

SKILL STATIONS FOR SAFER IV PRACTICE: A QUASI-EXPERIMENTAL STUDY AMONG NURSING STUDENTS

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ABSTRACT

Introduction: Intravenous (IV) infusion is a fundamental nursing procedure requiring sound theoretical knowledge, psychomotor competence, adherence to aseptic principles, and appropriate clinical judgment. Inadequate preparation may contribute to procedural errors and complications. Skill station-based learning provides a structured and controlled environment in which nursing students can practice procedures repeatedly, receive immediate feedback, and develop clinical competence before performing procedures in patient-care settings. This study evaluated the effectiveness of a structured skill station programme on knowledge and practice regarding intravenous infusion among nursing students.

Methods: A quantitative evaluative approach with a quasi-experimental one-group pre-test–post-test design was adopted. A total of 100 nursing students from selected nursing colleges in the Sangli–Miraj–Kupwad Corporation area of Maharashtra, India, were recruited using non-probability convenience sampling. Baseline knowledge and practice regarding intravenous infusion were assessed using a structured knowledge questionnaire and an observational practice checklist. A structured skill station programme of 45 minutes was subsequently administered. Post-intervention assessment was conducted on the fourth day. Descriptive statistics and paired *t*-tests were used for analysis.

Results: The mean knowledge score increased from 9.25 ± 4.09 at pre-test to 12.52 ± 4.26 at post-test. The observed paired *t*-value was -22.57 ($p < 0.00001$). The mean practice score increased from 21.20 ± 9.27 to 27.98 ± 9.91 , with a paired *t*-value of -13.66 ($p < 0.00001$). At baseline, 46% of participants demonstrated average knowledge and 53% demonstrated average practice. Following the intervention, 47% demonstrated good knowledge and 32% excellent knowledge, while 49% demonstrated good practice and 27% excellent practice.

Conclusion: The findings demonstrate significant improvement in both knowledge and practical performance following skill station-based training. Structured skill stations may provide an effective educational strategy for strengthening nursing students' clinical competence in intravenous infusion and for supporting safe transition from the educational laboratory to clinical practice.

KEYWORDS: intravenous infusion; nursing students; skill station; simulation-based learning; clinical competence; nursing education; psychomotor skills

INTRODUCTION

Intravenous infusion is one of the most frequently performed procedures in nursing practice and is essential for the administration of fluids, medications, blood products, and nutritional therapy. Safe intravenous therapy requires nurses to integrate theoretical knowledge with psychomotor skills, clinical judgment, infection-prevention practices, accurate calculation of infusion rates, and continuous patient monitoring. Consequently, competency in intravenous procedures is an important component of undergraduate nursing education. The present study was undertaken in response to the need for strengthening nursing students' knowledge and practical competence in intravenous infusion.

The transition from theoretical learning to clinical performance remains challenging for many nursing students. Limited clinical exposure, fear of making mistakes, inadequate opportunities for repeated practice, and lack of confidence can interfere with the development of procedural competence. Previous studies have identified deficiencies in students' knowledge, attitudes, confidence, and performance related to venipuncture and intravenous procedures.

Traditional classroom instruction and demonstration can provide students with conceptual information and an initial understanding of procedures; however, psychomotor competence requires opportunities for active practice and feedback. Simulation-based education has therefore increasingly been incorporated into nursing education. A simulated learning environment allows students to perform procedures repeatedly in a controlled setting without exposing patients to preventable errors. Evidence reported in the literature indicates that simulation-based

approaches can improve knowledge, practical performance, clinical assessment skills, confidence, and preparedness for clinical practice.

Skill stations represent a structured form of skills-based learning in which learners perform specific clinical procedures under standardized conditions. Such learning environments can facilitate demonstration, supervised return demonstration, repetition, immediate feedback, and objective assessment. These features may help address the theory–practice gap and support the progressive development of clinical competence.

Intravenous therapy is particularly appropriate for structured skills training because errors in technique may result in complications such as infiltration, phlebitis, infection, and medication-related errors. Accordingly, students should have opportunities to develop procedural competence before independently undertaking intravenous procedures in clinical settings.

Previous research has examined simulation, self-instructional modules, virtual reality, peer learning, and other innovative approaches to nursing education. However, the effectiveness of a focused skill station programme specifically directed toward knowledge and practice of intravenous infusion among nursing students in the Sangli–Miraj–Kupwad setting warranted further evaluation.

Therefore, the present study assessed the effectiveness of skill station-based training on knowledge and practice regarding intravenous infusion among nursing students.

Aim of the Study

To assess the effectiveness of skill station-based training on knowledge and practice regarding intravenous infusion among nursing students from selected nursing colleges in the Sangli–Miraj–Kupwad Corporation area.

