An Implementation Framework for the Clinically Indicated Removal Policy for Peripheral Intravenous Catheters

NCPD 1.5 Contact Hours

Mari Takashima, MEpi, RN; Marie Cooke, PhD, RN; Michelle DeVries, MPH; Tricia M. Kleidon, MNursSci(Nurs Prac), RN; Evan Alexandrou, PhD, RN; Vineet Chopra, MD, MSc, MBBS; Claire M. Rickard, PhD, RN

ABSTRACT

Background: Equivalent clinical outcomes, lower costs, and fewer invasive procedures have resulted in revised recommendations for the removal of peripheral intravenous catheters (PIVCs) from the traditional 72- to 96-hourly removal to removal based upon clinical indication.

Problem: Uptake of this evidence-based innovation to health systems is often delayed, in part due to the lack of a guiding framework for successful implementation strategies to guide systems to transition to and sustain clinically indicated PIVC removal.

Approach: We used the Consolidated Framework for Implementation Research (CFIR) to reflect on strategies likely important for the successful implementation of PIVC removal evidence into policy and practice.

Outcomes: We discuss and provide a critique of salient strategies for successful implementation of clinically indicated PIVC removal with regard to intervention characteristics, the outer and inner settings, characteristics of individuals, and implementation processes.

Conclusions: Successful implementation of clinically indicated PIVC removal can be achieved through planned and systematic processes within the CFIR framework.

Keywords: clinically indicated peripheral intravenous catheter removal, Consolidated Framework for Implementation Research, implementation science, intravenous administration, peripheral intravenous catheter

A major change in peripheral intravenous catheter (PIVC) policy in the past decade has been in criteria for PIVC removal, from a time-based policy to a policy based on clinical criteria.[1,2] After an outbreak of bloodstream infections in the early 1970s, the Centers for

Author Affiliations: *Alliance for Vascular Access Teaching and Research (AVATAR), Menzies Health Institute Queensland, Griffith University, Brisbane, Australia (Mss Takashima, DeVries, and Kleidon, Drs Cooke, Alexandrou, Chopra, and Rickard); Nursing and Midwifery, Griffith University, Brisbane, Australia (Drs Cooke and Rickard); Methodist Hospitals, Gary, Indiana (Ms DeVries); Vascular Assessment and Management Service, Queensland Children's Hospital, Brisbane, Australia (Ms Kleidon); School of Nursing and Midwifery, Western Sydney University, Sydney, New South Wales, Australia (Dr Alexandrou); Department of Intensive Care, Liverpool Hospital, Sydney, New South Wales, Australia (Dr Alexandrou); and Michigan Medicine, University of Michigan Health System, Ann Arbor (Dr Chopra).*

Marie Cooke's employer, Griffith University, has received funding on her behalf for investigator-initiated research or education grants from BD.

Michelle DeVries serves on the speakers' bureau for Access Scientific, BD-Bard, Ethicon, Eloquest, and Teleflex.

Tricia M. Kleidon's employer, Griffith University, has received funding on her behalf for investigator-initiated research or education grants from BD-Bard and Cardinal Health, in addition to funding on her behalf for consultancy lectures or advice from 3M, Access Scientific, BD-Bard, Medical Specialties Australia, and Vygon.

Evan Alexandrou's employer, Western Sydney University, has received funding on his behalf for investigator-initiated research or education grants from BD-Bard.

Vineet Chopra has received grant support from the Agency for Healthcare Research and Quality and American Hospital Association. He has also received royalties from Wolters Kluwer Health and Oxford University Press related to books he has authored.

Claire M. Rickard's employer, Griffith University, has received funding on her behalf for investigator-initiated research or education grants from BD-Bard and Cardinal health, in addition to funding on her behalf for consultancy lectures or advice from 3M, BBraun, and BD-Bard.

Mari Takashima declares no conflicts of interest.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.jncqjournal.com).

