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# Infusion unit nurses' ratings of risk factors for difficult intravenous access (DIVA) differ based on patients' type of cancer

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## ABSTRACT

The majority of patients receiving cancer chemotherapy are treated in the outpatient setting and require peripheral intravenous (IV) access. The purpose of this work was to evaluate for differences in infusion unit nurses' ratings of predictors of difficult intravenous access (DIVA) based on whether they cared for patients with solid tumours versus hematologic malignancies. Nurses (N=152) received an email with a link to a Qualtrics survey. Nurses completed the "Survey on Nurses" perceived DIVA factors that asked them to rate each factor using a 0 (not at all predictive) to 10 (extremely predictive) numeric rating scale. Compared to nurses who cared for patients with solid tumours, those who cared for patients with hematologic malignancies rated the following predictors higher: patient is overweight, patient has obesity, occurrence of psychomotor agitation, and occurrence of needle phobia or anxiety. Findings can be used to guide the education of infusion unit nurses on specific risk factors for DIVA.

*Keywords:* cancer; chemotherapy; difficult intravenous access; infusion

## INTRODUCTION

The majority of patients receiving cancer chemotherapy are treated in the outpatient setting and require peripheral intravenous (IV) access. However, IV insertion can be a challenge for patients with difficult access. Oncology nurses have the primary role in selecting the optimal site and device for the peripheral administration of intravenous chemotherapy (Gallieni et al., 2008). Equally important, oncology nurses need to recognize which patients are at increased risk for difficult intravenous access (DIVA) to avoid infusion-related complications, delays in care, and unnecessary pain; as well as to decrease patient's level of anxiety and stress, successfully administer life-saving treatment, and increase patients' satisfaction with care.

On a daily basis, infusion unit nurses need to assess each patient for specific characteristics that can contribute to DIVA within the context of their clinical expertise (Ehrhardt et al., 2018; Pagnutti et al., 2016). A comprehensive assessment is needed to guide nurses' decision-making processes regarding the optimal location and equipment for a successful cannulation. However, only one study has evaluated nurses' ratings of patient characteristics (i.e., risk factors) that predict DIVA (Piredda et al., 2019). The study of 450 nurses who worked in a variety of inpatient and outpatient settings in Italy, reported nine characteristics associated with risk scores  $\geq 6$  (i.e., a predictor of increased risk) on a 0 (not at all predictive of DIVA) to 10 (extremely predictive of DIVA) numeric rating scale (NRS). The characteristics were body mass index (BMI), drug abuse, lymphadenectomy, chemotherapy through a peripheral intravenous catheter, thrombophlebitis, hypovolemia, skin lesions, and irritant therapies. Piredda et al. (2019) noted that the nurses' ratings of the most significant risk factors matched those reported in the literature.

While the Piredda et al. (2019) study provides useful information on 26 potential risk factors for DIVA, the survey did not provide a detailed breakdown of many of the characteristics (e.g., younger versus older age, lower versus higher BMI) and did not include some unique characteristics that warrant assessment in patients with cancer (e.g., receipt of vesicant chemotherapy, current or past history of lymphedema). In addition, only 15.0% of the nurses who completed the survey cared for patients with cancer.

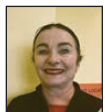
One clinical characteristic that may influence infusion nurses' appraisal of patients' risk for DIVA is their cancer diagnosis. Compared to patients with solid tumours, patients with hematologic malignancies may receive more complicated chemotherapy regimens that are administered more frequently.

## AUTHOR NOTES



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The associated increases in venipunctures may result in nurses assessing that these patients have a higher DIVA risk profile. Given the paucity of research on nurses' appraisals of risk factors for DIVA in general, and for patients with cancer in particular, the purpose of this study was to evaluate for differences in infusion unit nurses' ratings of predictors of DIVA, based on whether they cared for patients with solid tumours versus hematologic malignancies. We hypothesized that the infusion unit nurses who cared for patients with hematologic malignancies would report higher predictor scores for the majority of the risk factors.

