clinically suggested replacement group had higher infiltration, occlusion, and phlebitis levels than the standard replacement group.

A systematic review and meta-analysis of randomized controlled trials done by *Chen et al. (2022)* found that the study group had a higher risk of phlebitis than the control group, according to the various schedules (every 72, 72-96, and 96 h) of routine replacement in the control group. However, the differences did not achieve statistical significance. Moreover, compared to the control group, the study group had considerably increased risks of occlusion and infiltration *(Chen et al., 2022).*

The indwelling period of peripheral intravenous catheters in the clinically indicated replacement group was notably longer, averaging six days or more, compared to the routine replacement group, which typically had catheters in place for three or more days. This divergence in catheter dwell times is an interesting observation that warrants discussion.

One significant implication of this finding is the potential for cost reduction in healthcare facilities. Extending the use of IV catheters to six days, when clinically indicated, can lead to a reduction in the overall number of catheter replacements. Fewer replacements reduce the direct costs associated with purchasing and disposing of catheters and decrease the time and resources needed for catheter insertion and maintenance. This cost-saving potential aligns with the broader healthcare trend of resource optimization and cost containment.

This finding contrasts with the results of a study by *Maier (2019),* which had initially expected peripheral catheters to remain in place for a shorter duration. However, our study's results emphasize the economic benefits of adopting a more selective approach to catheter replacement while ensuring patient safety and satisfaction. According to Olivier et al. (2021), the average PIV dwell duration following the practice modification was seven days, with a range of 3 to 28 days *(Olivier et al., 2021).*

The causes of peripheral catheter removal in our study revealed an interesting contrast between the clinically required and routine replacement groups. Notably, one-third of catheters in the clinically required replacement group were removed due to occlusion, while only two in the routine replacement group exhibited the same issue. This disparity in occlusion-related removals suggests a potential advantage associated with routine catheter replacement.

An interpretation of this finding underscores the importance of routine replacement in reducing catheter obstruction. When catheters are routinely replaced, there is a decreased likelihood of prolonged catheter dwell time leading to occlusion, a problem that can impede patient care and necessitate unplanned catheter removal. This finding aligns with the conclusions drawn from a systematic review conducted by *Webster et al. (2019),* which reported evidence suggesting that routine peripheral intravenous catheter (PIVC) replacement can reasonably reduce the occurrence of catheter obstruction.

The present study illustrated that the cost of PIV insertion was significantly decreased when removing the PIVs as clinically indicated. The same conclusion—that clinically indicated removal lowers device-related costs—was reported by *Li et al., 2022 McGuire and Coronado, 2020; Webster et al., 2019; Foumani et al., 2018; Morrison and Holt (2015).*

7. Sustainability plan

To ensure the long-term success and sustainability of the evidence-based practice (EBP) project for peripheral intravenous catheter (PIVC) management, a comprehensive sustainability plan is outlined as follows:

Continued education: The cornerstone of sustainability is ongoing education. Nurses and healthcare providers will participate in regular training sessions to stay updated on best practices for PIVC management, including assessing phlebitis using the Visual Infusion Phlebitis (VIP) score. This continuous education ensures that staff remain competent in delivering high-quality care and are adept at utilizing the VIP scale within the health electronic system.

Quality monitoring and reporting: Collaborating with the Quality Department will be pivotal for monitoring outcomes. The VIP scale will be integrated into the health electronic system, enabling nurses to monitor phlebitis as a key performance indicator (KPI). This integration will facilitate continuous quality improvement by providing real-time data for analysis.

Regular reporting mechanism: Every quarter, a comprehensive report will be generated and submitted to department heads, the Quality Department, and the EBP Council. These reports will highlight outcomes, identify areas for improvement, and ensure that the project remains aligned with the hospital's quality objectives.

Hospital-wide rollout: The incremental rollout strategy will continue, extending the project's reach across the entire hospital. This expansion will be done methodically to ensure that each department adapts effectively to the updated PIVC management protocols.

Policy and procedure updates: Policies and procedures will be updated to reflect the new EBP guidelines. This update will include the official adoption of the VIP scale for routine phlebitis monitoring and the adjustment of PIVC replacement protocols based on clinical indications.

Incorporation of the VIP scale in electronic systems: By embedding the VIP scale into the health electronic system, we institutionalize the monitoring of phlebitis as part of routine patient care. This embedding enables nurses to input data directly, track trends over time, and respond promptly to any signs of phlebitis, enhancing patient outcomes.

The sustainability plan is designed to embed the EBP project's advancements into the fabric of the hospital's daily operations, ensuring that improvements in PIVC management are maintained and built upon over time.

8. Dissemination

This project's result was sent to the nursing office, and a practice change was started with the nursing quality team to

change the policy. This EBP practice change was presented as a poster and disseminated to all hospital departments. In addition, the project results will be sent to the Makkah healthcare cluster for implementation at Makkah cluster hospitals.

9. Conclusion

In conclusion, the outcomes of this evidence-based practice project underscore the transformative potential within healthcare settings when these results are put into action. Nurse leaders and frontline nurses alike can be catalysts for change, facilitating a range of benefits that encompass not only cost savings but also the enhancement of patient and employee satisfaction, as well as the fortification of safety measures and adherence to best practices.

By wholeheartedly embracing evidence-based practice, we uplift the standard of patient care while simultaneously bolstering a hospital's financial outlook. This concerted effort offers a holistic, triple-win scenario: an enriched experience for patients, a fulfilling workplace environment for healthcare professionals, and a financially sustainable future for healthcare institutions.

10. Recommendations

Based on recent data and the outcomes of the project's execution at King Abdullah Medical City, it can be recommended that:

- PIVs should only be replaced when clinically indicated.
- Education and policy change can successfully implement and sustain a system-wide shift to evidence-based PIV practice.
- An evidence-based strategy to modify PIV practices is economical and enhances patient care.
- Incorporation of the VIP Scale in Electronic Systems

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12. References

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