Correspondence: *Mari Takashima, MEpi, RN, Alliance for Vascular Access Teaching and Research (AVATAR), Menzies Health Institute Queensland, Griffith University, Brisbane, Queensland, Australia (m.takashima@griffith.edu.au).*

Accepted for publication: June 7, 2020

Published ahead of print: August 18, 2020

DOI: 10.1097/NCQ.0000000000000507

Disease Control and Prevention (CDC) recommended 24-hourly PIVC removal and replacement, instead of previous clinically determined removal.[3] Although the outbreak was ultimately traced to manufacturer-contaminated fluid, routine removal remained common policy, extended gradually by the CDC to 48-hourly, 72-hourly, and then 72- to 96-hourly removal.[4] Such policies required patients to undergo repeated PIVC insertion procedures to replace even functional, comfortable catheters to complete infusion therapy.

Contemporary evidence supports PIVC replacement by *clinical indication*, which relies on patient-centered, clinical decision-making to appropriately remove PIVCs.[5] Clinicians must continue to regularly examine PIVC insertion sites, ask patients about symptoms, and consider planned treatment, but it is also now imperative that they *act* on these findings to remove catheters that are no longer needed, not functioning, uncomfortable, or suspected of infection, or were inserted without appropriate infection prevention standards (eg, in an emergency situation).[5]

Evidence to support the policy change is substantial including a Cochrane systematic review released in 2011 and updated in 2019 that includes 9 randomized controlled trials (RCTs), concluding that there was no evidence to support routine catheter change every 72-96 hours.[6] The largest RCT of 3283 patients found almost identical complication rates of 68 versus 66 per 1000 PIVC days for clinically indicated and routine removal, respectively, with significantly reduced costs, staff time, and patient discomfort with clinically indicated removal.[7] Similarly, there was no difference in phlebitis or catheter-related bloodstream infection between the 2 removal approaches.[6] Additional large RCTs from China and Brazil had consistent findings,[8,9] and a global observational study of over 40 000 PIVCs found PIVC dwell was not associated with phlebitis.[10]

IMPLEMENTATION INTO POLICY

Government and professional bodies have progressively incorporated clinically indicated removal recommendations. In 2011, the CDC advised "there is no need to replace PIVCs more frequently than every 72-96 hours," but also "no recommendation is made regarding replacement of peripheral catheters in adults only when clinically indicated."[4(p16)] In the same year, the *Infusion Therapy Standards of Practice* recommended PIVC clinically indicated removal now[2] defined as: "1) any level of pain/tenderness with/without palpitation; 2) changes in colour, 3) changes in skin temperature; 4) oedema; 5) induration; 6) purulent discharge or leakage of fluid from the site; and/or 7) other types of dysfunction (flushing and aspiration difficulties)."[11(p91)] In 2011, the Swedish Nursing Association advocated clinically indicated removal with an individualized approach considering catheter material and insertion site, composition of infusion/medicine, fixation method, patient difficulty, and insertion by an IV team.[12] Implementation in the UK followed the 2014 *Epic 3: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England* recommendation that PIVCs "should be re-sited when clinically indicated and not routinely, unless device-specific recommendations from the manufacturer indicate otherwise."[1(p10)] More recently, all major medical specialties in Spain released a consensus recommending clinically indicated PIVC removal.[13]

IMPLEMENTATION INTO PRACTICE

While the past decade has seen many major international guidelines adopt clinically indicated removal, anecdotally, there has been slow uptake into clinical policy and practice at the local hospital level. In a recent worldwide survey,[10] only one-third of hospitals had taken up the policy data on file. The transition from any new innovation to routine clinical practice is challenging and typically has a 17-year time lag[14] even after major guidelines recommend implementation. In the case of clinically indicated removal, it is likely that the absence of a strong recommendation endorsing clinically indicated removal from the CDC was one delaying factor. Another may have been reluctance to generalize results of Australian trials to other health systems, although recent confirmatory trials have been undertaken elsewhere.[8,9] Finally, no published framework exists to guide implementation of clinically indicated removal policy, suggesting hospitals need guidance to overcome the barriers to change that exist at the patient, clinician, organizational, and outer regulatory body levels.[15]

IMPLEMENTATION USING THE CFIR FRAMEWORK

The Consolidated Framework for Implementation Research (CFIR) combines constructs from numerous published implementation theories.[15] The CFIR has 5 major domains: intervention characteristics, outer setting, inner setting, characteristics of the individuals involved, and the process of implementation (see the Supplemental Digital Content Figure, available at: http://links.lww.com/JNCQ/A740).[15] Each domain reflects an important component in the process that leads to implementation and service outcomes. We evaluated the adoption of clinically indicated PIVC removal policy, against CFIR's 5 domains and provide a discussion and critique of salient strategies for successful implementation of this change into practice and policy in health care settings. Standards for Quality Improvement Reporting Excellence SQUIRE 2.0 were used to prepare this article.

