



Patient Experience With Vascular Access Management Informs Satisfaction With Overall Hospitalization Experience

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ABSTRACT

Peripheral intravenous catheter (PIVC) insertion is a common invasive procedure performed during hospitalization. The present study reports results from a survey of 543 patients who have had PIVC insertion during their hospital stay in Singapore and the Philippines during the period between November 2018 and February 2019. The survey assessed the importance of 5 domains of patient-centered care on patient satisfaction with their hospitalization experience, including pain management, infection prevention, health care provider competence with vascular access, physical comfort, and effectiveness of communication during vascular access management. Health care provider competence, infection prevention, and pain management ranked as the most important determinants of patient satisfaction. Patients were more likely to lose their trust in health care providers and express anxiety if they experienced multiple needle insertion attempts or PIVC-related complications, whereas patients who were satisfied with their PIVC insertion were more likely to express satisfaction with their overall hospital stay. Improving vascular access management with a focus on enhancing vascular access skills, infection prevention, and pain management may improve patient satisfaction.

Key words: catheterization, infection control, infection prevention, quality in health care, vascular access management

Vascular access, specifically the insertion and maintenance of peripheral intravenous catheters (PIVCs), is one of the most common invasive procedures, performed in up to 100% of hospitalized patients in England and Scotland (median = 71%; range,

24% to 100%).^{1,2} PIVCs are critical to the delivery of care, from facilitation of diagnostic processes to intravenous (IV) delivery of medication and fluids.³

However, poor techniques employed during the insertion and maintenance of PIVCs may pose risks to patients

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and affect outcomes. A review of published literature suggested that successful PIVC placement required >1 attempt in 12% to 26% of adults and 24% to 54% of children.⁴ Failed attempts at PIVC placement can cause vessel trauma that may increase the risk of subsequent PIVC failure and lead to the use of more invasive, risky, and costly venous access devices.⁵ Furthermore, between 35% and 50% of PIVCs eventually require replacement prior to the completion of therapy due to avoidable complications, such as accidental removal or dislodgement, pain, phlebitis, occlusion, infiltration, and infection.⁵⁻⁷ Tee et al⁸ reported that patients frequently characterized the PIVC insertion experience as painful and a source of anxiety and discomfort. Absence of orders for IV fluids or medication during PIVC dwell time (redundant catheters) can contribute to complications including infection. This is a rare occurrence overall (16%), but regional variation exists, ranging from 43% in the islands of the South Pacific (Australia and New Zealand) to 3% in Asia (China and India).¹

Several aspects may influence patient experiences with vascular access management. These include staff training/competence and communication skills, along with the incidence of pain and related complications.^{7,8} Patient experiences with vascular access may in turn influence their perceptions regarding their hospital stay and their satisfaction with health care providers and institutions. Helm et al⁵ suggested that struggles with obtaining and maintaining PIVC access adversely affects a patient's overall hospital experience, although there was limited evidence to confirm this proposed association. Hence, a survey was administered to patients from private and public hospitals in Singapore and the Philippines to understand patients' overall satisfaction with the quality of care received during vascular access management by assessing their experiences with different patient-centered domains of care.

METHODS

Sample and Setting

The survey was conducted from November 2018 to February 2019 in the emergency rooms and medical and surgical wards of >200-bed institutions, including 7 publicly funded institutions in Singapore and 9 institutions in the Philippines (3 public and 6 private). Patients recruited had to meet the following criteria: aged >21 years; 2 or more PIVC insertions during the duration of their hospital stay; and hospitalization at the same facility more than twice in the past 24 months. Approval for the survey was secured from the participating institutions' local ethics committees.

Survey Design

The survey was designed to explore the drivers of patient satisfaction with their experience with vascular access management based on patient perception of 5 key domains of care: pain management (the level of pain experienced by

