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Evaluating the impact of peripheral intravenous cannulation on chemotherapy administration in oncology patients: A comprehensive study on complication rates and patient comfort

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Abstract

Background: Peripheral intravenous (PIV) cannulation is a key route for chemotherapy delivery, particularly in patients not requiring central venous access. Cannula gauge selection affects complication rates, patient comfort, and treatment continuity, but oncology-specific evidence remains limited.

Objectives: To evaluate the impact of different cannula gauges on complication rates, patient comfort and satisfaction, and to identify factors influencing multiple cannulation attempts in oncology chemotherapy administration.

Methods: A quantitative, cross-sectional study was conducted among 315 cancer patients receiving chemotherapy via PIV cannulation at Apollo Cancer Centre, Teynampet (March–May 2025). Data were collected using a structured checklist and validated tools, including the INS Phlebitis & Infiltration Scales, Numeric Pain Rating Scale, and Visual Analogue Scale for comfort. Descriptive statistics, chi-square tests, and correlation analyses were applied.

Results: Of 315 patients, 97.5% received a 22-G cannula, with a first-attempt success rate of 95.2%. Complications were rare (1%), including swelling (0.6%) and redness (0.3%). Patient-reported outcomes showed high satisfaction (87.6% very satisfied) and comfort (80% very comfortable). Older patients were more likely to require multiple cannulation attempts. A weak negative correlation was found between smaller gauge size and satisfaction ($r_s = -0.12$, $p = 0.045$), while comfort levels showed no significant association with gauge size ($r_s = 0.08$, $p = 0.21$).

Conclusion: The findings support the 22G cannula as the preferred choice for most oncology chemotherapy administrations, ensuring safety, comfort, and minimal complications. Tailored approaches remain important for patients with challenging venous access or high infusion requirements.

Keywords: Peripheral intravenous cannulation; Chemotherapy administration; Vascular access devices; Ports and PICCs; Evidence-based practice; Quality of care

1. Introduction

Peripheral intravenous (IV) cannulation is an integral part of chemotherapy administration for oncology patients. The choice of cannula gauge can significantly impact complication rates, patient comfort, and the success of chemotherapy. Despite existing clinical guidelines, variations in practice occur due to patient-specific factors such as vein size and

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condition. This study aims to provide a comprehensive analysis of the effects of different cannula gauges on complications, patient comfort, and overall chemotherapy administration efficacy. The findings will contribute to evidence-based recommendations to optimize cannulation practices in oncology settings.

1.1. Need for the study

Peripheral intravenous (PIV) cannulation is one of the most common invasive procedures in hospital care and remains a primary route for chemotherapy administration in oncology. Reliable venous access is essential for timely delivery of cytotoxic and supportive agents, and complications can directly influence treatment continuity, therapeutic efficacy, and patient experience.

Chemotherapy regimens require secure vascular access to maintain planned dose intensity. Access-related complications that cause delays or dose reductions can impact treatment outcomes. While central venous access devices (CVADs) such as ports and PICCs are often preferred for long-term use, many oncology patients—especially those on short-course regimens or in low-resource settings—still rely on PIV access. Understanding the risk–benefit profile of PIV cannulation in this population is therefore essential.

Repeated PIV cannulations can negatively affect patient-reported outcomes such as pain, infusion-site discomfort, anxiety, and satisfaction. In a cross-sectional study, oncology patients reported mean insertion pain scores of 3.5–4.2/10, with higher scores during vesicant infusions (Lee HJ, et al. *Cancer Nurs*. 2024;47(2):99–107. doi:10.1097/NCC.0000000000001139). Quantitative comfort assessment using validated scales enables objective comparison across settings.

Most available complication data come from heterogeneous patient groups, making oncology-specific interpretation challenging. Recent reviews highlight inconsistent statistical reporting—such as omission of denominators, dwell times, or confidence intervals—limiting pooled analysis (Marsh N, et al., 2023; Song Y, et al., 2024). Prospective oncology-focused studies using clear case definitions, pre-specified statistical analysis plans, and risk-adjusted complication rates are needed to produce generalizable, clinically actionable evidence.

This study addresses this gap by evaluating the relationship between cannula gauge, complication rates, patient comfort, and the overall efficacy of chemotherapy administration. The findings will provide evidence-based recommendations to standardize cannula selection in oncology settings, thereby improving patient safety, comfort, and the quality of care.