APPROACH

CFIR domains offer salient implementation strategies for successfully transforming practice and policy toward clinically indicated PIVC removal (Figure).

CFIR 1: Intervention characteristics

The components of CFIR indicate that implementation of clinically indicated PIVC removal should be perceived as attractive since it has high-quality supporting evidence, is patient-centered, and will likely succeed in meeting local patient and health service needs if education and feedback support are provided.

Patient-centered evidence-based practice

The evidence supporting clinically indicated PIVC removal is compelling and therefore can disrupt routine replacement practice, and trigger policy change. Evidence includes several RCTs[7] and a Cochrane systematic review.[6] Other evidence types can also be influential, for example, the Infusion Therapy Standards of Practice[11] and national guidelines from UK, Spain, and other countries.[1,13] Such evidence is likely to gain support from bedside clinicians for whom it is clinically meaningful to leave PIVCs in place where still needed, complication-free, and functional, rather than removing catheters that trigger additional insertion procedures. PIVC inspections for each shift are already a standard practice and thus involve no extra work for nurses. However, while existing assessments are embedded practice, clinically indicated removal requires additional decision-making based on these assessments that may have been neglected under a more simplistic time-based policy. Patients' needs to reduce pain and vessel damage from multiple PIVC insertions are well known by clinical staff, and the current emphasis on patient-centered care can be a further motivator and catalyst for implementation.[16]

Clinical leaders are likely to perceive implementation as advantageous when presented with

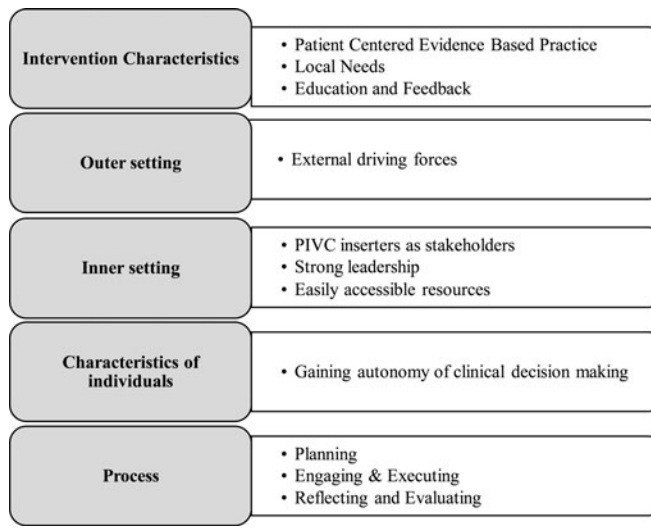

Figure. Salient implementation strategies based on the Consolidated Framework for Implementation Research.

the evidence about advantages in staff workloads and costs, without increased adverse events.[6] In addition, local experiential knowledge about the concept of clinically indicated removal already exists, since 96-hourly removal is not always possible, is deliberately extended in patients with difficult access or other supporting circumstances, and has always been the policy in pediatrics.[4,17] Clinicians are familiar with PIVCs, so motivating the multidisciplinary team including infection control, infectious disease, nursing, safety and quality, vascular access, and resource management to focus on benefits of fewer, painful, unnecessary procedures, preserving blood vessels, and improving patient satisfaction are key. A particularly important point is that the costs of implementation should be considered and agreed to before the project onset to engender a shared culture of understanding about the end benefit of undergoing change.

