Parker, S, Wilkins, J, Inayat, S, Hollingsworth, N, Causer, J, Virani, S and Caird, J

A randomized control trial to compare Quiet Eye training efficacy to traditional technical training with undergraduate student nurses' peripheral intravenous cannulation performance: A protocol

A randomized control trial to compare Quiet Eye training efficacy to traditional technical training with undergraduate student nurses' peripheral intravenous cannulation performance: A protocol

Quiet Eye training compared to traditional technical training

Authors: Parker, S. I. A., MN, RN[1*], Wilkins, J., BA[2], Inayat, S., BScN, MHR, PhD (Candidate)[1], Hollingsworth, N., SN3[1], Causer, J., PhD.[4], Virani, S., MSc, PMP[5], and Caird, J. K., PhD.[2,3,5]

[1] Faculty of Nursing, University of Calgary, Alberta, Canada

[2] Department of Psychology, Faculty of Arts, University of Calgary, Alberta, Canada

[3]Community Health Sciences, Faculty of Medicine, University of Calgary, Alberta, Canada

[4] School of Sport and Exercise Sciences, Faculty of Science, Liverpool John Moores University, United Kingdom

[5]Ward of the 21st Century, Cumming School of Medicine, University of Calgary, Alberta, Canada

*Corresponding Author

Shannon I. A. Parker, Associate Professor (Teaching), Faculty of Nursing, University of Calgary, PF 3252, 2500 University Dr. N.W., Calgary, Alberta T2N 1N4, Canada, +1 (403) 210-3843 (Office)
parkers@ucalgary.ca

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Parker, S.I.A.: Conceptualization, reviewing and editing, resources, supervision, project administration, funding acquisition
Wilkins, J.: Original draft, reviewing and editing, investigation
Inayat, S.: Methodology, original draft, reviewing and editing, investigation
Hollingsworth, N.: original draft, reviewing and editing, investigation, data curation, resources
Causer, J.: Methodology, validation, reviewing and editing, supervision, funding acquisition
Virani, S.: Reviewing and editing, resources, project administration, funding acquisition
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ABSTRACT

Introduction: Peripheral intravenous cannulation (PIVC) is a common and complex procedure with low first-attempt success rates, causing patient suffering and increased healthcare costs. Quiet Eye (QE) training, a gaze-focused approach, has shown promise in improving procedural PIVC skills. We will examine the effectiveness of traditional technical training (TT) and QE (QET) training on student nurse PIVC performance.

Methods: 44 participants will be randomly assigned to either the TT or QET groups using a blocked randomization method to ensure balanced group sizes. Blinded outcome assessments will minimize bias. Data will be collected using a structured questionnaire and a mobile eye tracker to simultaneously record gaze and hand movements. Participants will complete pre-intervention, post-intervention, and one-week retention tests using a light-skinned manikin arm. A transfer task, utilizing a dark-skinned manikin arm, will assess participants' skills post trials. The TT group will receive traditional instruction on hand movement improvement; the QET group will receive feedback on their gaze behaviours. The primary outcome measure will be PIVC first attempt success defined as being able to flush the inserted catheter with 10 mL (maximum) normal saline into the vessel. A trial will be considered unsuccessful if more than gentle pressure on the syringe plunger is needed to flush the catheter or if the participant abandoned the attempt before attempting the flush. Other dependent variables will be QE duration (%), number of fixations, total movement time (s), and movement phase time (s). We will analyze data with descriptive and inferential statistics, including mixed model ANOVA and Chi-Square tests.

Discussion: This study examines the significance of improving PIVC first attempt success rates and highlights QET potential as an intervention. Emphasis is placed on critical implications for healthcare, particularly the importance of integrating QETinto nursing education programs. Future research utilizing large-scale trials and longitudinal designs is recommended.

