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Research Paper

Establishment and implementation of a nurse-led interdisciplinary management strategy for central line maintenance: A single-center experience

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ABSTRACT

Objectives: This study aimed to establish and implement an interdisciplinary management strategy led by senior nurses via a vascular access specialist team (VAST) at a teaching hospital.
Methods: In 2021, the hospital established and implemented a nurse-led VAST management strategy to improve the quality of clinical central line maintenance. The VAST comprised senior nurses specialized in intravenous therapy, ultrasound/radiology technologists, medical doctors with central venous catheterization certificates, central line maintenance nurses, and administrative coordinators. The management strategy mainly included systemic on-the-job training for VAST members, the establishment of an interdisciplinary central line emergency "green channel," the formation of a VAST-based, nurse-led standardized clinical rounding system, and the standardization of central line self-care instructions for patients. During the pre- (July 2020 to April 2021) and post- (May 2021 to May 2022) of the implementation the interdisciplinary management strategy, overall patients' self-care ability, the success rate of catheterization at first time, central line management compliance rate, and patients' satisfaction with catheter maintenance were investigated and compared.
Results: The results showed the score self-care ability was increased from 74.75 ± 18.4 (pre-VAST) to 99.10 ± 23.65 (post- VAST); the success rate for catheterization at first time was improved to 100% (225/225), compared to 92.9% (209/225) at pre-VAST; the central line management compliance rate was also increased to 99.6% (224/225) at post-VAST from 93.3% (210/225) at pre-VAST. A patient satisfaction survey on catheter maintenance showed improvements in all five indicators were compared to the pre-VAST ($P < 0.05$).
Conclusions: The nurse-led VAST interdisciplinary strategy can effectively improve the quality of clinical central line management and should be used to reinforce clinical catheterization and maintenance of central lines.

What is known?

- Central line maintenance in China is mainly carried out by oncology nursing staff and involves limited collaboration with medical doctors, ultrasound experts, and radiology technologists.
- The National Infusion Therapy Standards of Practice of China have confirmed the importance of interdisciplinary management in intravenous therapy.
- Still, there are administrative difficulties in promoting this collaboration led by nursing staff.

What is new?

- The interdisciplinary management of central lines led by senior nurses should be recommended.

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- Medical institutions should implement improved interdisciplinary management guidelines on central line maintenance.
- Our proposed management strategy helps improve patients' self-care ability, central line management compliance, and satisfaction rate.

1. Introduction

The purpose of a central line in patients under intensive care conditions is to administer fluids, parenteral nutrition, chemotherapy medications, and blood products, monitor hemodynamic parameters, and collect routine laboratory samples [1,2]. The safe and effective use of a central line in continuous intravenous therapy represents a major advance; however, there are potential complications, such as central line-associated bloodstream infection (CLABSI), thrombosis, catheter breakage or deterioration, partial or total catheter extraction, and catheter occlusion [3]. Particularly after COVID-19, establishing a central line during resuscitation and treatment in critically ill patients has been increasingly emphasized [4,5]. Therefore, the maintenance of central lines, which include central venous catheters (CVCs), peripherally inserted central catheters (PICCs), and implantable venous access ports (PORTs), is a fundamental and vital skill for nurses in all aspects of health care [6].

The National Health Commission of the People's Republic of China issued National Infusion Therapy Standards of Practice in 2014 [7], which confirmed the importance of nurse-based interdisciplinary management of intravenous therapy and suggested that vascular access specialist team (VAST)-led interdisciplinary management is essential in enabling safe, high-quality, and efficient care in the maintenance of central lines as well as preventing complications [8]. The Infusion Nurses Society (INS) 2021 Guidelines later reiterated and emphasized this proposal. National collaborations have also advocated using nursing audits to improve central line maintenance compliance [9]. In 2020, at our tertiary medical institution with over 20,000 patient visits per year in East China, we established a senior nurse-led interdisciplinary VAST consisting of nurses, doctors, and radiology technologists. This study aimed to explore establishing a new management strategy for clinical central line-related intravenous therapy, enhance the safety of the related procedures and ensure proper catheter usage. Another objective of this study was to compare the overall self-care ability, central line management compliance, and maintenance satisfaction among central line patients under pre- and post-VAST management.