Local needs

Implementation can be promoted as an opportunity to develop a local bundle of interventions that improve all aspects of PIVC use to target local problems of PIVC bloodstream infections, *Staphylococcus aureus* bacteremia, and other complications such as phlebitis and occlusion that concern policy makers and clinicians. Clinically indicated implementation in the United States[18] comprised a bundle of improved PIVC insertion and maintenance interventions, terming this protected clinical indication, and addressed a local problem of primary bacteremia. The bundle included a focus on better insertion, antimicrobial dressings, and improved securement and continued to evolve after initial implementation with additional product changes in response to local needs.[19]

The perceived local needs of health care facilities to prevent infection but also avoid failed insertion procedures provide a basis for clinically indicated removal as logical and intuitive. Routine replacement can trigger delayed or failed PIVC replacement insertions, which delays treatment and potentially discharge.[20,21] If there is local history of patients with poor peripheral veins having complication-free PIVCs allowed to dwell for longer periods, then formal adoption of clinically indicated removal merely formalizes existing passive implementation. Or, a stepped implementation process where policy is first formally changed only for difficult-access patients may generate clinician confidence through experience and local data to build a supportive culture to expand the policy to all patients.[22]

Education and feedback

Successful implementation requires education and feedback for frontline staff to make appropriate decisions, which require confidence and competence with PIVC site assessment, indicators for removal, and negotiating decisions among the care team.[23] To successfully support staff in this change, workflows need to be reconfigured to integrate education and feedback into daily practice, making the right decision the easy decision every time. Point-of-care comprehensive, frequent PIVC assessment should be built into the medical record, with prompts for appropriate action based on negative findings (eg, if no IV therapy is prescribed, prompts to justify nonremoval should occur).

Initial and ongoing educational support incurs costs including educator time, time for staff to attend sessions, and tailoring and reprogramming health records. In addition are costs for modifying e-learning webpages, policy manuals, and audits to embed the new protocol. These need to be considered in a business case for implementation, with cost-benefits also articulated. This includes reduced staff time and equipment costs for PIVC replacements and costs associated with treatment interruptions from delayed/failed insertions. New mechanisms for regular audit and feedback to bedside staff about their achievements in appropriate removals and improved patient outcomes are critical to embed as part of the implementation.

CFIR II: Outer setting

The outer setting includes the economic, political, and social context within which organizations reside.[15] External driving forces strongly influence successful implementation.

External driving forces

The external driving forces of PIVC removal policies include organizational bodies such as regional or national health boards/departments and national professional organizations such as nursing, infection control, and vascular access societies. Higher hierarchical bodies such as national health departments and societies who recommended clinically indicated removal[1,12,13] can facilitate local approval from nursing and

medical leaders and local health boards. Such bodies often promote guidelines via websites, email distribution lists, social media, and promotional materials, hence influencing bedside clinicians. Mass adoption on a broader scale tends to be created through peer pressure. Financial incentives or disincentives can also be powerful, particularly where payers require certain quality targets to be met. National clinical care standards for PIVCs can ultimately be linked to accreditation, facilitating institutions to develop documentation and processes to ensure safe removal as part of the broader safe use of these devices.[24]

CFIR III: Inner setting

The inner setting features structural, political, and cultural contexts through which implementation processes proceed.[15] Three important inner setting areas are PIVC inserters as stakeholders, strong leadership, and easily accessible resources.

PIVC inserters as stakeholders

Garnering support from clinical staff directly responsible for insertions is vital for appropriate removal decision-making and successful implementation. Hospitals have myriad medical and nursing staff undertaking PIVC insertions, and therefore multiprofessional involvement in implementation is necessary at multiple levels of the organization (eg, junior clinicians to nursing/medical educators and departmental directors).[25] Unfortunately, multiple care providers can lead to reluctance to address problems, given social and behavioral tendencies (eg, bystander effect).[26] Champions need to be prepared to work outside their specialty since implementation requires interprofessional solutions (nursing, infection prevention/infectious diseases, safety and quality, clinical management and education, anesthetics, radiology, and vascular access). Where whole facility implementation cannot be achieved due to inadequate stakeholder support, stepped implementation (eg, in the medical division alone) may be achievable with potential to later extend facility-wide.