INTRODUCTION

Most hospitalized people (70%-80%) require vascular access device placement (Alexandrou et al., 2012; Zingg & Pittet, 2009). These peripherally inserted thin plastic tubes allow venous system access to infuse essential fluids, blood, blood products, and medications. Although this common and complex skill is routinely taught in undergraduate nursing programs, peripheral intravenous cannulation (PIVC) first attempt success rates (FASRs) differ considerably between novice (23%) and expert (98%) nurses (Carr et al., 2016; Frey, 1998). When significant complications such as infection occur, increased hospital length of stay and patient's pain and suffering often result (Catarino et al., 2022; Marsh et al., 2020; Millington et al., 2020).

Factors affecting first-attempt success rates

Several factors contribute to inexperienced registered nurses' (RNs') and student nurses' low FASRs, including the lack of appropriate evidence-based education and PIVC skill development opportunities (Gorski et al., 2021; Rodriguez-Calero et al., 2020; Yalçınlı et al., 2019). Traditionally, nurses learn PIVC utilizing the cognitive apprenticeship model and simulation (Wooley & Jarvis, 2007). However, despite widespread PIVC teaching in nursing education and calls for close examination of individual clinical differences there has not been a significant FASR improvement (Arslan et al., 2022; Frey, 1998; Parker et al., 2017). To increase FASRs more quickly and effectively, students and RNs urgently need improved training and support (Rivaz et al., 2017).

Outcomes of unsuccessful PIVC

Low FASRs result in negative outcomes, including multiple painful skin punctures, diagnostic test and treatment delays, and increased patient morbidity and mortality (Zingg et al., 2023). Repeated PIVC attempts can cause additional tissue damage and delay necessary medical interventions, resulting in longer hospital stays and increased healthcare costs (Buyukyilmaz et al., 2020; Santos-Costa et al., 2022). Also, repeated unsuccessful PIVC attempts usually necessitate alternative insertion methods, such as central venous cannulation, which is more invasive and associated with higher risk of complications

(Santos et al., 2020). Therefore, it is crucial to ensure that nurses are equipped with proper evidence-based PIVC training to increase success rates and reduce negative outcomes associated with unsuccessful attempts.

Quiet Eye training

Novices and experts consistently demonstrate different gaze behaviours. Expert surgeons and athletes use a specific gaze immediately prior to the final task movement. For example, during surgical knot tying, expert surgeons have a long and stable final fixation on the knot location to ensure accurate placement and tension to avoid slippage or shear force or undue ischemia (Causer et al., 2014). This final fixation, referred to as the Quiet Eye (QE) is within three degrees (or less) of visual angle at a specific location for a minimum of 100 ms before a motor movement . An individual's information processing may be facilitated during this last fixation due to the external focus of attention and allowing key movement parameters, such as force and placement, to be effectively programmed, resulting in successful execution of a motor skill. The QE differentiates successful from unsuccessful performance, and novices from experts (Vickers, 2016). Most importantly, evidence-based QE training programs assist novices to adopt the characteristics of expert performers earlier in multiple sports, medicine, radiology, surgery, and pathology (Ashraf et al., 2018, Vickers, 2007). This results in performance gains that are maintained during high anxiety conditions (Causer et al., 2014). A recent study by Parker and colleagues (2021) confirmed that expert RNs utilize fewer eye fixations on the insertion site than novice student nurses and that their final fixation duration was associated with insertion success. The higher number of novices' fixations could indicate their higher information processing demands compared to experts. The experts' final fixation location and duration may indicate the need to focus on an essential cue used to guide the movement that novices have not yet learnt (Causer et al., 2014). Therefore, a QE training program, focusing on gaze behaviour could increase PIVC teaching effectiveness. To compare traditional

technical teaching, focused on hand movements, to QE training focused on gaze behaviours, we propose the current study.

Research objective

Our aim is to conduct a randomized controlled trial with undergraduate student nurses learning PIVC to investigate the effectiveness of QE training compared to traditional technical training. We expect that QE training will result in both increased FASRs and increased PIVC procedural performance for these students.

Key definitions

Quiet Eye. The final fixation, within three degrees of visual angle, for a minimum of 100 ms before a critical motor movement (Vickers, 1996).