## METHODS

### Participants and settings

Nurses ( $n = 152$ ) who performed peripheral intravenous catheter insertions for adult patients with cancer in the outpatient infusion units of the University of California, San Francisco (UCSF) Helen Diller Family Comprehensive Cancer Center were invited to participate in this study. A total of 80 nurses completed the survey and provided information on the primary diagnosis (i.e., hematologic or solid tumour) of the patients who were cared for in their infusion unit (52.6% response rate). The study was approved by the Committee on Human Research at UCSF.

### Study procedures

A total of 152 nurses received an email with an explanation of the study and a link to a Qualtrics survey. Completion of the survey indicated the provision of informed consent. Nurses completed an adapted version of the 26-item "Survey on Nurses" perceived DIVA factors (SUN-DIVA) developed by Piredda and colleagues (Piredda et al., 2019). The current research team, that consisted of a Clinical Nurse Specialist, four infusion unit nurses, and a faculty member, evaluated this instrument and adapted it to reduce item ambiguity (e.g., age was divided into four categories) and include additional items specific to patients with cancer. The final instrument contained a list of 53 risk factors. Nurses rated the extent to which each factor was perceived as a risk factor for DIVA, based on their experience, using a NRS that ranged from 0 (not at all predictive) to 10 (extremely predictive).

In addition, nurses provided information on their age, gender, highest level of education, number of years of nursing experience; number of years of experience in oncology nursing, estimated weekly number of intravenous insertions, estimated weekly number of intravenous insertions perceived as difficult, and estimated weekly number of intravenous insertions perceived as very difficult. (N.B., these questions are the same ones that the nurses completed for the study by Piredda and colleagues [2019].) Nurses received a \$10 gift card for completion of the survey.

### Data analysis

Using IBM Statistics version 29.0 (IBM Corporation, Armonk, NY), descriptive statistics were calculated for the nurses' demographic characteristics and ratings of each factor's predictability for DIVA. Differences in demographic characteristics and ratings of risk factors between nurses who cared for patients with solid tumours versus those caring

for patients with hematologic malignancies were evaluated using parametric and non-parametric tests. Using the same approach from the previous study (Piredda et al., 2019), factors with a mean rating of  $\geq 6.0$  were considered as potential predictors of DIVA that may have clinical importance. A  $p$ -value of  $<.05$  is considered statistically significant.

## RESULTS

### Demographic characteristic of the nurses

As shown in Table 1, the majority of the nurses were female (92.5%); had a bachelor's degree (67.9%); were approximately 44 years of age; had more than 18 years of nursing experience; and had more than nine years of experience in infusion nursing. Compared to the nurses who cared for patients with solid tumours, the nurses who cared for patients with hematologic malignancies were older (i.e., 42.5 [ $\pm 10.6$ ] versus 48.7 [ $\pm 8.5$ ] years) and evaluated their success rate on the first IV attempt higher (i.e., 82.7% [ $\pm 12.6$ ] versus 88.4% [ $\pm 6.5$ ]).

### Differences in mean ratings of predictors of DIVA

The nurses' mean ratings of each of the predictors of DIVA for the total sample and the two types of patients with cancer are listed in Table 2. Compared to the nurses who cared for patients with solid tumours, the nurses who cared for patients with hematologic malignancies rated the following predictors higher: patient is overweight, patient has obesity, occurrence of psychomotor agitation, and occurrence of needle phobia or anxiety. The only predictor that these nurses rated with a lower score was patient is on anticoagulation. To compare the nurses' ratings from the total sample and the two types of patients with the extant literature, Table 3 provides a summary of the rankings of the predictors with scores of  $\geq 6.0$ .