2. Methods

2.1. Identification and analysis of problems

In the previous management of central line catheterization and maintenance, when nurses could not establish a PICC, they reported the issue to doctors, who might contact an anesthesiologist or perform CVC placement with or without ultrasound support. In patients with CVCs or PORTs, who were initially evaluated and underwent catheter insertion by medical doctors accompanied by ultrasound or radiology technologists, catheter maintenance was carried out by oncology nurses daily with very short briefings between nurses and doctors. Due to communication and coordination issues, catheterization and the management of central lines are often performed with a need for more collaboration between medical and nursing staff. Additionally, central line maintenance represents a complex nursing knowledge network involving multiple disciplines, such as hospital infection, radiology support, interventional therapy, and vascular access anatomy, which makes it impossible for even professional oncology nurses to complete the comprehensive management process independently. In addition, due to the lack of professional catheter maintenance guidance after discharge, out-of-hospital central line-related complications are common in clinical practice [10].

2.2. Procedures

2.2.1. Establishment of VAST-led interdisciplinary central line management strategy

The VAST, as a collaborative team consisting of infusion nurses, medical doctors, and radiology technologists, is clinically involved in managing central lines from catheterization to maintenance to minimize the risk of CLABSI and reduce medical costs [11]. Before implementing the new central line management strategy, a preliminary assessment was conducted for junior specialized nurses via practical skills assessment and written examination. The recruited junior specialized nurses had to meet certain requirements, such as at least three years of clinical infusion therapy experience, a Bachelor of Nursing Science degree, and a PICC catheterization certificate. Since the management strategy involved doctors and technologists, the hospital office suggested an administrative order for clinical and technological departments to recommend qualified candidates to participate in the VAST program.

2.2.1.1. Composition of the VAST. The VAST members included one senior nurse (in charge) specializing in clinical intravenous therapy, two ultrasound/radiology technologists, two medical doctors capable of CVC/PORT catheterization, five junior specialized nurses in central line maintenance, and two administrative coordinators for interdisciplinary coordination or interhospital cooperation. As the leader of the VAST, the senior nurse set up a WeChat (a social network mobile device app widely used in China) group to facilitate communication and information sharing [12,13].

Finally, the study included several departments, each with a junior specialized nurse from the hospital-certified VAST, an ICU, an oncology unit (2nd oncology department), a hematology & oncology unit (1st oncology department), a chemotherapy clinic, and an intravenous infusion clinic.

2.2.1.2. Responsibilities of the VAST. Before the actual implementation of the VAST management strategy, the responsibilities of each member of the VAST were articulated. The senior nurse was in charge of all PICC catheterizations, basic training of junior specialized nurses in ultrasound administration, central line catheterization and complication management, and general daily maintenance standardization. With technologists and doctors from the VAST, under coordination by the administrative coordinators, the on-call junior specialized nurse would report to the patient's bedside within 24 h for possible central line catheterization on medical request, inform the patient of the procedure, and obtain written consent.

After insertion of the CVC or PICC (by a doctor or specialized nurse from the VAST, respectively), the maintenance and indwelling time of all catheters were monitored by the junior specialized nurse on a daily or weekly basis and registered in a central line management registry that had already been incorporated within the hospital's computerized management system.

2.2.2. Implementation of the management strategy

2.2.2.1. Management strategy approval. In advance, all protocols involving healthcare workers and patients were vetted and approved by the Hospital Review Board for Ethics Committee of No.

971 Hospital of the PLA Navy. The senior nurse in charge of the interdisciplinary management strategy submitted the protocol to the hospital administration for approval. After approval was granted, the announcement was sent to the related departments and staff for implementation.

2.2.2.2. VAST member on-the-job training. A specific training program for the new central line management strategy consisted of group and individual sessions. The group training, which lasted approximately three days, focused on introducing VAST core values, clarifying the organization and operating strategy of VAST management, and allocating working units within the hospital. Individual training sessions lasted around seven days, and the curriculum was chosen and delivered by senior doctors or nurses invited by the VAST senior nurse. This program covered various topics necessary for the implementation of the new strategy, including vascular anatomy of central veins, intravenous infusion-related skills, ultrasound-guided central line tip positioning techniques, ultrasound-related knowledge of catheterization, PICC selection (for nurses only), maintenance instructions, and emergency management of complications.