First Attempt Success. Insertion of the catheter into the vein as demonstrated by blood return into the catheter hub and/or successfully flushing the inserted catheter with 5–10 mL of normal saline.

METHODS

Study population

The target population for this study comprises undergraduate student nurses. The in-depth PIVC and nursing knowledge, skills, and techniques commonly taught in nursing programs are essential for achieving adequate FASR. By focusing on this population, we aim to deepen our understanding of QE training and its role in a successful first attempt PIVC.

Study setting

The study will be conducted in the simulation centres at the Faculty of Nursing, University of Calgary, and Ward of the 21st Century (W21C), Calgary, Canada. The Clinical Simulation Learning Centre in the Faculty of Nursing and W21C feature state of the art simulation labs and high fidelity mannikins regularly used in undergraduate nursing education. The Faculty of Nursing offers several undergraduate,

graduate, and post-graduate degree programs, inducting approximately 250 new undergraduate students each year.

Study design

We selected a parallel randomized controlled trial study design since observations will be collected from the participants in the technical training and QE groups without any cross-over of the groups to a different condition (Polit & Beck, 2017).

Eligibility criteria

Student nurses with the following characteristics will be eligible for this study: (a) self-reported normal or corrected-to-normal vision; b) have completed a Fundamentals of Nursing course; and c) have not received any formal PIVC training. Exclusion criteria will include:(a) completion of any additional PIVC training; (b) reportedregular PIVC practice in any context; (c) have attempted more than 5 PIVCs or phlebotomies on a human or animal; and d) any physical injury or disability that would prevent the effective completion of the PIVC.

Sample size

Overall, 44 student nurse participants (22 each in the control and intervention groups) will be recruited. This sample size was calculated using Statistical Package for Social Sciences (SPSS version 29) software for a one-sided test using a large sample approximation. The estimation of statistical power was based on the Pearson Chi-Square test and the pooled standard deviation. Marsh et al. (2018) conducted a pilot randomized controlled trial and identified that vascular expert specialists' PIVC success rate was 100% compared to a 72% success rate in general nursing or medical specialists. We used these figures as a reference point for calculating our sample size. To achieve 80% power with an alpha of 0.05, the estimated sample size was 40 participants. A maximum 10% dropout is considered reasonable for this type of study, therefore the total sample size for this trial is 44 participants.

Sampling technique

A simple random sampling technique will be used to recruit participants, such that every individual in the population has a known chance to be selected (Polit & Beck, 2017). A comprehensive list of undergraduate student nurses will be obtained from the undergraduate nursing office and each student enrolled in the years 2–4 of the program will be invited to participate in this voluntary study. These invitations will be extended by research assistants (RAs) attending classes to describe the study, posting recruitment flyers on bulletin boards around the Faculty of Nursing, and sending emails that include a description of the study and RA contact information. Research Assistants will provide a gift card to student s who participate for the duration of the study. Snowball sampling, where RAs ask participants to invite their peers to join the study, will be utilized if the desired sample size has not been reached when trials commence. Participants will not be required to reach out to peers, nor will they receive any added benefits from doing so.

Intervention

All participants will watch the same standardized PIVC training video and wear a mobile eye tracker while completing PIVC attempts on a light-skinned manikin arm (Laerdal Medical, product number 270-00001) capable of provided blood flashback in the needle hub and receiving the 10mL saline flush to indicate PIVC success. The traditional technical training group participants will receive ongoing feedback, focused on hand movements, while completing the pre-intervention, post-intervention, and one-week retention tests. The QE training group will view a video of an expert performing the procedure, with the 'gold-standard' eye movements overlaid. This expert model is based on the Parker et al. (2021) paper, which showed a longer, stable, final fixation on the insertion site. A transfer task, utilizing a dark-skinned manikin arm, will assess participants' skills post trials (Ballard et al., 2022). While the traditional technical teaching group will receive traditional instruction on hand movement improvement; the QE training group will receive feedback on their gaze behaviours. In

addition, a RA will use a standard script to explain to the intervention group the significance of controlling eye movement and focusing on the area of interest during the PIVC procedure.