## DISCUSSION

This study is the first to evaluate infusion unit nurses' assessments of a comprehensive list of predictors of DIVA in patients with solid tumours versus hematologic malignancies. While no differences were found for the majority of the predictors, partially consistent with our a priori hypothesis, nurses who cared for patients with hematologic malignancies rated four of the predictors significantly higher. One potential explanation for the limited number of differences in DIVA characteristics between the two patient groups is that the characteristics of the chemotherapy regimens for a number of solid tumours is changing (e.g., dose dense regimens; Blondeaux et al., 2019; Kim et al., 2020). Therefore, future prospective studies need to evaluate for differences in risk factors for DIVA, including the specific characteristics of the chemotherapy regimens (e.g., frequency of administration, types of chemotherapy), between patients with solid tumours and hematologic malignancies. The remainder of the Discussion highlights some of the key findings from this study.

Of the 53 predictors of DIVA listed on Table 2, in the current study, 11 were rated as  $\geq 6$  across the total sample and the two patient groups (i.e., patient has had multiple IV attempts on the day of treatment; patient has a history of multiple IV sticks on previous visits; current or past history of IV drug

**Table 1**

*Differences in the Self-reported Characteristics of the Infusion Unit Nurses Who Care for Patients with Solid Tumors Versus Hematologic Malignancies*

Characteristic	Total Sample	Solid Tumours	Hematologic Malignancies	Statistics
	n = 80	72.5% (n = 58)	27.5% (n = 22)	
	% (n)	% (n)	% (n)	
Gender				
Female	92.5 (74)	94.8 (55)	86.4 (19)	X <sup>2</sup> =3.15, p=.207
Male	6.3 (5)	3.4 (2)	13.6 (3)	
Other	1.3 (1)	1.7 (1)	0.0 (0)	
Highest level of education				
Bachelor's degree	67.9 (53)	69.6 (39)	63.6 (14)	X <sup>2</sup> =0.83, p=.661
Master's degree	23.1 (18)	23.2 (13)	22.7 (5)	
Other	9.0 (7)	7.1 (4)	13.6 (3)	
	Mean (SD)	Mean (SD)	Mean (SD)	
Age	44.2 (10.3)	42.5 (10.6)	48.7 (8.5)	t=-2.46, p=.016
Years of nursing experience	18.7 (9.9)	17.5 (10.1)	22.1 (8.9)	t=-1.89, p=.063
Years of experience in infusion nursing	9.4 (8.3)	8.9 (7.7)	11.0 (9.7)	t=-1.02, p=.309
Percent success rate in inserting an IV on the first attempt	84.2 (11.4)	82.7 (12.6)	88.4 (6.5)	t=-2.67, p=.009
Number of IV insertions performed per week	12.5 (6.5)	12.8 (7.2)	11.8 (4.3)	t=0.75, p=.456
Number of IV insertions that are difficult	4.3 (2.7)	4.3 (3.0)	4.3 (1.8)	t=0.03, p=.976
Number of IV insertions that are very difficult	2.3 (1.7)	2.2 (1.5)	2.6 (2.0)	t=-1.03, p=.305

Note. SD = standard deviation; IV = intravenous.

abuse; occurrence of dehydration; presence of sclerosis; presence of small veins; patient has obesity; current or past history of lymphedema; occurrence of needle phobia or generalized anxiety; occurrence of hypovolemia; current or past history of prolonged hospitalization). However, as shown in Table 3, the rank order of the scores differed among the total sample and the two patient groups. The predictors that were unique to the nurses who cared for patients with solid tumours were patient age is 80 years or older and presence of valves. The predictors that were unique to the nurses who cared for patients with hematologic malignancies were presence of a vascular access device (i.e., malfunctioning port/peripherally inserted central catheter [PICC], arteriovenous [AV] fistula); patient is receiving vesicant chemotherapy; and patient is also on dialysis.

While a direct comparison of all of the predictors with the previous report is not possible because of refinements made to the original survey (Piredda et al., 2019), obesity, hypovolemia, and drug abuse were three consistent characteristics across the previous and current studies. However, when comparisons were made with the ratings of the Italian nurses who worked on oncology units in the previous study (Piredda et al., 2019), additional characteristics were similar between the current and previous

studies including prolonged hospitalization and occurrence of needle phobia or generalized anxiety. The majority of the previous studies of DIVA evaluated hospitalized patients or patients who were cared for in the emergency department (Armenteros-Yeguas et al., 2017; Fields et al., 2014; Juvin et al., 2003; Piredda et al., 2017; Sebbane et al., 2013; van Loon et al., 2019). Across these previous studies, the evidence supports that a higher BMI and hypovolemia are the strongest predictors of DIVA. Findings from the current study add to the body of knowledge about risk factors that oncology nurses consider to be the salient ones that warrant evaluation in patients with cancer.