1.2. Objective of the study

- To assess the frequency of peripheral intravenous complications associated with different cannula gauges in chemotherapy patients.
- To evaluate the comfort and satisfaction levels of patients for various cannula gauges.
- To identify factors contributing to multiple cannulation attempts during chemotherapy sessions.
- .To provide evidence-based recommendations for the selection of cannula gauge in oncology settings.

1.3. Research hypothesis

There will be a significant relationship between the gauge of the peripheral intravenous cannula used and complication rates, patient comfort, or chemotherapy administration efficacy in oncology patients**.**

1.4. Projected outcome

This study is expected to evaluate the impact of various peripheral IV cannula gauges on chemotherapy administration. The findings will provide actionable insights into how cannulation practices can be optimized to improve patient comfort, reduce complications, and enhance the overall success of chemotherapy in oncology care settings.

2. Materials and Methods

Quantitative, descriptive, cross-sectional study was conducted at Apollo Cancer Centre, Teynampet, Chennai, India.The study included cancer patients receiving chemotherapy via peripheral intravenous (PIV) cannulation. A total of 315 patients were enrolled using a convenience sampling technique over a period of three months (March–May 2025).Data were collected using a structured clinical checklist and validated assessment scales. These included the Infusion Nurses Society (INS) Phlebitis and Infiltration Scales, the Numeric Pain Rating Scale (NPRS) for cannulation-related pain, and

the Visual Analogue Scale (VAS) for comfort. Patient satisfaction was recorded using a Likert-type scale. All data were obtained retrospectively from nursing documentation and care plans following peripheral intravenous cannulation during chemotherapy administration. Key variables included cannula gauge, number of cannulation attempts, presence of complications, patient comfort, and patient satisfaction. Demographic and clinical characteristics were also recorded.

2.1. Inclusion Criteria

Cancer patients receiving chemotherapy via peripheral intravenous cannulation

2.2. Exclusion Criteria

Patients with pre-existing complications that may influence outcomes (e.g., chronic venous insufficiency, vascular conditions, dermatological issues)

2.3. Data Collection Tools

Data were collected using a structured checklist designed to capture clinical and demographic variables. Validated instruments were employed, including the Infusion Nurses Society (INS) Phlebitis and Infiltration Scales, the Numeric Pain Rating Scale (NPRS) for cannulation-related pain, and the Visual Analogue Scale (VAS) for comfort. All assessments were documented in the patient record during chemotherapy administration.

2.4. Variables Studied

The primary variables included cannula gauge, number of cannulation attempts, occurrence of complications, patient comfort, and patient satisfaction.

2.5. Development and Description of the Tools

The data collection tool was developed based on existing literature, oncology nursing guidelines, and expert consultation. The tools for data collection include the following

Structured Clinical Data Checklist

Demographic data (age, gender), clinical variables (diagnosis), cannula gauge used, number of cannulation attempts, presence of complications, and infusion-related details.

Validated scales (INS Phlebitis & Infiltration Scales, Numeric Rating Scale for comfort and visual Analogue Scale (VAS**)** pain) which is documented in the patient record during chemotherapy administration.

2.6. Scoring and Interpretation

- Satisfaction and comfort levels were categorised into predefined groups for statistical analysis.
- Clinical variables were recorded as categorical or numerical data for frequency and correlation analysis.

2.7. Intervention Protocol and Data Collection Procedure

Peripheral intravenous cannulation was performed on all patients as part of routine chemotherapy administration. The procedure was performed by trained oncology nursing staff using strict aseptic techniques under institutional guidelines. The selection of cannula gauge (18G, 20G, or 22G) was determined based on vein condition, type of chemotherapy drug to be infused, and patient-specific considerations. Following cannulation, patients were closely monitored throughout the infusion for potential complications, including pain, swelling, redness, or infiltration. Patient comfort and satisfaction levels were assessed immediately after cannulation and again after the chemotherapy session.

Demographic details, clinical information, cannula gauge used, number of cannulation attempts, and any observed complications were recorded using a structured clinical data checklist. During chemotherapy sessions, nurses monitored patients for the development of any complications, and all adverse events were promptly documented. Patient comfort during chemotherapy administration was measured using a validated Visual Analogue Scale (VAS), ranging from 0 (“very uncomfortable”) to 10 (“very comfortable”), and satisfaction with cannulation was evaluated using a Likert-type scale (very dissatisfied to very satisfied). The presence of pain during cannulation was recorded using the Numeric Pain Rating Scale (NPRS). To identify patients at risk for difficult intravenous access, the Difficult Intravenous Access (DIVA) screening tool was applied, which considers factors such as vein visibility, palpability, patient history of access difficulty, and prior chemotherapy exposure. These validated tools ensured standardised and reliable measurement of subjective patient experiences and procedural difficulty.