2.2.2.3. Establishment of a central line emergency "green channel". When patients need to, the "green channel" is initiated upon arrival at the hospital for immediate central line catheterization, whether outpatients or inpatients. The first emergency responder notified the VAST senior nurse directly, who was responsible for coordinating with VAST members within 2 h. Before catheterization, the patient's medical chart noted VAST-based diagnoses and intravenous therapy suggestions from the VAST doctors or senior nurse. Additionally, a radiology technologist and the VAST senior nurse were required to confirm catheter tip positioning within 30 min of catheterization. An ultrasound department established a rapid diagnostic channel for patients suspected of thrombosis caused by catheterization.

2.2.2.4. Formation of a VAST-based 24/7 clinical rounding system. The VAST senior nurse, technologist, and administrative coordinators were required to participate in a first-day round after catheterization. Meanwhile, the other team members held a round-table weekly summary seminar (RWSS) every Wednesday, focusing on three aspects: 1) whether the evaluation of indications and contradictions before catheterization was adequate, 2) whether the risks and difficulties during catheterization were fully assessed or reviewed, and 3) whether other potential situations may jeopardize the use of indwelling catheters. The VAST senior nurse signed off on the summary uploaded to the in-hospital computerized registry system. On normal days, VAST doctors or senior nurses shared feedback on the maintenance and performance of the central line through WeChat group, which was responded to in real time.

2.2.2.5. Standardization of central line self-care instructions. To ensure the maintenance and care of patients with central lines, the VAST provided regular self-care training, including indications for PICC/CVC/PORT, prevention of thrombosis, dressing fixation, and replacement, and emergency complication identification to improve patients' understanding of central lines. VAST was also responsible for editing operational manuals that included general principles, procedures, and treatment complications through central line catheterization based on the 2021 INS guidelines. Training patterns, including WeChat-based group chatting and other social network connections through messages, videos, or vlogs, were versatile.

2.3. Data collection

2.3.1. Patient demographic data

We conducted this prospective, descriptive study between May 2021 and May 2022 at our single-center, 1,500-bed compound hospital in Qingdao, East China. During the 12-month study, 225 patients who were to undergo catheterization with a central line (including CVCs, PICCs, and PORTs) in four oncology departments were recruited as the post-VAST management group. Another 225 patients from July 2020 to April 2021 were selected as the pre-VAST management group for baseline comparison. The inclusion criteria were as follows: age above 18 years; voluntary cancer-related chemotherapy; first central line insertion; veins in good condition at the puncture site; normal limb movement, with adequate self-care ability; and complete verbal communication ability. The exclusion criteria were congenital vascular malformation, venous thrombosis, and serious complications or critical illness that may compromise the patient's free will to complete the study.

2.3.2. Measures

The hospital admission registration system was used to gather the basic identity and contact information of all 450 patients. For patients in the pre-VAST group, telephone follow-up was mostly used, with occasional supplementation of online video medical consultations if required due to COVID-19 quarantine restrictions. On the other hand, for patients in the post-VAST group, face-to-face interviews or telephone follow-ups were arranged by the VAST after chemotherapy. The data obtained from both groups were summarized for statistical analysis three months after the central line use. The Exercise of Self-Care Agency (ESCA) scale was distributed to patients in the pre-VAST group via WeChat and Survey Star®. In contrast, patients in the post-VAST group completed the same scale during their first chemotherapy treatment at No. 971 Hospital of the PLA Navy.

Additionally, our central line catheterization data are processed through a customized software program called "No. 971 Hospital VAST Management 1.0", which has been integrated with the hospital management system. This allows doctors and nurses to schedule catheterizations or dressing changes via the hospital intranet and automatically fill in basic patient information such as name, ID number, and primary diagnosis. The program can also record reasons for unscheduled catheter removal and generate statistical results.

2.3.2.1. Self-care ability. The ESCA scale [14,15] was compiled by Kearney and Fleischer [16] and had a Cronbachs' α coefficient of 0.86–0.92 [17]. The scale comprises four dimensions with 43 items: self-concept (8 items); self-care responsibility (6 items); self-care skills (12 items); and health knowledge level (17 items). Each item on the scale is scored from 0 to 4, with a total score of 172; the higher the score, the stronger the self-care ability.

2.3.2.2. Central line management compliance of patients. The compliance of the patients was judged as follows [18]: 1) full compliance: the patient could fully follow VAST advice; 2) partial compliance: the patient could follow and carry out the doctor's advice, with irregular maintenance occurring occasionally; 3) no compliance: the patient could not follow the doctor's advice during placement or maintenance of the central line and could not adhere to the standard treatment protocol. The compliance rate was calculated as follows: Compliance rate = (number of patients with complete compliance + number of patients with partial compliance)/total number of patients × 100%.