Obesity is one of the most common DIVA characteristics. An obese extremity does not allow for visualization and palpation of venous vessels (Laksonen & Gasiewicz, 2015). Given that greater than 40% of adults in the United States are obese (Laddu et al., 2024), this risk factor may pose significant problems for infusion nurses. While no estimates are available for the occurrence of dehydration in oncology patients receiving chemotherapy, the visualization and palpation of veins decreases with this clinical condition. Infusion nurses need to assess patients' hydration status and common causes for dehydration (e.g., vomiting, fever, diarrhea) prior to the initiation of chemotherapy.

**Table 2**

*Differences in the Mean Ratings of Predictors of Difficult Venous Access Between Infusion Unit Nurses Who Care for Patients with Solid Tumours Versus Nurses Who Care for Patients with Hematologic Malignancies*

Predictors*	Total Sample n = 80	Solid Tumours 72.5% (n = 58)	Hematologic Malignancies 27.5% (n = 22)	Statistics
	Mean (SD)	Mean (SD)	Mean (SD)	
Age				
Patient age is 18–29 years	2.0 (2.7)	2.0 (2.6)	2.1 (3.0)	t=-0.20, p=.840
Patient age is 30–59 years	2.5 (2.7)	2.4 (2.7)	2.7 (2.9)	t=-0.37, p=.715
Patient age is 60–79 years	4.2 (2.8)	4.3 (2.8)	3.7 (3.0)	t=0.88, p=.380
Patient age is 80 years or older	5.7 (3.2)	6.0 (2.8)	5.0 (3.9)	t=1.05, p=.304
Gender				
Patient sex was female at birth	1.9 (2.6)	1.8 (2.5)	1.9 (2.8)	t=-0.02, p=.982
Patient sex was male at birth	1.6 (2.5)	1.4 (2.3)	1.9 (3.1)	t=-0.77, p=.441
Race/ethnicity/skin tone and quality				
Patient is White/Caucasian	1.6 (2.6)	1.3 (2.2)	2.1 (3.2)	t=-1.21, p=.228
Patient is Black/African American	3.5 (2.9)	3.5 (2.8)	3.6 (3.2)	t=-0.25, p=.807
Patient is Asian/Pacific Islander	2.0 (2.7)	2.0 (2.5)	2.2 (3.2)	t=-0.32, p=.751
Patient is Hispanic/Latinx	1.9 (2.5)	1.8 (2.4)	2.1 (2.8)	t=-0.55, p=.586
Patient is of mixed or unknown race	1.6 (2.5)	1.7 (2.4)	1.5 (2.8)	t=0.30, p=.765
Patient has thinner skin	4.5 (2.7)	4.7 (2.6)	3.9 (2.8)	t=1.15, p=.253
Patient has thicker skin	5.3 (2.8)	5.2 (2.8)	5.5 (3.0)	t=-0.44, p=.661
Patient has lighter skin	2.2 (2.9)	2.0 (2.7)	2.6 (3.4)	t=-0.93, p=.354
Patient has darker skin	3.9 (2.8)	3.8 (2.7)	4.2 (3.1)	t=-0.62, p=.270
Patient has tattoos	3.9 (2.8)	4.2 (2.6)	3.1 (3.1)	t=1.58, p=.119
Body mass index				
Patient has a healthy BMI	2.3 (2.7)	2.1 (2.5)	2.9 (3.4)	t=-1.23, p=.222
Patient is underweight	3.4 (2.9)	3.5 (2.8)	3.1 (3.2)	t=0.54, p=.589
Patient is overweight	5.8 (2.6)	5.3 (2.6)	7.0 (2.4)	t=-2.61, p=.011
Patient has obesity	6.6 (2.6)	6.3 (2.6)	7.7 (2.2)	t=-2.26, p=.027
Current or past medical history				
Current or past history of smoking	3.0 (2.5)	3.2 (2.4)	2.6 (2.5)	t=0.99, p=.328
Current or past history of IV drug use	7.2 (2.9)	7.1 (2.8)	7.6 (3.0)	t=-0.74, p=.460
Current or past history of non-IV drug use	2.6 (2.9)	2.8 (2.8)	2.2 (3.3)	t=0.79, p=.431
Current or past history of peripheral edema	6.2 (2.8)	6.1 (2.8)	6.9 (2.7)	t=-1.13, p=.261
Current or past history of lymphadenectomy	6.0 (2.6)	5.9 (2.5)	6.5 (2.7)	t=-0.89, p=.376
Current or past history of lymphedema	6.6 (2.7)	6.5 (2.7)	7.0 (2.7)	t=-0.76, p=.447
Current or past history of thrombophlebitis	4.6 (2.6)	4.8 (2.4)	4.3 (3.0)	t=0.84, p=.402
Current or past history of vasculopathy	5.1 (2.5)	5.1 (2.4)	5.1 (2.8)	t=0.08, p=.938
Current or past history of prolonged hospitalization	6.1 (2.7)	6.2 (2.6)	6.0 (2.7)	t=0.26, p=.793