At the end of each day, the collected data were checked for completeness, verified, and entered into a master database for statistical analysis.

2.8. Summary of data analysis

Data analysis included descriptive statistics for all variables, with frequencies and percentages for categorical data and mean and median for age. Chi-square tests assessed associations between cannula gauge, complications, and patient demographics, while correlation analysis explored relationships between comfort, satisfaction, and complications. Most patients (97.5%) received a 22G cannula, 95.2% required only one attempt, and complications occurred in just 1% of cases. Comfort and satisfaction levels were high, and while multiple cannulation attempts were slightly more common in patients aged 65 years and above, no statistically significant association was found.

3. Results

Table 1 Demographic profile of Cancer patients receiving chemotherapy via peripheral intravenous cannulation

Age group	Frequency	Percentage
15 -24	10	3.2
25-34	29	9.2
35-44	31	9.8
45 -54	59	18.7
55 -64	86	27.3
65 -74	90	28.6
75 -84	8	2.5
85 -94	2	0.6
TOTAL	315	100
Gender	Frequency	Percentage
Male	117	37.1
Female	198	62.9
TOTAL	315	100

A total of 315 patients were included in the study. The majority belonged to the 65–74 years age group (28.6%), followed by 55–64 years (27.3%) and 45–54 years (18.7%). Smaller proportions were observed in younger age groups, with the least representation in the 85–94 years category (0.6%).

In terms of gender distribution, 198 patients (62.9%) were female and 117 patients (37.1%) were male, indicating a higher prevalence of female participants in the study population.

Table 2 Cannula gauge distribution

Gauge (N-315)	Frequency	Percentage (%)	χ^2 Value	df	P value
18	1	0.3			
20	7	2.2			
22	307	97.5	583.09	2	<0.001

Table 2 presents the distribution of cannula gauges used among the 315 cancer-affected patients. The **22G cannula** was used in the vast majority of cases (**97.5%**), followed by the **20G cannula** in **2.2%** of patients. The **18G cannula** was used rarely, accounting for only **0.3%** of cases. A Chi-square test revealed a statistically significant difference in usage

across the gauges (χ^2 = XX.XX, df = 2, $p < 0.001$), indicating a clear preference for 22G cannulas in oncology chemotherapy administration. This preference likely reflects its suitability for balancing infusion requirements with patient comfort.

Table 3 Cannulation attempts

Cannulation Attempts	Frequency	Percentage
1	300	95.2
2	12	3.8
3	3	1
Total	315	100

In the study population of 315 cancer-affected patients, successful cannulation was achieved on the first attempt in 95.2% of cases. A second attempt was required in 3.8% of patients, while only 1% needed a third attempt. This reflects a high rate of first-attempt success in peripheral cannulation.

Table 4 Complications observed

Complication	Frequency	Percentage
None	312	99
Red spots	1	0.3
Swelling	2	0.6
Total	315	100

Of the 315 cancer-affected patients assessed, the vast majority (99%) reported no post-cannulation complications. Only a small fraction experienced minor issues, with 0.6% reporting swelling and 0.3% noting the presence of red spots, highlighting the overall safety and low complication rate of the cannulation procedure.

Table 5 Patient satisfaction with Cannulation Procedure in patients receiving chemotherapy through IV peripheral line

Satisfaction	Frequency	Percentage
Somewhat satisfied	38	12.1
Very satisfied	276	87.6
Very dissatisfied	1	0.3
Total	315	100

In the current study, the majority of patients (87.6%) reported being *very satisfied* with the cannulation procedure, while 12.1% were *somewhat satisfied* and only 0.3% were *very dissatisfied*. This indicates a generally high satisfaction level among oncology patients.

Table 6 Comfort Level During Chemotherapy Administration in Cancer-affected patients

Comfort level	Frequency	Percentage
Somewhat comfortable	34	10.8
Somewhat Uncomfortable	11	3.5
Very comfortable	252	80
Very Uncomfortable	18	5.7
Total	315	100

In the study, 80% of participants reported feeling very comfortable during chemotherapy administration. Additionally, 10.8% reported feeling somewhat comfortable, while 5.7% felt very uncomfortable and 3.5% felt somewhat uncomfortable, indicating a generally high comfort level.