patients during PIVC insertion, including pain, redness, swelling, itching, bruising, burning sensation, pus or hardening of skin surrounding the PIVC insertion site); infection prevention (patient perception of measures taken to cleanse the area prior to insertion and maintenance of the catheter after receiving explanation of infection control measures, including hand hygiene, sterility of medical equipment, and health care provider use of gloves, mask, and eye protection); competence (patient confidence in the health care provider's ability to successfully insert a PIVC or draw blood on the first attempt, provider's level of qualification [certification, length of time in profession] to provide adequate care and treatment, and responsiveness to patient's needs); patient physical comfort; and effectiveness of communication (patient perception of how thoroughly their health care provider explained the need for catheterization and catheter manipulation for cleaning and medication administration). The survey was composed of a mixture of open-ended questions, closed-ended questions, and rating questions. A 5-point Likert scale was used for the rating questions. The 5 key domains of care, including (1) effectiveness of communication; (2) infection prevention measures; (3) pain management; (4) physical comfort; and (5) health care provider competence, were identified within a patient-centered care framework adapted from Picker's 8 Principles of Patient Centered Care.^{9,10} Picker's principles provide an understanding of how patient-centered care can be shaped and how it affects patient satisfaction. It was also the basis of several patient satisfaction surveys, including the first National Health Service Patient Experience Surveys conducted in England.¹¹

Data Collection

The 20- to 25-minute survey was administered to consenting patients by consultants from the Health Policy and Clinical Evidence Research Division of The Economist Intelligence Unit just prior to patient discharge. The survey was administered before discharge to capture patient perception of the quality of care received throughout their hospital stay. Patients >21 years of age or who had a hospital stay of >1 day were excluded from the survey. Before the survey was administered, patients completed a consent form that explained the survey's objectives and guaranteed participant privacy and confidentiality. The latter included secured data storage and maintenance of data anonymity, whereby analysis was performed at an aggregate level without reference to individuals or facilities. To increase candor of response, patients were assured that their answers would not be shared with hospital personnel.

Statistical Analysis

A standard correlation test was initially performed on the data set for a preliminary understanding of the relationships among the 5 domains of care identified. The random forest model was then applied to measure the relative importance of each as a predictor of patient satisfaction. Domains that were identified as important were finally

TABLE 1

Patient Demographics, Catheterization Profiles, and Satisfaction Scores

Parameters	Singapore (N = 143)	Philippines (N = 401)
Patient demographics		
Sex, %		
Women	72.7	58.9
Men	27.3	41.1
Hospital type, %		
Public	100.0	40.1
Private	0	59.9
Patient paying scheme, %		
Self-paying	62.1	75.3
Subsidized	37.9	24.7
Age, %		
21–40 years	47.6	36.4
41–65 years	28.0	36.9
>65 years	24.5	26.7
Catheterization profiles		
Location of catheter insertion, %		
Emergency room	13.5	84.5
Wards	61.8	12.5
Operating room	14.8	2.2
Others	9.8	0.7
Venous access attempts needed for successful catheterization, n (%)		
1	112 (78.3)	288 (71.8)
2–3	23 (16.1)	87 (21.7)
4–5	3 (2.1)	8 (2.0)
>5	1 (0.7)	15 (3.7)
Did not remember	4 (2.8)	3 (0.7)
Catheter insertions throughout patient hospital stay, %		
1 insertion	70.4	83.8
2–5 insertions	29.6	16.2
Average duration of catheter dwell time throughout patient hospital stay, days		
First insertion	1.9	2.2
Second insertion	0.5	3.4
Third insertion	0.3	4.0
Fourth insertion	0.1	3.1
Fifth insertion	0.1	2.2
Site of catheterization, %		
Hand	69.2	89.5
Wrist	20.3	5.2
Upper arm	8.4	4.7
Leg	2.1	0.2
Foot	0	0.2
Patient satisfaction scores, mean^a		
Infection management	4.44	4.23
Competence of HCPs	4.44	4.30

(Continues)

TABLE 1

Patient Demographics, Catheterization Profiles, and Satisfaction Scores (*Continued*)

Parameters	Singapore (N = 143)	Philippines (N = 401)
Effectiveness of communication	4.31	4.11
Physical comfort	4.21	4.06
Pain management	4.09	3.89
Overall	4.23	4.01

^aPatients scored their level of satisfaction with aspects of these parameters on a Likert scale of 1–5, with 1 indicating very dissatisfied and 5 indicating very satisfied. Abbreviation: HCPs, health care providers.

tested in the Bayesian network model to define the relationships of these domains compared with patient satisfaction levels and identify steps that would improve satisfaction levels. A Bayesian network model is a probabilistic graphical model that represents a set of variables and their conditional dependencies via a directed acyclic graph and is ideal for taking an event that occurred and predicting the likelihood that any one of several possible known causes was the contributing factor.¹²