Predictors*	Total Sample n = 80	Solid Tumours 72.5% (n=58)	Hematologic Malignancies 27.5% (n=22)	Statistics
	Mean (SD)	Mean (SD)	Mean (SD)	
Current or past history of cirrhosis	4.8 (2.6)	4.8 (2.5)	5.0 (2.7)	t=-0.31, p=.761
History of organ transplant	4.5 (2.6)	4.6 (2.7)	4.3 (2.4)	t=0.50, p=.618
Patient is also a dialysis patient	5.9 (2.9)	5.9 (2.7)	6.0 (3.4)	t=-0.17, p=.867
Current Conditions				
Occurrence of neurovascular deficit	4.7 (2.5)	4.8 (2.5)	4.6 (2.3)	t=0.40, p=.688
Occurrence of hypovolemia	6.4 (2.5)	6.4 (2.2)	6.6 (3.0)	t=-0.40, p=.693
Occurrence of dehydration	7.0 (2.4)	6.9 (2.4)	7.5 (2.4)	t=-0.95, p=.346
Presence of skin lesions	5.4 (2.5)	5.3 (2.5)	5.7 (2.3)	t=-0.65, p=.516
Presence of contractures	6.2 (2.6)	5.9 (2.6)	7.0 (2.4)	t=-1.71, p=.092
Occurrence of psychomotor agitation	5.9 (2.6)	5.5 (2.4)	7.1 (2.8)	t=-2.51, p=.014
Occurrence of needle phobia or generalized anxiety	6.6 (2.6)	6.2 (2.5)	7.8 (2.4)	t=-2.53, p=.014
Cancer Treatment Characteristics				
Receipt of radiation therapy	3.9 (2.9)	3.9 (2.9)	4.0 (2.8)	t=-0.10, p=.922
Receipt of two or more doses of intravenous chemotherapy	4.2 (2.6)	4.4 (2.7)	3.7 (2.5)	t=0.95, p=.348
Presence of a vascular access device (malfunctioning port/ PICC; AV fistula)	5.5 (2.9)	5.2 (3.0)	6.4 (2.7)	t=-1.62, p=.109
Patient is receiving irritant chemotherapy	5.6 (2.7)	5.7 (2.6)	5.6 (2.9)	t=0.18, p=.855
Patient is receiving vesicant chemotherapy	6.0 (2.7)	5.9 (2.7)	6.2 (2.9)	t=-0.37, p=.713
Patient has a history of multiple sticks in previous visits	7.7 (2.5)	7.8 (2.4)	8.0 (2.6)	t=-0.30, p=.764
Patient has had multiple IV attempts on day of treatment	8.0 (2.6)	8.0 (2.4)	8.3 (2.6)	t=-0.41, p=.680
Challenging Vein Characteristics				
Presence of sclerosis	6.7 (2.5)	6.6 (2.4)	7.1 (2.7)	t=-0.87, p=.385
Presence of valves	5.8 (2.4)	6.0 (2.3)	5.6 (2.7)	t=0.68, p=.500
Presence of small veins	6.7 (2.4)	6.7 (2.4)	6.9 (2.6)	t=-0.21, p=.837
Presence of rolling veins	5.4 (2.6)	5.5 (2.4)	5.5 (3.0)	t=-0.01, p=.989
Concurrent Medications				
Patient is receiving hormone therapy	2.6 (2.8)	2.7 (2.8)	2.3 (2.8)	t=0.57, p=.571
Patient is receiving corticosteroids	3.8 (2.8)	3.8 (2.8)	3.8 (2.9)	t=-0.03, p=.978
Patient is receiving anticoagulation therapy	3.3 (2.8)	3.7 (2.7)	2.3 (2.8)	t=2.06, p=.021