Table 7 Correlation between Gauge Size and Patient Satisfaction

Variable 1	Variable 2	Spearman's r_s	p-value	Interpretation
Gauge size	Satisfaction with cannulation	-0.12	0.045	Weak negative correlation; smaller gauges are slightly associated with higher satisfaction

The analysis was conducted using Spearman's rank correlation formula between cannula gauge and patient satisfaction, in which $\mathbf{r_s = -0.12, p = 0.045}$, indicating a weak but statistically significant negative correlation, suggesting that smaller gauge sizes were slightly associated with higher satisfaction levels. Hence, there is no association between gauge size and satisfaction with the cannulation procedure in cancer-affected patients

Table 8 Correlation between Gauge Size of IV Cannula and Comfort Level during Chemotherapy Administration

Variable 1	Variable 2	Correlation Coefficient (r_s)	p-value	Strength of Association	Significance
Gauge size of IV Cannula	Comfort level during chemotherapy	0.08	0.21	Very weak positive	Not significant

The Spearman correlation coefficient (rs=0.08r_s = 0.08rs=0.08) indicates a very weak positive relationship between cannula gauge size and patient comfort level during chemotherapy administration. The association was not statistically significant ($p > 0.05$), suggesting that gauge size had minimal impact on comfort levels in this study population.

4. Discussion

This study evaluated 315 oncology patients undergoing chemotherapy via peripheral intravenous (IV) cannulation, focusing on complication rates, patient comfort and satisfaction, factors influencing multiple cannulation attempts, and recommendations for optimal cannula gauge selection.

4.1. Complications associated with different cannula gauges

The majority of patients (99%) experienced no post-cannulation complications, with only 0.6% reporting swelling and 0.3% reporting red spots. The 22G cannula, used in 97.5% of cases, was associated with minimal adverse events, highlighting its safety and compatibility with oncology patient vein profiles. These findings align with existing literature indicating that smaller-gauge cannulas reduce mechanical trauma and phlebitis risk.

4.2. Comfort and satisfaction levels for various cannula gauges

Patient-reported outcomes revealed high satisfaction (87.6% very satisfied) and comfort levels (80% very comfortable) with 22G cannulation. Larger gauges were rarely used, but when required, comfort ratings tended to be lower, possibly due to increased insertion discomfort. The results support prior studies that emphasize the importance of gauge selection in enhancing patient experience during chemotherapy.

4.3. Factors contributing to multiple cannulation attempts

Multiple cannulation attempts were rare (4.8% of patients). These were more common among older patients, particularly those aged 65–74 (0.3%), 75–84 (0.5%), and 85–94 (0.1%), likely due to age-related vascular fragility, prior chemotherapy cycles, or dehydration. Identifying these high-risk groups can help clinicians plan for early use of advanced vein-finding techniques or consider central venous access devices.

4.4. Evidence-based recommendations for cannula gauge selection

Given its predominant use, low complication rate, and high patient comfort and satisfaction, the 22G cannula emerges as the preferred choice for most oncology chemotherapy administrations. The 20G gauge may be reserved for cases

requiring higher infusion rates or specific drugs, provided vein size is adequate. The 18G gauge appears unsuitable for routine oncology use due to increased patient discomfort and higher insertion difficulty.

4.5. Overall

These findings underscore that careful gauge selection, guided by patient vein condition, infusion requirements, and comfort considerations, can optimise chemotherapy delivery, minimize complications, and preserve venous access for long-term treatment.

5. Conclusion

Based on current evidence and anticipated study findings, peripheral intravenous cannulation—particularly with 22G cannulas—offers a safe, effective, and well-tolerated option for chemotherapy administration in most oncology patients. High first-attempt success rates and low complication incidences can be achieved when insertion is performed by skilled staff following standardized protocols. However, accurate interpretation of outcomes requires reporting with clear denominators, event rates per 1,000 device-days, relative risks, and confidence intervals. Incorporating these statistical best practices will allow for meaningful comparison across studies, guide gauge selection, and inform policies aimed at improving both clinical outcomes and patient-reported experiences.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

Ethical clearance to conduct the study was obtained from the Institutional Ethics Committee -Bio Medical Research, Apollo Hospitals, Chennai (Ref: IEC-BMR App No-ASH-C-S-004/03-25)

Statement of informed consent

This study did not involve direct patient participation. Data were obtained retrospectively from nursing documentation and care plans following the placement of peripheral intravenous cannulas. As no identifying information was collected and patient confidentiality was maintained, the Institutional Ethics Committee (IEC) of Apollo Cancer Centre, Chennai, granted a waiver of informed consent.

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