RESULTS

Participant Characteristics

A total of 143 patients from Singaporean hospitals and 401 patients from Philippine hospitals were surveyed from November 2018 to February 2019. The number of women and patients aged 40 years and younger in the Singapore cohort was 104 (72.7%) and 68 (47.6%), respectively, and in the Philippine cohort was 236 (58.9%) and 146 (36.4%), respectively. All Singaporean patients included in this survey were treated in publicly funded institutions, and 240 (59.9%) Filipino patients surveyed were admitted into private institutions. On average, patients in the Philippine cohort reported catheter dwell times (for each instance of catheterization) that were longer than those reported in the Singapore cohort. Demographics and catheterization profiles of the patient cohorts are described in Table 1.

Patient Satisfaction With Catheterization

Satisfaction levels in the Singapore cohort were relatively higher across the 5 domains of patient care associated with patient experiences with vascular access management compared with satisfaction levels reported in the Philippine cohort. The overall average scores were 4.23 and 4.01, respectively (Table 1), although there were differences in satisfaction levels between private and public institutions within the Philippine cohort. Notably, the proportion of patients who characterized their overall satisfaction level

as satisfied or very satisfied in the Singapore and Philippine cohorts were 133 (92.8%) versus 323 (80.5%), respectively.

Pain management ranked the lowest of the 5 domains assessed within the Singapore cohort. It received an average score of 4.09, and the proportion of patients who were either very satisfied or satisfied with pain management were 36

(25.2%) and 87 (60.8%), respectively. Infection prevention measures ranked the highest of the domains, scoring an average of 4.44, with 81 (56.7%) and 57 (39.7%) patients described as being either very satisfied or satisfied, respectively (Figure 1A).

Across the 5 domains, Filipino patients were less likely to be very satisfied compared with their Singaporean