Randomization and blinding

After recruitment, RAs will obtain written informed consent (Appendix A) from all participants before randomizing them to one of the two trial arms using freely available Research Randomizer software (2020; www.randomizer.org) designed specifically for this purpose. We will use the blocked randomization method, which ensures balanced groups when the total sample is less than 100 participants (Kang et al., 2008), to create a block size of four with two control and two intervention subjects.

Due to the nature of the intervention, participants will not be blinded to their study group. Two RAs will be present for each trial, one of whom will be blinded to the participants' group allocation. The blinded RA will leave the room during the trial, re-entering upon trial completion to assess the PIVC outcome (success or failure) based on video data that has been de-identified and had eye-tracking data removed. Therefore, outcome adjudicators will be blinded to group allocation to minimize differential treatment or outcome assessment during this study (Karanicolas et al., 2010).

Data collection tool

Demographic information including participants' highest level of education, age, gender, and any previous experience inserting a peripheral intravenous catheter or phlebotomy attempts on human or animal subjects will be collected using a structured digital questionnaire. Outcome variables that will be measured include first-attempt PIVC success (rated as a binary variable, yes, or no), quiet eye duration (%), number of fixations, movement phase time (s), and total movement time (s). A validated PIVC skills checklist will be utilized by trained raters to determine the PIVC procedural success (Schuster et al., 2016). Eye tracking-related data will be recorded using Tobii Pro Lab Analyzer Edition software (n.d., www.vinis.co.kr/TPL_manual.pdf).

Data collection process

This study will be conducted in the Clinical Simulation Learning Centre at the Faculty of Nursing and W21C at the University of Calgary, where a realistic replicate of a common healthcare environment will be created, including the materials needed to complete a successful PIVC. Participants will be able to adjust aspects of this setting as they see fit, for example, the height of the hospital bed.

Each participant will wear a head-mounted Tobii Pro eye tracker (Tobii Technology, Danderyd, Sweden) that captures gaze and motor movements throughout their PIVC attempts on a simulated arm. Individual participant baseline data will be collected during three PIVC attempts. After this pre-intervention test stage, participants in both groups will complete the training stage. All participants will first view standardized video instruction about the PIVC insertion task and then read conventional instructions based on the current training provided by the Faculty of Nursing. Participants in the intervention group will be provided with QE instruction based on previous literature, watch a video showing an expert's QE while completing a PIVC attempt, and receive specific gaze behaviour feedback using a standard script followed by their own pre-intervention test video to compare to the expert model. Participants in the technical training group will be offered technical instruction based on the Faculty of Nursing teaching guides, view a video of an expert's hand movements during a PIVC and view a video of their hand movements from the pre-intervention test.

The post-intervention test for both groups will consist of completing three PIVC attempts, along with a one-week retention test. Subsequently, a transfer task consisting of a more difficult PIVC insertion environment will be completed, utilizing a simulated arm with a dark skin color (Ballard et al., 2022). As darker skin provides less contrast to see the veins clearly, this post-intervention challenge will allow us to examine the training effects more clearly. Appendix B outlines the anticipated participant timeline.

Data analysis

All study data will be uploaded to the Tobii Pro Lab Analyzer Edition software (version 1.49) and exported to SPSS for analysis, using both descriptive and inferential statistics. The mean and standard deviation will be used to summarize continuous variables, while frequencies and percentages will be used with categorical variables. A mixed model Analysis of Variance (ANOVA) will be used to compare the groups' gaze behaviours and movement times and examine these results with appropriate follow-up tests. The difference in FASRs between the technical training and intervention groups will be compared for statistical significance, using a Chi-Square test with a significance level of 0.05.

Data monitoring

To ensure ethical conduct, accurate data collection and documentation, and protocol compliance, research team members will frequently monitor the data. As we are not testing new devices or therapeutics, no substantial safety risks exist that need continual monitoring (Lin & Lu, 2014).