2.3.2.3. Catheter maintenance satisfaction. We conducted a

questionnaire-based survey of patients to assess their satisfaction with the central line service before and after introducing the VAST management strategy. The following questions were asked: 1) Were/are you satisfied with the catheterization protocols and the maneuvers of the doctors/nurses? 2) Were/are you satisfied with the central line maintenance service and its outcome during the observation period? 3) Were/are you satisfied with the preventive measures taken by the current catheterization team for potential or existing complications? 4) Were/are you satisfied with the usage time of the central line, or has it reached the expected service life? 5) Were/are you satisfied with the maintenance education provided by the current catheterization team during central line use? These questions inquired about yes or no responses; the results were presented as a percentage of positive responses.

2.4. Data analysis

Statistical Package for Social Sciences (SPSS) version 26.0 was used for all statistical analyses. Continuous variables are presented as the *Mean* ± *Standard deviation* (*SD*) and were compared using the independent sample *t*-test. In contrast, categorical variables are expressed as the frequency and were compared using the Pearson chi-square (χ^2) test. Paired *t*-tests were used for comparisons between the pre-VAST and post-VAST groups. All probability values were two-tailed, and *P*-values of 0.05 or less were considered to indicate statistical significance.

2.5. Ethical considerations

The Hospital Review Board approved the protocol to conduct the study for the Ethics Committee (Certification No. 20210501A) of No. 971 Hospital of the PLA Navy. Approval for disclosing the data for publication was obtained in June 2023 from No. 971 Hospital of the PLA Navy. The patients involved in this study were fully informed of all aspects relevant to their decision to participate before confirming their willingness to participate.

3. Results

A total of 450 patients were recruited for this study, with 225 patients in the pre-VAST group and 225 in the post-VAST group. Table 1 summarizes the characteristics of these patients, and there were no significant differences in baseline data before and after the VAST management strategy was introduced ($P > 0.05$).

After introducing the VAST-based management strategy, the total score of self-care ability and its dimensions, the catheterization success rate at first time, and the central line management compliance of patients were higher than before introducing the VAST intervention ($P < 0.05$). (Table 2, Table 3) Patient satisfaction ratings with catheterization maneuvers, maintenance outcomes, complication prevention, catheter indwelling time, and maintenance education were higher in the post-VAST group ($P < 0.05$). (Table 4)

4. Discussion

After introducing a senior nurse-led VAST-based interdisciplinary management strategy, a significant improvement in the total score of self-care ability, including maintenance knowledge, responsibility, skills, and self-concept, was observed. As the observation period progressed, patients with central lines improved their self-care ability. Our VAST-based interdisciplinary management strategy effectively accelerated this improvement, consistent with previous research [11]. This could be attributed to patients with good self-care ability being more aware of the importance of self-care, which motivates them to actively gain relevant maintenance knowledge as their treatment progresses, thereby facilitating their engagement in their chemotherapy.

As shown in Table 3, the success rate of central line catheterization at first time and compliance with central line management showed improvement. We concluded that establishing the VAST-based management strategy had substantially impacted motivating and standardizing nursing staff throughout the hospital. For patients undergoing intravenous fluid therapy with a central line, the presence of certified (senior and junior) nurses on the VAST has improved the education provided for and the quality of central line maintenance, thereby alleviating patient fears and anxieties. Additionally, the implementation of standardized and continuous interdisciplinary management for central line maintenance enables healthcare workers to make evidence-based choices regarding central line access options, promotes the selection of more appropriate catheters for different patients under various conditions, enhances the safety and precision of catheter maintenance, and improves the quality of intravenous fluid administration. These findings are consistent with those reported by Pol-Castaneda et al. [19].

As shown in Table 4, satisfaction with catheterization maintenance was higher under VAST-based management. We concluded that establishing an interdisciplinary management strategy for central line maintenance had improved the professional skills of VAST members in clinical infusion therapy and positively influenced non-VAST nurses. From another perspective, this approach optimizes the selection and application of central lines, enhances work efficiency, reduces maintenance time, and greatly improves clinical venous infusion services' safety, accuracy, and professionalism. There are also reasons for the improved satisfaction with central line management that are worth emphasizing. 1) The real-time monitoring of quality indicators in clinical infusion therapy through interdisciplinary and comprehensive management facilitates regular and periodic follow-ups and timely feedback to address any issues that may arise during catheter usage effectively. 2) The interdisciplinary VAST consisted of doctors, nurses, and technologists with clear job descriptions. Invasive catheterization, in addition to PICC placement, was directly completed by doctors and technologists; maintenance responsibilities were carried out periodically by the VAST team, led by the senior nurse, ensuring more professional management of hospital infections and better implementation of preventive measures [11].