Strong leadership

Successful implementation requires strong leadership.[15] DeVries et al[18] demonstrated the value of a leadership team with explicit desire to improve patient experiences when tasked with implementing clinically indicated PIVC removal and evaluating its impact. They reviewed standards, and presented practice change elements and projected benefits to managers.[18] The team included an internationally respected infection preventionist who could articulate local PIVC-related risk issues that supported investment in prevention.[18] An organizational history of evidence-based recommendations to benefit patients, a culture of measuring impact, and strong interprofessional collaboration promote success. In other organizations, the individual spearheading implementation could be a vascular access, physician, or nursing leader with support from an executive sponsor (eg, director of nursing or infectious diseases). The sponsor must be briefed along with the project initiator to establish a working group to promote change, engage stakeholders, and identify and overcome barriers.[18] High-level support is vital to ensure implementation resources (eg, a project manager) and resources to collect and review audit data that sustain motivation and behavior change.[27,28]

Easily accessible resources

Clinical change requires multiple strategies for different stakeholders, but point-of-care support for PIVC removal decision-making is vital.[29] This must include good quality and easily accessible education resources, combined with feedback, for frontline staff to engender confidence and autonomy in clinical decision-making on appropriate PIVC removal. Professor Leonard A. Mermel from Warren Alpert Medical School of Brown University in Providence commented on PIVC removal that "it's best to make things simple and easy to follow and have black-and-white rules of what to do."[30] Adoption of clinically indicated removal, therefore, needs new, simple algorithms such as the I-DECIDED tool, which prompts care and removal decisions by aggregating clinical guidelines into a simple mnemonic.[31]

Nursing commentary has recommended education of patients, family members, and clinicians on how to assess for complications and decide on PIVC removal, plus the need to regularly audit local outcomes.[32] Accessible material for busy clinicians might include electronic or paper-based support tools at the bedside and as e-learning packages that allow flexible delivery. Initial education sessions and after-hours bedside teaching could be followed by visual

materials that reinforce regular PIVC assessments and appropriate removal criteria. Consistency of education materials between medicine, nursing, and departments is critical. Furthermore, annual mandatory competency assessment for PIVC maintenance and removal could be added to the existing insertion-only competencies to address regular staff turnover and to sustain change.

CFIR IV: Characteristics of individuals

Individuals within an organization heavily influence implementation.[15] This is particularly true for changing to a patient-centered decision, whereby clinicians, generally nurses, enact more autonomy in decision-making than under the previous time-driven criteria.[21,31] Heightened autonomy requires individuals to cognitively understand the new policy and their role in it. This requires knowledge of how to decide which PIVCs to remove and the confidence to make this decision and communicate it with the care team. Positive or negative affective feedback (eg, medical staff support or criticism regarding nurses' PIVC removal decisions) will influence individuals' future behavior. Additionally important is belief in the ability to provide replacement insertions for those patients needing ongoing therapy after a PIVC is removed. Under the new policy, PIVC removal occurs at any time of day, but advanced inserters who may once have undertaken routine replacements may only work business hours. Experiencing success personally and in the organizational workflow with the new policy will build confidence that reinforces individuals' self-efficacy and behavior. Scope of practice and escalation pathways may need clarification, as there is variation internationally in the nurse's role in PIVC insertion and the availability of advanced inserters.[10] Implementation can benefit clinicians at the individual level by enhanced professional competence via active learning and ability to precisely assess, act on their assessment, and document the PIVC every shift. This is an opportunity for upgrading clinical skills and knowledge to enjoy the full scope of practice and professional decision-making at the point of care.

CFIR V: Process

Successful implementation requires active change involving interrelated subprocesses that can be formally planned or spontaneous.[15]

Planning

DeVries et al[18] report preparations to initiate clinically indicated PIVC removal require approximately 6 months, during which time existing professional standards and literature, internal policies, and practice audits must be reviewed to refine implementation strategies. This important period prepares the education and feedback systems that will motivate the inner setting and engage strong, influential local leaders. During this time, it is important that the correct stakeholders are involved who have the willingness and aptitude to spend hours on social interventions, which require humility, patience, and interprofessional approaches, and that indicators for success are clearly defined by the team.[26,29]

Engaging and executing

Within this dimension, strong leadership and connecting and interacting with stakeholders remain key to execute the policy and practice change. Practice changes will be facilitated by attracting and involving others through education using posters and training with audit and feedback systems.[15] Engagement with the outer setting should continue to enhance organizational capacity, credibility, and enthusiasm for change through social marketing and role modeling.[15] While strong supportive leadership is key, even unsupportive organizational stakeholders must be engaged, with feedback systems that can allay concerns and value the effort of change.[33] Execution can be carried out by practice simulations or sessions before going live, pilot trials, or incremental interventions depending on what is suitable for the organization.[15]