Note. SD = standard deviation; BMI = body mass index; IV = intravenous; PICC = peripherally inserted central catheter AV = arteriovenous.

\*Rate the extent to which each of the factors listed below is a predictor of difficult intravenous access in oncology patients using a 0 (not at all predictive) to 10 (extremely predictive) scale.



**Table 3**

*Rankings of the Predictors with Mean Scores of Greater Than or Equal to Six for the Total Sample of Infusion Unit Nurses and for Nurses Who Care for Patients with Solid Tumours Versus Nurses Who Care for Patients with Hematologic Malignancies*

Rank	Total Sample		Solid Tumours		Hematologic Malignancies	
	Predictor	Mean	Predictor	Mean	Predictor	Mean
1	Patient has had multiple IV attempts on day of treatment	8.0	Patient has had multiple IV attempts on day of treatment	8.0	Patient has had multiple IV attempts on day of treatment	8.3
2	Patient has a history of multiple IV sticks in previous visits	7.7	Patient has a history of multiple IV sticks in previous visits	7.8	Patient has a history of multiple IV sticks in previous visits	8.0
3	Current or past history of IV drug abuse	7.2	Current or past history of IV drug abuse	7.1	Occurrence of needle phobia or generalized anxiety	7.8
4	Occurrence of dehydration	7.0	Occurrence of dehydration	6.9	Patient has obesity	7.7
5	Presence of sclerosis	6.7	Presence of small veins	6.7	Current or past history of IV drug use	7.6
5	Presence of small veins	6.7	-----	-----	-----	-----
6	Patient has obesity	6.6	Presence of sclerosis	6.6	Occurrence of dehydration	7.5
6	Current or past history of lymphedema	6.6	-----	-----	-----	-----
6	Occurrence of needle phobia or generalized anxiety	6.6	-----	-----	-----	-----
7	Occurrence of hypovolemia	6.4	Current or past history of lymphedema	6.5	Occurrence of psychomotor agitation	7.1
7	-----	-----	-----	-----	Presence of sclerosis	7.1
8	Current or past history of peripheral edema	6.2	Occurrence of hypovolemia	6.4	Patient is overweight	7.0
8	Presence of contractures	6.2	-----	-----	Current or past history of lymphedema	7.0
8	-----	-----	-----	-----	Presence of contractures	7.0
9	Current of past history of prolonged hospitalization	6.1	Patient has obesity	6.3	Presence of small veins	6.9
10	Current or past history of lymphadenectomy	6.0	Current of past history of prolonged hospitalization	6.2	Occurrence of hypovolemia	6.6
10	Patient is receiving vesicant chemotherapy	6.0	Occurrence of needle phobia or generalized anxiety	6.2	-----	-----
11	-----	-----	Patient age is 80 years or older	6.0	Presence of vascular access device (malfunctioning port/PICC; AV fistula)	6.4
11	-----	-----	Presence of valves	6.0	-----	-----
12	-----	-----	-----	-----	Patient is receiving vesicant chemotherapy	6.2
13	-----	-----	-----	-----	Current of past history of prolonged hospitalization	6.0
13	-----	-----	-----	-----	Patient is also on dialysis	6.0

Note. IV = intravenous; PICC = peripherally inserted central catheter; AV = arteriovenous.