The term VAST often represents a group of personnel specifically affiliated with vascular access device catheterization and care and is now synonymous with numerous team titles in current healthcare settings [20]. With the maintenance-promoting instructions given by the VAST, patients with a central line have a better maintenance experience even after they have been discharged from the hospital. Meanwhile, as the success of catheterization at first time is effective in minimizing possible central line-related complications, our study confirmed the positive effect of the VAST-based interdisciplinary management strategy, which was of great assistance in catheterization evaluation of the vascular status, on-site positioning of the catheter, post catheterization maintenance and self-care ability promotion [21]. Regarding patient satisfaction, VAST-led management fully leveraged these advantages and effectively ensured the safety of central line use clinically. Therefore, we propose to minimize the imbalanced nursing resources among medical facilities where most central line catheters are placed and managed [22,23].

The primary limitation of this study is that it was a preliminary, single-center observational study with an insufficient sample size to provide a fully representative conclusion. We present this as a pilot study emphasizing a senior nurse-led VAST for interdisciplinary management in clinical intravenous therapy.

Table 1
Baseline characteristics of the participants ($n = 450$).

Characteristics	Total ($n = 450$)	Post-VAST ($n = 225$)	Pre-VAST ($n = 225$)	t/χ^2	P
Age, years	42.11 ± 2.35	42.72 ± 4.36	40.55 ± 2.98	0.63	0.517
Gender				1.44	0.214
Female	227 (50.4)	115 (51.1)	112 (49.8)		
Male	223 (49.6)	110 (48.9)	113(50.2)		
Diagnosis				3.94	0.721
Leukemia	170 (37.8)	80 (35.6)	90 (40.0)		
Gastric caner	106 (23.5)	52 (23.0)	54 (24.0)		
Lung cancer	72 (16.0)	40 (17.8)	32 (14.2)		
Other oncological malignancy	102 (22.7)	53 (23.6)	49 (21.8)		
Clinical stage of cancer				0.57	0.462
Stage II	223 (49.6)	108 (48.0)	115 (51.1)		
Stage III	140 (31.1)	67 (29.8)	73 (32.4)		
Stage IV	87 (19.3)	50 (22.2)	37 (16.5)		
Hemoglobin level, g/L		108.76 ± 10.97	114.76 ± 9.93	1.18	0.231
BMI at 1st catheterization, kg/m^2		25.76 ± 1.22	26.12 ± 2.01	1.32	0.150
Habitual residence				0.05	0.839
Rural area	204 (45.3)	99 (44.0)	105 (46.7)		
City	246 (54.7)	126 (56.0)	120 (53.3)		
Marital status				0.84	0.331
Married	351 (78.0)	169 (75.1)	182 (80.9)		
Unmarried (single, divorced or widowed)	99 (22.0)	56 (24.9)	43 (19.1)		
Medical payment				0.92	0.641
Pay by oneself	19 (4.2)	15 (6.7)	4 (1.8)		
Medical insurance	431 (95.8)	210 (93.3)	221 (98.2)		
Central line category				1.99	0.425
CVC	124 (27.5)	59 (26.2)	65 (28.9)		
PICC	309 (68.7)	160 (71.1)	149 (66.2)		
PORT	17 (3.8)	6 (2.67)	11 (4.9)		

Note: Data are *Mean* ± *SD* or *n* (%). CVC = central venous catheter. PICC = peripherally inserted central catheter. PORT = implantable venous access port. VAST = vascular access specialist team.

Table 2
Comparison of overall self-care ability between the pre- and post-VAST management strategies.

Groups	Maintenance knowledge	Maintenance responsibility	Maintenance skills	Self-concept	Overall self-care ability score
Post-VAST ($n = 225$)	33.56 ± 5.98	24.67 ± 7.21	20.21 ± 4.98	18.66 ± 5.48	99.10 ± 23.65
Pre-VAST ($n = 225$)	24.01 ± 4.78	20.00 ± 5.43	15.76 ± 4.85	14.98 ± 3.34	74.75 ± 18.4
t	22.14	8.87	14.76	10.70	48.60
P	0.001	0.001	0.002	0.020	0.030

Note: Data are *Mean* ± *SD*. VAST = vascular access specialist team.