Reflecting and evaluating

Dr Naomi P. O'Grady (an infectious disease specialist in the department of critical care medicine at the National Institutes of Health in Bethesda) cautions "if you go to an as-needed PIVC removal policy, one could become less rigorous about changing it. You have to pay close attention to the catheter daily for signs of phlebitis."[30] Thus, surveillance is needed to monitor the safety and effectiveness of the new policy, with feedback to frontline staff including celebrations of success for staff engagement. Audit data on reasons for PIVC removal reveal device failure trends, which can inform future quality improvement projects.

One hospital reported a 19% reduction in PIVC bloodstream infections[18] following implementation; such data provided positive reinforcement for frontline clinical staff. Consequently, their infection prevention staff undertake weekly audits of every catheter including dwell time, reason for removal, insertions in the emergency department/inpatient units, gauge, and anatomical site to identify real-time trends rather than the previous annual audit. In addition, monthly bedside audits of more than 1000 PIVCs focus on process measures to document site assessment, administration set date compliance, presence of chlorhexidine gluconate sponge and alcohol caps, and dressing integrity. Audit results are provided regularly to staff to reinforce consistent understanding about appropriate criteria for PIVC removal. At 2 years postimplementation, the hospital reported 20% of PIVCs remained functional at 7 days and 35% after 5 days.[19] Such data remind stakeholders of benefits and sustain the policy.

Ongoing internal feedback was an overlapping theme for the intervention characteristics and process constructs of the CFIR. Access to and review of PIVC surveillance data and documentation reassure stakeholders that there is no harm from the new policy. For example, implementation of clinically indicated removal in one NHS Trust in the UK incurred unease from the Infection Prevention Action Group due to fear of impacting local health care–associated infections.[34] Six months after implementation, PIVC-associated outcomes were not adversely affected, costs were significantly reduced, and 11 750 clinical hours was saved from unnecessary PIVC insertions, which convinced the Trust to fully implement the new policy.[34] Therefore, regular auditing and reporting can allay real or perceived concerns.

CONCLUSIONS

Clinically indicated removal has long been the norm in pediatrics and an unofficial policy in difficult-to-cannulate adults to avoid multiple, painful insertion attempts. Now that evidence strongly supports clinically indicated PIVC removal for all patients, implementation requires a focused effort, which can be achieved through planned processes using the CFIR framework. Specific considerations include emphasis of the patient-centered, evidence-based nature of the intervention, policy change to meet existing local needs, provision of quality, accessible education and resources, and regular audit and feedback to clinical staff.