Validity and reliability

Throughout the study, we will adhere to high quality research practices guided by the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) Statement (Chan, Tetzlaff, Altman et al., 2013; Chan, Tetzlaff, Gøtzsche et al., 2013). This includes prospective registration of the study protocol and regular auditing for allocation and protocol adherence by research staff and investigators.

Ethical and dissemination considerations

Ethical approval for this study will be obtained from the Conjoint Health Research Ethics Board at the University of Calgary, Canada. All potential and actual participants will be informed that their participation is completely voluntary, that their decision will not influence their education or standing in the nursing program in any way, and that the primary investigators will not have access to any personal identifiers. Written informed consent will be obtained from all study participants before commencing the trial, including an explanation of its risks and benefits and that they are free to withdraw from the study at any time prior to data analysis. We do not anticipate a need for post-trial care; however, participants

assigned to the technical training group may request QE training after the trial is complete. Any protocol amendments will be approved by all trial investigators and the research ethics board, with updates submitted to the trial registry. All Principal and Co-Investigators and collaborators will declare any financial and competing interests during the ethics approval process; the current authors have none to declare. The published protocol will be publicly accessible to ensure transparency of our research plan and appropriate reporting of study results. Results will be published in peer-reviewed journals and shared with educators through conference presentations.

DISCUSSION

Our study will examine the implementation of QE training as a potential solution to the persistently low PIVC FASRs experienced by student nurses and novice RNs. This randomized controlled trial will compare a gaze-focused QE method with a traditional training method on the PIVC FASRs for a group of 44 student nurse participants. Data will be collected via structured questionnaires and eye-tracking technology, with pre-intervention tests, post-intervention tests, retention tests, and transfer tests used to assess PIVC skills for each group. Descriptive and inferential statistics will be used to analyze similarities and differences between the intervention and control groups.

Implications

Study findings are likely to have substantial implications for nursing education and practice, at the University of Calgary and across the country. Currently, low PIVC FASRs lead to increased morbidity and mortality, unnecessary patient suffering, and increased healthcare costs. Implementing QE-based PIVC training will help ensure that novice nurses acquire these essential skills more effectively, thereby reducing patient complications, delays in treatment, and extended hospital stays.

This study also is expected to lay a foundation for the curricular adjustments needed to incorporate QE-based PIVC training modules as a standard component of undergraduate nursing programs at universities across Canada and around the world. For example, the structured, video-based

training and expert model comparisons used with the intervention group could be readily integrated into existing curriculum at the University of Calgary, providing students with more practical and relevant training experiences. Implementing such curricular modifications is key to enhancing students' PIVC FASRs, a vital competency for these future nursing professionals.

Limitations

Certain potential limitations must be noted for this planned trial, including sample size. With only 44 participants, the study may not sufficiently capture the diversity of backgrounds and experiences among student nurses. Also, despite best efforts to avoid such circumstances, researchers or student participants may introduce bias relating to previous PIVC experience or training. These limitations could potentially impact the generalizability of study findings to the broader nursing population.

Future research

Future research should consider larger-scale trials involving more participants from various educational institutions (e.g., student nurses across Canada) and healthcare settings (e.g., novice RNs) to validate the effectiveness of QE training on PIVC FASRs. Additionally, a longitudinal study may be beneficial for investigating the long-term retention and application of QE-based PIVC training in clinical practice. Understanding how QE training influences nurses' PIVC performance over time is essential for enhancing patient outcomes and reducing healthcare costs.

CONCLUSION

This innovative study provides a strong foundational methodology for investigating the potential of QE-based training techniques for improving student nurse and novice RN first attempt success rates in peripheral intravenous cannulation procedures. Moreover, it is expected to provide insightful and practical solutions for this common but challenging healthcare procedure. The implications of this trial for patient care, healthcare costs, and nursing education are substantial, and future research will be needed to expand on our initial findings. Ultimately, the implementation of QE-based PIVC training in

undergraduate nursing programs is expected to better equip future nurses to provide improved quality of care for their patients.