Table 3
Comparison of success rate of catheterization and compliance between the pre- and post-VAST management strategies.

Groups	The success rate at first time	Central line management compliance
Post-VAST ($n = 225$)	224 (99.6)	225 (100)
Pre-VAST ($n = 225$)	210 (93.3)	209 (92.9)
χ^2	5.98	9.67
P	0.015	0.002

Note: Data are *n* (%). VAST = vascular access specialist team.

Table 4
Comparison of patient satisfaction with catheter maintenance between the pre- and post-VAST management strategies.

Group	Catheterization maneuver	Maintenance outcome	Prevention of complications	Catheter indwelling time	Maintenance education
Post-VAST ($n = 225$)	225 (100)	224 (99.6)	223 (99.1)	225 (100)	225 (100)
Pre-VAST ($n = 225$)	210 (93.3)	208 (92.4)	210 (94.6)	208 (92.4)	202 (89.8)
χ^2	5.85	12.93	6.89	8.34	15.46
P	0.015	0.001	0.009	0.003	0.001

Note: Data are *n* (%). VAST = vascular access specialist team.

5. Conclusions

The senior nurse-led VAST for the interdisciplinary management and maintenance of central lines can effectively improve the self-care ability of patients, catheter management compliance, and satisfaction ratings. This single-center experience in VAST-based management is important for clinical intravenous therapy management during the COVID-19 pandemic and is worth

recommending among nurses, doctors, and technologists at tertiary hospitals.

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Data availability statement

The data that support the findings of this study are available from [No.971 hospital of the PLA Navy], but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of [No.971 hospital of the PLA Navy]

CRediT authorship contribution statement

Yuxin Yin: Methodology, Validation, Investigation, Resources, Writing - review & editing. **Changhua Tang**: Conceptualization, Validation, Data curation, Writing - review & editing. **Lijie Zhang**: Methodology, Validation, Investigation, Resources, Writing - review & editing. **Di Wu**: Conceptualization, Methodology, Data curation, Formal analysis, Writing - original draft. **Qing Sun**: Validation, Formal analysis, Writing - review & editing, Supervision, Project administration.

Declaration of competing interest

None declared.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijnss.2023.06.014.

References

[1] Estrada-Orozco K, Cantor-Cruz F, Larrotta-Castillo D, Díaz-Ríos S, Ruiz-Cardozo MA. Central venous catheter insertion and maintenance: evidence-based clinical recommendations. Rev Colomb Obstet Ginecolog 2020;71(2):115–62. https://doi.org/10.18597/rcog.3413.

[2] Jarding EK, Flynn Makic MB. Central line care and management: adopting evidence-based nursing interventions. J PeriAnesthesia Nurs 2021;36(4):328–33. https://doi.org/10.1016/j.jopan.2020.10.010.

[3] Alexandrou E, Ray-Barruel G, Carr PJ, Frost S, Inwood S, Higgins N, et al. International prevalence of the use of peripheral intravenous catheters. J Hosp Med 2015;10(8):530–3. https://doi.org/10.1002/jhm.2389.

[4] Crivelli A, Fabeiro M, Puga M, Dieguez N, Giunta L, Pochettino F, et al. Care of patients on home parenteral nutrition during the first year of the COVID-19 pandemic: management of central line-associated bloodstream infections. Clin Nutr ESPEN 2022;52:250–3. https://doi.org/10.1016/j.clnesp.2022.11.003.

[5] Meynaar IA, van Rijn S, Ottens TH, van Burgel ND, van Nieuwkoop C. Increased risk of central line-associated bloodstream infection in COVID-19 patients associated with dexamethasone but not with interleukin antagonists. Intensive Care Med 2022;48(7):954–7. https://doi.org/10.1007/s00134-022-06750-w.

[6] Chopra V, Kuhn L, Ratz D, Shader S, Vaughn VM, Saint S, et al. Vascular access specialist training, experience, and practice in the United States: results from the national PICC survey. J Infusion Nurs 2017;40(1):15–25. https://doi.org/10.1097/NAN.0000000000000203.

[7] Ramsden S, Abidogun A, Stringer E, Mahgoub S, Kastrissianakis A, Baker P. A peer-led teaching initiative for foundation doctors. Clin Teach 2015;12(4):236–40. https://doi.org/10.1111/tct.12297.