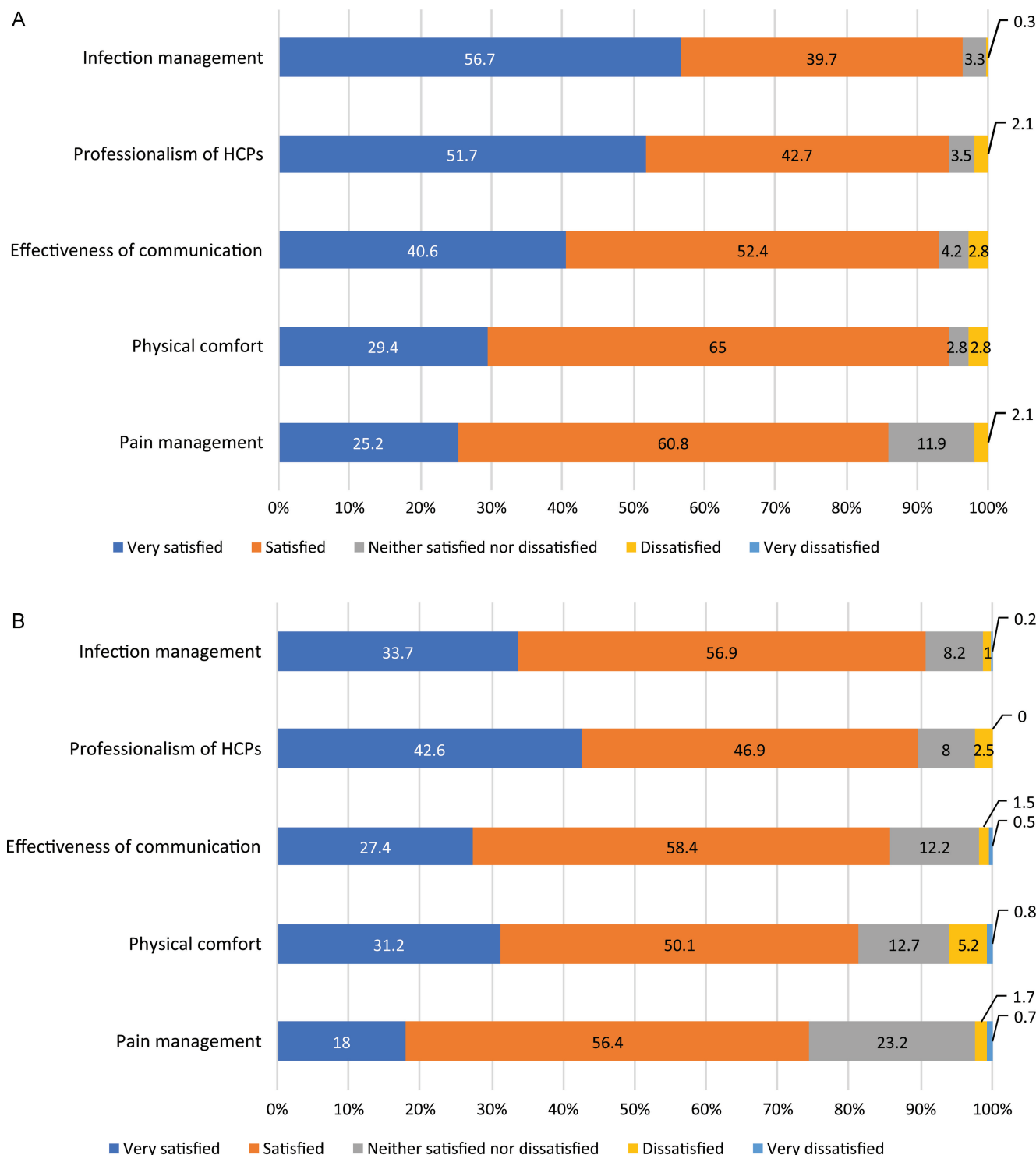


Figure 1 Patient levels of satisfaction with 5 domains of patient-centered care associated with vascular access management, as reported in (A) the Singapore cohort ($n = 143$) and (B) the Philippine cohort ($n = 401$). Patients scored their levels of satisfaction with aspects of these parameters on a Likert scale of 1–5, with 1 indicating very dissatisfied and 5 indicating very satisfied. *Abbreviation: HCPs, health care providers.*

counterparts. Pain management was again ranked lowest of the domains, with an average score of 3.89. Infection prevention measures had the second highest scores, whereas the highest satisfaction levels were reported for the competence of health care providers (average score = 4.30; 170 [42.6%] and 228 [46.9%] were very satisfied and satisfied, respectively; Figure 1B).

Relative Importance of Domains on Overall Patient Satisfaction

A random forest model analysis ranked the importance of these domains in predicting patient satisfaction with their overall hospital stay. In both cohorts, competence of health care providers (expressed as patient confidence in provider ability to successfully achieve venous access on the first

attempt and perceived level of qualification and provision of care) was the most important domain of care within vascular access management to predict patient satisfaction with their overall hospital stay. The other 2 top domains were pain management, specifically the level of pain experienced by patients during PIVC insertion, and infection prevention measures on the catheter site prior to medical administration (Table 2).¹³

Domains Associated With Vascular Access That Impact Patient Satisfaction

Based on the Bayesian network model analysis, 4 key observations emerged that defined the relationship between patient experience with vascular access management and satisfaction levels. First, patients who reported satisfactory

TABLE 2
Importance of Domains of Patient-Centered Care and Effect on Catheterization Experience

Singapore				The Philippines			
Rank	Domains of care	Factors of patient care	Mean decrease accuracy ^a	Rank	Domains of care	Factors of patient care	Mean decrease accuracy ^a
1	Competence of HCPs	Confidence in HCPs' ability to insert IV catheter	13.70	1	Competence of HCPs	Confidence in HCPs' ability to insert IV catheter	26.1
2	Pain management	Level of pain experienced during catheter insertion	4.90	2	Infection prevention measures	Confidence that IV catheter site was cared for and cleaned appropriately before medical administration	23.7
3	Infection prevention measures	Confidence that IV catheter site was cared for and cleaned appropriately before medical administration	3.45	3	Pain management	Level of pain experienced during catheter insertion	22.7
4	Infection prevention measures	Confidence with cleanliness of IV catheter process, before insertion	1.30	4	Effectiveness of communication	How well HCPs explained the need for an IV catheter	22.7
5	Effectiveness of communication	How well HCPs explained the need for an IV catheter	0.95	5	Pain management	Level of satisfaction with hospital's response to pain management	14.0
6	Effectiveness of communication	How well HCPs explained the need for manipulating IV catheter for cleaning/medical administration	0.30	6		Extent of impact of catheter experience on hospital stay	13.8
7	Pain management	Duration of pain	0.17	7	Infection prevention measures	Confidence that IV catheter site was cared for and cleaned appropriately before catheter administration	8.8
				8	Effectiveness of communication	How well HCPs explained the need for manipulating IV catheter for cleaning/medical administration	2.4
				9	Pain management	Level of discomfort experienced due to catheter location	2.2