Objectives

1. To assess the pre-test level of knowledge regarding intravenous infusion among nursing students.
2. To assess the pre-test level of practice regarding intravenous infusion among nursing students.
3. To assess the post-test level of knowledge regarding intravenous infusion after skill station-based training.
4. To assess the post-test level of practice regarding intravenous infusion after skill station-based training.
5. To determine the difference between pre-test and post-test knowledge scores.
6. To determine the difference between pre-test and post-test practice scores.
7. To evaluate the effectiveness of skill station-based training in improving knowledge and practice regarding intravenous infusion.

Hypotheses

H₁: There is a significant difference between pre-test and post-test knowledge scores regarding intravenous infusion among nursing students following skill station-based training.

H₂: There is a significant difference between pre-test and post-test practice scores regarding intravenous infusion among nursing students following skill station-based training.

MATERIALS AND METHODS

Study Design

A quantitative evaluative approach was adopted using a quasi-experimental one-group pre-test–post-test design. The design was represented as:

$$O_1 \rightarrow X \rightarrow O_2$$

Where:

- **O₁:** Pre-test assessment of knowledge and practice
- **X:** Structured skill station-based training
- **O₂:** Post-test assessment of knowledge and practice

The original study specifies the same quasi-experimental design and sequence.

Study Setting

The study was conducted among nursing students from selected nursing colleges in the Sangli–Miraj–Kupwad Corporation area of Maharashtra, India.

Sample

The study included **100 nursing students**. Participants were selected using **non-probability convenience sampling**. The study population comprised nursing students from the selected nursing colleges.

Data Collection Instruments

Data were collected using three sections:

Section A: Demographic Characteristics

The demographic section included variables such as:

- Age
- Gender
- Course
- Year of study
- Clinical exposure

Section B: Structured Knowledge Questionnaire

A structured questionnaire consisting of multiple-choice questions was used to assess students' knowledge regarding intravenous infusion.

Section C: Practice Observation Checklist

An observational checklist was used to assess students' performance of the intravenous infusion procedure. The source manuscript describes the questionnaire and observational checklist as the principal instruments used to evaluate knowledge and practice.

Validity and Reliability

The research instrument was submitted to subject experts for content validation. Necessary modifications were proposed based on expert suggestions. Reliability assessment and a pilot study were also planned. The pilot study was described as involving 10% of the sample in a similar setting.

Intervention

A structured **45-minute skill station programme** on intravenous infusion was administered immediately after the pre-test. The programme provided students with an opportunity to learn and practice the procedure in a structured educational environment. A post-test assessment was conducted on the fourth day following the intervention.

Data Collection Procedure

Administrative permission was obtained from the concerned authorities. Participants were informed about the purpose and procedures of the study, and written informed consent was obtained. Confidentiality and privacy were maintained throughout the study.

Baseline knowledge and practice were assessed on Day 1. The structured skill station intervention was administered following the pre-test. Post-intervention assessment was undertaken on Day 4.

Statistical Analysis

Demographic characteristics were summarized using frequency and percentage. Mean and standard deviation were used to describe knowledge and practice scores. A paired *t*-test was applied to determine the difference between pre-test and post-test scores. A significance level of $p < 0.05$ was considered statistically significant.

RESULTS

Demographic Characteristics

The study included 100 nursing students. The largest proportion of participants was aged 20 years (42%), followed by 21 years (37%) and 22 years (21%). Females constituted 60% of the sample and males 40%.

Table 1. Demographic characteristics of participants

Variable	Category	Percentage
Age	20 years	42%
	21 years	37%
	22 years	21%
Gender	Female	60%
	Male	40%

Pre-test and Post-test Knowledge Levels

Before the intervention, 46% of students demonstrated average knowledge, 35% good knowledge, and 19% excellent knowledge.

Following skill station-based training, 47% demonstrated good knowledge, 32% excellent knowledge, and 21% average knowledge.

Table 2. Distribution of participants according to knowledge level

Knowledge level	Pre-test n (%)	Post-test n (%)
Average	46 (46%)	21 (21%)
Good	35 (35%)	47 (47%)
Excellent	19 (19%)	32 (32%)
Total	100 (100%)	100 (100%)

Pre-test and Post-test Practice Levels

In the pre-test, 53% of students demonstrated average practice, 33% good practice, and 14% excellent practice. After the skill station intervention, 49% demonstrated good practice, 27% excellent practice, and 24% average practice.

Table 3. Distribution of participants according to practice level

Practice level	Pre-test n (%)	Post-test n (%)
Average	53 (53%)	24 (24%)
Good	33 (33%)	49 (49%)
Excellent	14 (14%)	27 (27%)
Total	100 (100%)	100 (100%)

Comparison of Knowledge Scores

The mean knowledge score increased from 9.25 ± 4.09 before the intervention to 12.52 ± 4.26 after the intervention.

The paired *t*-test demonstrated a statistically significant improvement:

$t = -22.57, p < 0.00001$.

Thus, the observed difference in knowledge scores was statistically significant.