[8] Krein SL, Kuhn L, Ratz D, Chopra V. Use of designated nurse PICC teams and CLABSI prevention practices among U.S. hospitals: a survey-based study. J Patient Saf 2019;15(4):293–5. https://doi.org/10.1097/PTS.0000000000000246.

[9] Gorski LA, Hadaway L, Hagle ME, Broadhurst D, Clare S, Kleidon T, et al. Infusion therapy standards of practice. 8th edition J Infusion Nurs 2021;44(1S Suppl 1):S1–224. https://doi.org/10.1097/NAN.0000000000000396.

[10] Gabbard ER, Klein D, Vollman K, Chamblee TB, Soltis LM, Zellinger M. Clinical nurse specialist: a critical member of the ICU team. AACN Adv Crit Care 2021;32(4):413–20. https://doi.org/10.4037/aacnacc2021511.

[11] Morrow S, DeBoer E, Potter C, Gala S, Alsbrooks K. Vascular access teams: a global outlook on challenges, benefits, opportunities, and future perspectives. Br J Nurs 2022;31(14):S26–35. https://doi.org/10.12968/bjon.2022.31.14.S26.

[12] Wu SW, Zhang JW, Du LH. I do not trust health information shared by my parents: credibility judgement of health (mis)information on social media in China. Health Commun 2022;22:1–11. https://doi.org/10.1080/10410236.2022.2159143.

[13] Sun KF, Chen YS, Wang ZZ, Liu Y, Pan Y, Mao XL, et al. Application of a WeChat-based mini-app as a patient reminder in *Helicobacter pylori* eradication: a prospective multi-center randomized controlled study. BMC Gastroenterol 2022;22(1):520. https://doi.org/10.1186/s12876-022-02614-1.

[14] Wong CL, Ip WY, Shiu TY. Translation and validation of the Chinese-Cantonese version of the exercise of self-care agency scale. Int J Nurs Stud 2012;49(9):1122–37. https://doi.org/10.1016/j.ijnurstu.2012.04.004.

[15] Gao H, Söderhamn U, Cliffordson C, Guo LN, Guo QY, Liu K. Reliability and validity of the Chinese version of the self-care ability scale for the elderly. J Clin Nurs 2017;26(23–24):4489–97. https://doi.org/10.1111/jocn.13779.

[16] Kearny B, Fleischer B. Development of all instrument measure exercise of self-care agency. Res Nurs Health 1979;2(1):25–34. https://doi.org/10.1002/nur.4770020105.

[17] Wang H-H, Laffrey SC. Preliminary development and testing of instruments to measure self-care agency and social support of women in Taiwan. Kaohsiung J Med Sci 2000;16(9):459–67. https://doi.org/10.4267/10608/1675.

[18] Fang S, Yang J, Song L, Jiang Y, Liu Y. Comparison of three types of central venous catheters in patients with malignant tumor receiving chemotherapy. Patient Prefer Adherence 2017;12(11):1197–204. https://doi.org/10.2147/PPA.S142556.

[19] Pol-Castañeda S, Rodriguez-Calero MA, Villafáfila-Gomila CJ, Blanco-Mavillard I, Zaforteza-Lallemand C, Ferrer-Cruz F, et al. Impact of advanced practice nurses in hospital units on compliance with clinical practice guidelines: a quasi-experimental study. BMC Nurs 2022;21(1):331. https://doi.org/10.1186/s12912-022-01110-x.

[20] Peng Q, Wu WY. Development and validation of oral chemotherapy self-management scale. BMC Cancer 2020;20(1):890. https://doi.org/10.1186/s12885-020-07404-0.

[21] McGuire R, Bagallon G. Development and evaluation of an intravascular link nurse network to sustain improvements in practice. Br J Nurs 2021;30(2):S16–22. https://doi.org/10.12968/bjon.2021.30.2.S16.

[22] Xu H, Dong CQ, Yang YQ, Sun HY. Developing a professional competence framework for the master of nursing specialist degree program in China: a modified Delphi study. Nurse Educ Today 2022;118:105524. https://doi.org/10.1016/j.nedt.2022.105524.

[23] Yang Z, Wang H, Zheng C, Wang A. An exploratory model of advance care planning clinical training for oncology nurses: a constructivist grounded theory study. Nurse Educ Pract 2022;65:103484. https://doi.org/10.1016/j.nepr.2022.103484.