^aMean decrease accuracy in the random forest model expresses how much accuracy the model loses by excluding a variable. The more the accuracy decreases, the greater the importance the variable is for successful classification. The greater the value of the mean decrease accuracy, the higher the importance of the variable in the model.¹³
 Abbreviations: HCPs, health care providers; IV, intravenous.

experience with vascular access were more likely to be satisfied with their overall hospital experience: Singaporean patients and Filipino patients who were very satisfied/satisfied with their vascular access experience (112 [78.2%] and 283 [70.6%], respectively) similarly ranked their overall hospital experience (Figure 2). Although 281 Filipino patients (70.0%) agreed that their vascular access experience had moderate-to-very-high impact on their overall hospital stay, the reverse was observed in the Singapore cohort, in which 85 patients (59.5%) indicated that their vascular access had low-to-very-low impact.

Second, the number of unsuccessful vascular access attempts during the PIVC insertion process negatively affected patient trust in their health care provider. Among the 112 Singaporean and 288 Filipino patients who experienced successful venipuncture with a single needle insertion, 92 (82.1%) and 190 (66.0%), respectively, were very/extremely confident in their health care provider's ability to insert their PIVC. By comparison, only 20 Singaporean patients (63.0%) and 54 Filipino patients (40.7%) experiencing multiple attempts at needle insertion were very/extremely confident in their health care provider's ability to insert their PIVC. Patients who experienced multiple attempts at vascular access were also more likely to report feeling very/extremely anxious during PIVC insertion (13 [48.4%] of 27 Singaporean and 26 [23.6%] of 110 Filipino patients) compared with patients who experienced successful placement of PIVC during the first attempt (29 [25.9%] of 112 and 34 [11.8%] of 288, respectively).

Third, reports of PIVC-related complications, specifically across PIVC maintenance, appeared to lead to lower satisfaction levels. Indicators for patient perception of catheter maintenance included the ability of health care providers to successfully insert the catheter on the first try, pain, fluid leakage, and the catheter coming out of the vein after insertion. Around 15 (11.1%) of 134 Singaporean patients

and 54 (14.7%) of 367 Filipino patients who experienced symptoms across PIVC maintenance were dissatisfied/very dissatisfied with their experience compared with 2.2% and 3.5% of Singaporean and Filipino patients, respectively, who were without symptoms across PIVC maintenance.

Finally, the incidence of PIVC-related complications appeared to be linked to patient trust in health care provider abilities, particularly among Singaporean patients, and reported anxiety levels during the first PIVC insertion. Among patients who had complications, 40 (61.5%) of 65 Singaporeans and 82 (28.5%) of 288 Filipinos agreed/strongly agreed that their health care provider's inability to complete PIVC insertion during their first try reduced their trust in their health care provider. Patients who had PIVC-related complications were more likely to have felt very/extremely anxious during PIVC insertion than patients without complications: 27 (41.5%) versus 14 (21.8%), respectively, in the Singapore cohort and 53 (18.3%) versus 12 (10.2%) in the Philippine cohort.

DISCUSSION

Background

Although countries in Southeast Asia do not have reliable longitudinal health trend data, the relative wealth of a country is inversely associated with disease prevalence and mortality rates, which can be largely attributed to efficient delivery of health services to a larger proportion of the population.¹⁴ From 1970 to 2010, Singapore consistently had the lowest adult and child mortality rates; Laos, Cambodia, and Myanmar had the highest; and the rates for the Philippines were between these upper and lower rates. Among the major health challenges in Singapore are rising costs due to lifestyle and aging of the population, whereas inappropriate delivery and inequitable distribution of health care resources remain challenging in the Philippines.¹⁴