REFERENCES

1. Loveday HP, Wilson JA, Pratt RJ, et al. epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. *J Hosp Infect*. 2014;86(suppl 1):S1-70. doi:10.1016/s0195-6701(13)60012-2
2. Infusion Nurses Society. Infusion nursing standards of practice. *J Infus Nurs*. 2011;34(suppl 1):S1-S110.
3. Centers for Disease Control. Nosocomial bacteremia associated with intravenous fluid therapy. *MMWR Morb Mortal Wkly Rep*. 1971;20(suppl 9):81-82.
4. O'Grady NP, Alexander M, Burns LA, et al. Guidelines for the prevention of intravascular catheter-related infections. 2011. *Clin Infect Dis*. 2011;52(9):162-193. doi:10.1093/cid/cir257
5. Patel SA, Alebich MM, Feldman LS. Routine replacement of peripheral intravenous catheters. *J Hosp Med*. 2017;12(1):42-45. doi:10.1002/jhm.2676
6. Webster J, Osborne S, Rickard CM, Marsh N. Clinically-indicated replacement versus routine replacement of peripheral venous catheters. *Cochrane Database Syst Rev*. 2019;(1):CD007798. doi:10.1002/14651858.CD007798.pub5
7. Rickard CM, Webster J, Wallis MC, et al. Routine versus clinically indicated replacement of peripheral intravenous catheters: a randomised controlled equivalence trial. *Lancet*. 2012;380(9847):1066-1074. doi:10.1016/S0140-6736(12)61082-4
8. Vendramim P, Avelar AFM, Rickard CM, Pedreira MDLG. The RESPECT trial-Replacement of peripheral intravenous catheters according to clinical reasons or every 96 hours: a randomized, controlled, no-inferiority trial. *Int J Nurs Stud*. 2020;107:103504. doi:10.1016/j.ijnurstu.2019.103504
9. Xu L, Hu Y, Huang X, Fu J, Zhang J. Clinically indicated replacement versus routine replacement of peripheral venous catheters in adults: a nonblinded, cluster-randomized trial in China. *Int J Nurs Pract*. 2017;23(6):e12595. doi:10.1111/ijn.12595
10. Alexandrou E, Ray-Barruel G, Carr PJ, et al. Use of short peripheral intravenous catheters: characteristics, management, and outcomes worldwide. *J Hosp Med*. 2018;13(5). doi:10.12788/jhm.3039
11. Infusion Nurses Society. Infusion therapy standards of practice. *J Infus Nurs*. 2016;39(suppl 1):S1-S169.
12. Swedish Nursing Association. Guideline on insertion and maintenance of peripheral venous catheters. Published 2011. Accessed June 2, 2020. https://www.swenurse.se/globalassets/01-svensk-sjukskoterskeforening/publikationer-svensk-sjukskoterskeforening/re-aktion-publikationer/reaktion.venkateter.web.2011-10-17.pdf
13. Capdevila JA, Guembe M, Barberan J, et al. 2016 Expert consensus document on prevention, diagnosis and treatment of short-term peripheral venous catheter-related infections in adult. *Rev Esp Quimioter*. 2016;29(4):230-238. doi:10.2016/j.circv.2016.06.001
14. Morris ZS, Wooding S, Grant J. The answer is 17 years, what is the question: understanding time lags in translational research. *J R Soc Med*. 2011;104(12):510-520. doi:10.1258/jrsm.2011.110180
15. Damschroder LJ, Aron DC, Keith RE, et al. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci*. 2009;4(1):50. doi:10.1186/1748-5908-4-50