While the exact prevalence of intravenous drug use in oncology patients is not known, a report from the Substance Abuse and Mental Health Services Administration noted that in 2022, 48.7 million people in the United States aged 12 or older (17.3%) had a substance use disorder. Of these individuals, 29.5 million had an alcohol use disorder, 27.2 million had a drug use disorder, and 8.0 million had both alcohol and drug use disorders (Substance Abuse and Mental Health Services Administration et al., 2023). Therefore, it is not surprising that a current or past history of drug abuse received a risk score >7. As noted in one review (Robertson et al., 2021), damage to the skin, as well as surrounding subcutaneous tissues and blood vessels are among the most common harms associated with intravenous drug use. The damage to blood vessels can range from being relatively superficial to severe (e.g., local or systemic infections). Given this high prevalence rate, oncology nurses need to assess patients for this clinical condition.

It is not surprising that, for patients with cancer, a higher number of previous or current IV attempts received scores of approximately eight. Given that some patients, depending on their chemotherapy protocol, can receive intravenous treatments on a weekly, biweekly, or monthly basis for several months, the availability of peripheral access decreases over time. However, no literature is available on the physiologic effects of repeated punctures on venous integrity and/or the number of venipunctures that would warrant the placement of an indwelling catheter. Prospective studies are warranted to answer these highly relevant clinical questions.

As noted in a recent study (DeSnyder et al., 2021), 60.2% of breast cancer surgeons instruct patients to avoid venipuncture or injections in the at-risk arm to decrease the risk of lymphedema. However, in several reviews (Brophy et al., 2022; Jakes & Twelves, 2015; McLaughlin et al., 2017), the authors noted that limited evidence exists to support the avoidance of IV catheter placement and venipuncture in the affected limb following axillary lymph node dissection and sentinel lymph node biopsy. The current recommendations are to assess the patient for risk factors for lymphedema before recommending the use of the affected limb for venous access.

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While in the United States the prevalence of needle phobia is 2.1% (Stinson et al., 2007), findings from a scoping review suggest that the prevalence of needle phobia in patients with cancer ranged from 17% to 52% (Duncanson et al., 2021). Therefore, it is not surprising that the scores for this predictor ranged from 6.6 to 7.8. However, as noted in this scoping review, the most common management strategies (e.g., cognitive-behavioural stress management techniques, distraction) do not have a strong evidence base.

### Limitations

Several limitations regarding this work warrant consideration. While the 52.6% response rate was relatively high, the percentages of nurses caring for the two patient groups was not evenly distributed. Therefore, additional differences in predictor ratings may have been identified with a larger group of nurses who cared for patients with hematologic cancers. This study relied on nurses' self-reports of ratings of predictors of DIVA. Future qualitative studies would provide a more in-depth understanding of the decision-making processes that nurses use when patients have one or more of these predictors of DIVA. Given that the survey was conducted in one academic medical centre, these findings may not generalize to other oncology infusion units.

### Implications for clinical practice

Taken together, the findings from the current study provide important information on predictors of DIVA in patients with cancer. While the data suggest that a few of these predictors are common across patients with a variety of chronic conditions, several of the most highly rated predictors were unique to patients with cancer (e.g., current or past history of lymphedema, multiple IV attempts on the day of treatment). The findings can be used to guide the education of infusion unit nurses on specific risk factors for DIVA in patients with cancer. For example, an educational guide can be developed to provide effective approaches to mitigate each of the risk factors. In addition, knowledge of these risk factors can assist infusion unit nurses with their clinical decision-making regarding the optimal location and approach to intravenous access.



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