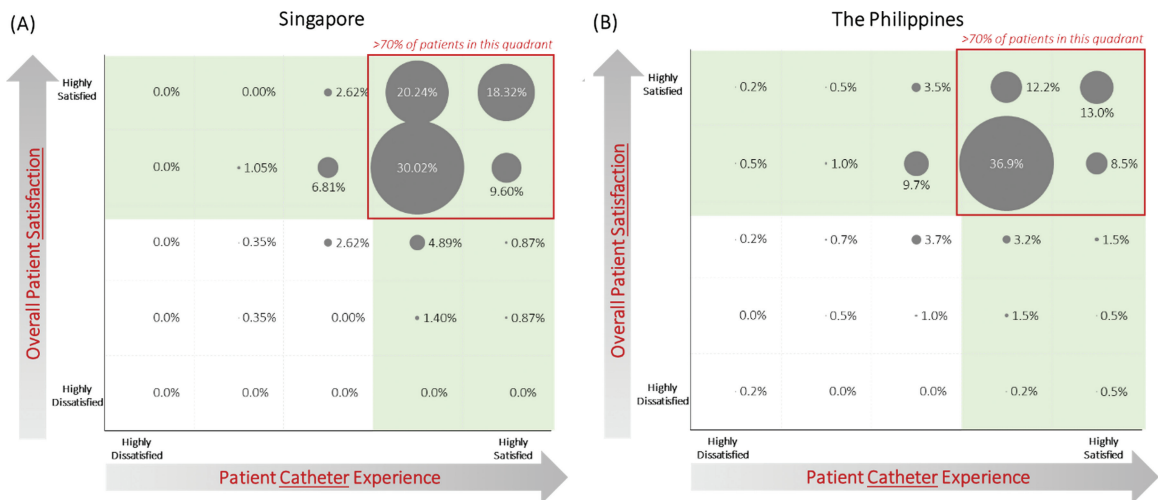


Figure 2 Patient levels of satisfaction with vascular access management in relation to overall satisfaction with hospital stay, as reported in (A) the Singapore cohort (n = 143) and (B) the Philippine cohort (n = 401).

Recognizing the disparity in health care quality, the World Health Organization and the Organisation for Economic Cooperation and Development developed a questionnaire to collect information on quality policies in 16 Asia Pacific countries. The survey emphasized patient safety and sought information on (1) general questions on quality of care policies, (2) infrastructure and measurement of quality of care, and (3) implementation of health care quality improvement initiatives including accreditation, licensing of health care providers, and standardization and monitoring of health care delivery. Hospitals in Singapore and the Philippines reported adhering to a global health standard for collecting inpatient data, requiring accreditation, and having government-developed clinical practice guidelines, but national standards for hospitals were in existence for the Philippines but not Singapore, and Singapore but not the Philippines had clinical guidelines in place for hospital care. Both countries have national quality indicators to monitor hospital inpatient care and mortality and mechanisms to ensure consistency and feedback on quality of care, but only Singapore provides a list of these indicators. Moreover, only Singapore has a system in place to allow for national public reporting of quality of health care that has been influential in changing health policy and practice.¹⁵

RESULTS

The survey findings suggest that patient experiences with the insertion and maintenance of PIVCs influenced their overall satisfaction levels with their hospital stays. Overall, high satisfaction levels were reported by Singaporean patients within the 5 domains of care associated with vascular access management within the country's publicly funded health care system. In the Philippine cohort, which included both public and private institutions, satisfaction levels were higher for patients who were managed in private hospitals, where there are presumably higher health care standards and a greater institutional emphasis on optimizing patient-centered care.

It is difficult to draw conclusions between patient satisfaction and type of institution (public or private) in the current study because no such comparison was possible for the Singapore cohort (100% publicly funded institutions), most Philippine patients surveyed (60%) were in private institutions, and only details regarding patient perception (not quality of care provided) were collected for this study. Patient satisfaction in the Singapore cohort is consistent with that measured by the Ministry of Health in the 2015 National Patient Satisfaction Survey, where overall satisfaction levels (indicated as *excellent* or *good*) ranged from 81% to 91% among 7 public institutions.¹⁶ Measures of patient satisfaction with the quality of health care services in the Philippines are scarce and hampered by challenges related to severe understaffing and the perception that social class and ability to pay are the greatest barriers to

quality health care and respectful treatment by health care providers. Nonetheless, studies of patient experience have demonstrated that the perception is that health care providers try to treat their patients sympathetically and with a high level of professionalism. Effective communication that gives patients a sense of support, trust, and confidence has been achieved in both public and private hospitals in the Philippines.¹⁷ Therefore, despite known challenges with health care delivery in lower middle- and low-income countries in Southeast Asia, patient perceptions of quality of and therefore satisfaction with health care are multifaceted and may ultimately have little to do with the relative wealth of the region.