16. Cooke M, Ullman AJ, Ray-Barruel G, et al. Not "just" an intravenous line: consumer perspectives on peripheral intravenous cannulation (PIVC). An international cross-sectional survey of 25 countries. *PLoS One*. 2018;13(2):e0193436-e36. doi:10.1371/journal.pone.0193436
17. Palese A, Cassone A, Kulla A, et al. Factors influencing nurses' decision-making process on leaving in the peripheral intravascular catheter after 96 hours: a longitudinal study. *J Infus Nurs*. 2011;34(5):319-326. doi:10.1097/NAN.0b013e3182290a20
18. DeVries M, Valentine M, Mancos P. Protected clinical indication of peripheral intravenous lines: successful implementation. *JAVA*. 2016;21(2):89-92.
19. DeVries M, Strimbu K. Short peripheral catheter performance following adoption of clinical indication removal. *J Infus Nurs*. 2019;42(2):81-90. doi:10.1097/NAN.0000000000000318
20. Marsh N, Webster J, Larsen E, et al. Expert versus generalist peripheral catheter insertion: a pilot randomised controlled trial. *Trials*. 2018;19(1):564. doi:10.1186/s13063-018-2946-3
21. Kleidon TM, Cattanach P, Mihala G, Ullman AJ. Implementation of a paediatric peripheral intravenous catheter care bundle: a quality improvement initiative. *Paediatr Child Health*. 2019;55(10):1214-1223. doi:10.1111/jpc.14384
22. Alexandrou E, Mifflin N, McManus C, et al. Extended dwell peripheral catheters in patients with difficult venous access: comparison of a peripheral intravenous catheter and midline catheter. *Vascular Access*. 2018;4(1):1-5.
23. Halm MA, Alway A, Bunn S, et al. Intersecting evidence-based practice with a lean improvement model. *J Nurs Care Qual*. 2018;33(4):309-315. doi:10.1097/ncq.0000000000000313
24. Australian Commission on Safety and Quality in Health Care. Peripheral Venous Access Clinical Care Standard. Published 2019. Accessed June 3, 2020. https://www.safetyandquality.gov.au/standards/clinical-care-standards/peripheral-venous-access-clinical-care-standard
25. Curry SJ. Organizational interventions to encourage guideline implementation. *Chest*. 2000;118(2 suppl):40S-46S.
26. Rosenbaum L. The not-my-problem problem. *N Engl J Med*. 2019;380(9):881-885. doi:10.1056/NEJMms1813431
27. Foy R, Eccles M. Audit and feedback interventions. In: Straus S, Tetroe J, Graham I, eds. *Knowledge Translation in Health Care*. 2nd ed. Wiley; 2013.
28. Oh JH, Shelly M, Nersinger S, Cai X, Olsan T. Implementing clinical practice guidelines for replacing peripheral intravenous catheters. *J Nurs Care Qual*. 2020;35(2):108-114. doi:10.1097/NCQ.0000000000000429
29. Grol R, Grimshaw J. From best evidence to best practice: effective implementation of change in patients' care. *Lancet*. 2003;362(9391):1225-1230. doi:10.1016/s0140-6736(03)14546-1
30. Colwell J. Is it time to end routine catheter replacement? ACP Hospitalist. Published 2013. Accessed May 20, 2020. https://acphospitalist.org/archives/2013/01/catheter.htm
31. Ray-Barruel G, Cooke M, Chopra V, Mitchell M, Rickard CM. The I-DECIDED clinical decision-making tool for peripheral intravenous catheter assessment and removal: a clinimetric evaluation. *BMJ Open*. 2020;10(1):e035239. doi:10.1136/bmjopen-2019-035239
32. Ho KH, Cheung DS. Guidelines on timing in replacing peripheral intravenous catheters. *J Clin Nurs*. 2012;21(11/12):1499-1506. doi:10.1111/j.1365-2702.2011.03974.x
33. Aarons G, Horowitz J, Dlugosz L, et al. The role of organizational process in dissemination and implementation research. In: Brownson R, Colditz G, Proctor E, et al., eds. *Dissemination and Implementation Research in Health*. 1st ed. Oxford University Press; 2012:128-153.
34. Bolton D. Clinically indicated replacement of peripheral cannulas. *Br J Nurs*. 2015;24(19):S4-S12. doi:10.12968/bjon.2015.24.Sup19.S4

For more than 90 additional nursing continuing professional development activities related to Quality Improvement, go to NursingCenter.com.

Lippincott® NursingCenter®

NCPD Nursing Continuing Professional Development

TEST INSTRUCTIONS

- Read the article. The test for this nursing continuing professional development (NCPD) activity is to be taken online at **www.nursingcenter.com/CE/JNCQ**. Tests can no longer be mailed or faxed.
- You'll need to create an account (it's free!) and log in to access My Planner before taking online tests. Your planner will keep track of all your Lippincott Professional Development online NCPD activities for you.
- There's only one correct answer for each question. A passing score for this test is 14 correct answers. If you pass, you can print your certificate of earned contact hours and access the answer key. If you fail, you have the option of taking the test again at no additional cost.
- For questions, contact Lippincott Professional Development: 1-800-787-8985.
- Registration Deadline: June 2, 2023.

PROVIDER ACCREDITATION

Lippincott Professional Development will award 1.5 contact hours for this nursing continuing professional development activity.

Lippincott Professional Development is accredited as a provider of nursing continuing professional development by the American Nurses Credentialing Center's Commission on Accreditation.

This activity is also provider approved by the California Board of Registered Nursing, Provider Number CEP 11749 for 1.5 contact hours. Lippincott Professional Development is also an approved provider of continuing nursing education by the District of Columbia, Georgia, and Florida, CE Broker #50-1223. Your certificate is valid in all states.

Payment: The registration fee is $12.50 for CNLA members and $17.95 for nonmembers.

Disclosure: Authors Marie Cooke, Michelle DeVries, Vineet Chopra, Claire M. Rickard, Evan Alexandrou, and Tricia M. Leidon, noted grant monies received either by them or by their employers. LPD's conflict of interest process revealed no conflicts of interest. Author Mari Takashima had no potential conflicts of interest, financial or otherwise.