Table 4. Comparison of pre-test and post-test knowledge scores

Assessment	Mean $\pm$ SD	Mean difference	<i>t</i>	<i>p</i> value
Pre-test	9.25 ± 4.09	3.27	-22.57	<0.00001
Post-test	12.52 ± 4.26			

Comparison of Practice Scores

The mean practice score increased from 21.20 ± 9.27 at pre-test to 27.98 ± 9.91 at post-test.

The paired *t*-test demonstrated a statistically significant difference:

$t = -13.66, p < 0.00001$.

Table 5. Comparison of pre-test and post-test practice scores

Assessment	Mean $\pm$ SD	Mean difference	<i>t</i>	<i>p</i> value
Pre-test	21.20 ± 9.27	6.78	-13.66	<0.00001
Post-test	27.98 ± 9.91			

DISCUSSION

The present study demonstrated significant improvement in nursing students' knowledge and practice regarding intravenous infusion following a structured skill station programme. The mean knowledge score increased by 3.27 points, while the mean practice score increased by 6.78 points. Both improvements were statistically significant at $p < 0.00001$.

At baseline, nearly half of the students demonstrated average knowledge, while more than half demonstrated average practical performance. This finding indicates the presence of a theory–practice gap in intravenous infusion skills before the intervention. The finding is consistent with the concern identified in previous literature that nursing students may experience inadequate knowledge, confidence, and performance related to intravenous procedures.

The improvement following the intervention may be explained by the active and repetitive nature of skill station-based learning. Unlike purely didactic teaching, a skill station enables learners to observe the procedure, perform the procedure, receive supervision, identify errors, and repeat the procedure. The opportunity for immediate feedback may further strengthen procedural learning.

The improvement in practice scores is particularly important because intravenous infusion is a psychomotor skill requiring coordination of multiple steps. Competent performance involves appropriate preparation, infection-prevention measures, technical execution, monitoring, and recognition of possible complications. Simulation and skills-laboratory approaches provide an opportunity to develop these competencies before students undertake procedures on actual patients.

The findings are broadly consistent with literature supporting simulation-based education as a strategy for improving nursing students' knowledge and clinical skills. A 2024 systematic review reported positive effects of simulation-based learning on students' knowledge and skills in nursing programmes. Research specifically addressing intravenous therapy has also reported improvements in students' knowledge and performance following simulation-based learning.

The present findings also support the use of structured learning approaches in nursing curricula. Previous studies have explored virtual reality, self-instructional modules, and other educational interventions for intravenous therapy, indicating the growing importance of active and technology-supported approaches in clinical skills education.

However, interpretation of the current findings should take the study design into account. Because the study used a single-group pre-test–post-test design without a concurrent control group, improvement cannot be attributed exclusively to the intervention with the same strength of inference as a randomized controlled trial. Testing effects, maturation, and other uncontrolled influences may also have contributed to the observed change.

Educational Implications

The findings have several implications for nursing education.

First, skill stations may be incorporated into nursing skills laboratories as a structured approach to teaching high-frequency clinical procedures. Second, repeated supervised practice can be used before students perform procedures independently in clinical settings. Third, objective observation checklists can provide standardized assessment of psychomotor competence.

Skill stations may also facilitate integration of theoretical knowledge with practical application. Immediate feedback can help students recognize procedural errors and correct them before such errors occur in patient-care settings.

Nursing educators may therefore consider integrating structured skill stations with demonstrations, return demonstrations, simulation, objective checklists, and competency-based assessment.

Strengths of the Study

1. The study addressed an important and frequently performed nursing procedure.
2. Both cognitive and psychomotor outcomes were evaluated.
3. The intervention was structured and delivered in a controlled learning environment.
4. Pre-test and post-test measurements enabled assessment of change following the intervention.
5. The study provides locally relevant evidence for nursing skills education.

LIMITATIONS

The principal limitations include:

1. The study used a one-group pre-test–post-test design without a control group.
2. Participants were selected through convenience sampling, limiting generalizability.
3. The study was restricted to selected nursing colleges in the Sangli–Miraj–Kupwad Corporation area.
4. The intervention focused specifically on intravenous infusion and therefore may not directly represent competency in other clinical procedures.
5. Post-intervention assessment was conducted within a short period; therefore, long-term retention of knowledge and skills was not established.
6. The study did not establish whether improved performance subsequently translated into improved performance during routine patient care.

CONCLUSION

The present study found statistically significant improvement in both knowledge and practice regarding intravenous infusion among nursing students following structured skill station-based training. The mean knowledge score increased from 9.25 ± 4.09 to 12.52 ± 4.26 , while the mean practice score increased from 21.20 ± 9.27 to 27.98 ± 9.91 . Both improvements were statistically significant ($p < 0.00001$).

The findings suggest that structured skill station-based learning can support the development of nursing students' theoretical understanding and psychomotor competence in intravenous infusion. Such approaches may help bridge the gap between classroom instruction and clinical practice.

Future studies should employ randomized or controlled designs, larger samples, multicentre recruitment, and longer follow-up periods to determine the durability and generalizability of these findings.

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