Although differences in wealth and availability of health care resources exist between Singapore and the Philippines, common themes emerged among patients from both countries in the current study. Notably, the ranking of domains and their importance was similar between the 2 cohorts. Satisfaction with infection management and health care provider competence was ranked highest whereas pain management was ranked lowest for both groups. Patients in both cohorts who were satisfied with their vascular access procedure(s) were more likely to be satisfied with their overall hospital experience.

The survey did identify opportunities for improvement in both countries, specifically by reducing the number of needle insertion attempts to achieve successful PIVC placement and by reducing the risk of complications associated with the insertion and maintenance of PIVCs. This echoed the findings of a global survey of 712 adult and pediatric patients administered PIVCs that highlighted key issues determining patients' experiences: pain experienced and difficulty with PIVC insertion that led to multiple venous access attempts. Patients in the global survey prioritized (1) safe and consistent PIVC care that aligned with infection prevention strategies, (2) communication, and (3) staff training and competence.⁷

Health care provider competence, defined in this study as the ability of the health care provider to successfully insert the PIVC upon the first try and patient-perceived level of provider qualification and provision of care, emerged as the most important factor in these cohorts to influence patients' experiences during PIVC insertion. The Infusion Nurses Society's *Infusion Therapy Standards of Practice* (the *Standards*) acknowledges that successful first-attempt access is associated with a reduction in undesirable outcomes, including infection, occlusion, and accidental catheter removal, and that personnel responsible for vascular access and management should have appropriate training and validated competency in these techniques.¹⁸ As recommended by Cooke et al⁷ in the global survey discussed above, initiatives to enhance health care provider competence by developing their technical skills during PIVC insertion would minimize the number of needle insertion attempts and pain experienced by patients during the process. Another factor that may contribute to first-attempt vascular access success

is the use of imaging technology such as near-infrared light and ultrasound to assist in vessel location.¹⁸

Enhancement of health care provider communication skills were also necessary to address the psychological distress associated with painful and difficult PIVC insertion experiences.⁸ As this survey revealed, multiple attempts at vascular access and complications affected patient trust in their health care provider and increased their anxiety levels. In her review of patient distress and anxiety during cannulation, McGowan¹⁹ proposed that fear and anxiety experienced during the process activates the sympathetic nervous system, which in turn causes vasoconstriction of the peripheral veins. Vasoconstriction adds to the difficulty of inserting a catheter, which could increase the number of failed PIVC insertion attempts, further distressing patients.

LIMITATIONS

Several study limitations need to be acknowledged. First, due to strict regulations related to patient recruitment in Singaporean institutions, the sample of patients recruited was smaller than that of the Philippine cohort and only included Singaporean patients admitted to public institutions. These different operational processes between Singaporean institutions prevented recruitment of patients from private institutions, and the breadth of patient perception in the Singapore cohort may have been limited when compared with patient perception in the Philippine cohort. Second, investigators were aware that because patients were surveyed at their bedside, their responses may have been influenced by existing comorbidities, including the presence of pain. Investigators took mitigating steps, including requiring patients to sign a consent form fully informing the patient of the survey's objectives to ensure that patients were aware of the survey's intentions and conducting the interview prior to discharge so that the patient was able to provide comments from recent memory. Patients were also sampled from different wards to ensure that there was a diverse representation of views.

CONCLUSIONS

This survey highlights the importance of enhancing the vascular access skills of health care providers, preventing infection, and managing pain to improve patients' experiences with vascular access management and overall satisfaction levels during their hospital stay. Institutions can take meaningful steps to improve patients' overall satisfaction levels by adopting a multipronged, patient-centered approach to improve the key domains of vascular access management.

The study identified opportunities for improvement in both countries, specifically by reducing the number of attempts at vascular access to achieve successful PIVC placement and by reducing the risk of complications associated with the

insertion and maintenance of PIVCs. Initiatives to highlight and address the prevalence of PIVC-related complications that affected the majority of patients surveyed, particularly across vascular access, are required. The *Standards* suggests implementation of a plan that includes a continuous process of staff collaboration, skills assessment, and educational opportunities, as this approach is associated with improvement in first-attempt venous access success and reduction of complication rates.¹⁸ These initiatives should also address the other major factors that impact patient satisfaction, as identified in the survey, specifically effective pain management to reduce the severity and duration of pain experienced and stringent infection prevention measures during catheterization and catheter site maintenance.

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