References

Alexandrou, E., Ramjan, L., Murphy, J., Hunt, L., Betihavas, V., & Frost, S. A. (2012). Training of undergraduate clinicians in vascular access: An integrative review. *Journal of the Association for Vascular Access*, *17*(3), 146–158.

Arslan, S., Kuzu Kurban, N., Takmak, S., Sanlialp Zeyrek, A., Oztik, S., & Senol, H. (2022). Effectiveness of simulation-based peripheral intravenous catheterization training for nursing students and hospital nurses: A systematic review and meta-analysis. *Journal of Clinical Nursing*, *31*(5-6), 483–496. https://doi.org/10.1111/jocn.15960

Ashraf, H., Sodergren, M. H., Merali, N., Mylonas, G., Singh, H., & Darzi, A. (2018). Eye-tracking technology in medical education: A systematic review. *Medical teacher*, *40*(1), 62-69.

Ballard, H. A., Hajduk, J., Cheon, E. C., King, M. R., & Barsuk, J. H. (2022). Clinical and demographic factors associated with pediatric difficult intravenous access in the operating room. *Paediatric Anaesthesia*, *32*(7), 792–800. https://doi.org/10.1111/pan.14438

Buyukyilmaz, F., Sendir, M., Kus, B., & Yaman Guclu, H. (2020). The effectiveness of a non tourniquet procedure on peripheral intravenous catheterization in older patients: A pilot study. *Contemporary Nurse: A Journal for the Australian Nursing Profession, 56*(5-6), 405–416. https://doi.org/10.1080/10376178.2020.1801351

Carr, P., Rippey, J., Budgeon, C., Cooke, M., Higgins, N., & Rickard, C. (2016). Insertion of peripheral intravenous cannulae in the emergency department: Factors associated with first attempt success. *The Journal of the Association for Vascular Access, 20*(4), 256–257. https://doi.org/10.5301/jva.5000487

Catarino, F., Lourenço, C., Correia, C., Doria, J., Dixe, M., Santos, C., Sousa, J., Mendonca, S., Cardoso, D., & Costeira, C. (2022). Nursing care in peripheral intravenous catheter (PIVC): Protocol of a best

practice implementation project. *Nursing Reports (Pavia, Italy), 12*(3), 515–519. https://doi.org/10.3390/nursrep12030049

Causer, J., Vickers, J. N., Snelgrove, R., Arsenault, G., & Harvey, A. (2014). Performing under pressure: Quiet eye training improves surgical knot-tying performance. *Surgery*, *156*(5), 1089–1096. https://doi.org/10.1016/j.surg.2014.05.004

Chan, A.-W., Tetzlaff, J. M., Altman, D. G., Laupacis, A., Gøtzsche, P. C., Krleža-Jerić, K., Hróbjartsson, A., Mann, H., Dickersin, K., Berlin, J., Doré, C., Parulekar, W., Summerskill, W., Groves, T., Schulz, K., Sox, H., Rockhold, F. W., Rennie, D., & Moher, D. (2013). SPIRIT 2013 statement: Defining standard protocol items for clinical trials. *Annals of Internal Medicine, 158,* 200-207.

Chan, A.-W., Tetzlaff, J. M., Gøtzsche, P. C., Altman, D. G., Mann, H., Berlin, J., Dickersin, K., Hróbjartsson, A., Schulz, K. F., Parulekar, W. R., Krleža-Jerić, K., Laupacis, A., & Moherj D. (2013). SPIRIT 2013 explanation and elaboration: Guidance for protocols of clinical trials. *BMJ, 346*(7586).

Frey, A. (1998). Success rates for peripheral IV insertion in a children's hospital. Financial implications. *Journal of Intravenous Nursing, 21*(3), 160–165.

Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharpe, E., & Alexander, M. (2021). Infusion therapy standards of practice (8th ed.). *Journal of Infusion Nursing*, *44*(1), 1–224. https://doi.org/10.1097/NAN.0000000000000396

Kang, M., Ragan, B. G., & Park, J. H. (2008). Issues in outcomes research: An overview of randomization techniques for clinical trials. *Journal of Athletic Training, 43*(2), 215–221. https://doi.org/10.4085/1062-6050-43.2.215

Karanicolas, P. J., Farrokhyar, F., & Bhandari, M. (2010) Practical tips for surgical research: Blinding: Who, what, when, why, how? *Canadian Journal of Surgery, 53*(5), 345–348.

Lin, J. Y., & Lu, Y. (2014). Establishing a data monitoring committee for clinical trials. *Shanghai Archives of Psychiatry, 26*(1), 54.

Marsh, N., Webster, J., Larsen, E., Genzel, J., Cooke, M., Mihala, G., Cadigan, S., & Rickard, C. M. (2018). Expert versus generalist inserters for peripheral intravenous catheter insertion: A pilot randomised controlled trial. *Trials*, *19*(1), 564. https://doi.org/10.1186/s13063-018-2946-3

Marsh, N., Webster, J., Ullman, A., Mihala, G., Cooke, M., Chopra, V., & Rickard, C. (2020). Peripheral intravenous catheter non-infectious complications in adults: A systematic review and meta-analysis. *Journal of Advanced Nursing, 76*(12), 3346–3362. https://doi.org/10.1111/jan.14565

Millington, S., Hendin, A., Shiloh, A. L., & Koenig, S. (2020). Better with ultrasound: Peripheral intravenous catheter insertion. *Chest, 157*(2), 369–375. https://doi.org/10.1016/j.chest.2019.04.139

Parker, S. I. A., Benzies, K. M., Hayden, K. A., & Lang, E. S. (2017). Effectiveness of interventions for adult peripheral intravenous catheterization: A systematic review and meta-analysis of randomized controlled trials. *International Emergency Nursing*, *31*, 15–21. https://doi.org/10.1016/j.ienj.2016.05.004

Parker, S. I. A., Simmons, S. M., Rutherford, A., Caird, J. K., & Benzies, K. M. (2021). Novice and expert nurses' eye movements and success with simulated peripheral intravenous catheterization. *Clinical Simulation in Nursing*, *53*, 42–48. https://doi.org/10.1016/j.ecns.2020.12.010

Polit, D. F., & Beck, C. T. (2017). *Nursing research: Generating and assessing evidence for nursing practice* (10th ed.). Lippincott Williams & Wilkins.

Research Randomizer. (2020). Randomizer.org. www.randomizer.org

Rivaz, M., Momennasab, M., Yektatalab, S., & Ebadi, A. (2017). Adequate resources as essential component in the nursing practice environment: A qualitative study. *Journal of Clinical and Diagnostic Research, 11*(6). https://doi.org/10.7860/JCDR/2017/25349.9986

Rodriguez-Calero, M., de Pedro-Gomez, J. E., Molero-Ballester, L. J., Fernandez-Fernandez, I., Matamalas-Massanet, C., Moreno-Mejias, L., Blanco-Mavillard, I., Moya-Suarez, A. B., Personat-Labrador, C., & Morales-Asencio, J. M. (2020). Risk factors for difficult peripheral intravenous cannulation. The PIVV2 multicentre case-control study. *Journal of Clinical Medicine, 9*(3), 799. https://doi.org/10.3390/jcm9030799

Santos-Costa, P., Paiva-Santos, F., Sousa, L. B., Bernardes, R. A., Ventura, F., Fearnley, W. D., Salgueiro-Oliveira, A., Parreira, P., Vieira, M., & Graveto, J. (2022). Nurses' practices in the peripheral intravenous catheterization of adult oncology patients: A mix-method study. *Journal of Personalized Medicine, 12*(2). https://doi.org/10.3390/jpm12020151

Santos, F., Flumignan, R. L. G., Areias, L. L., Sarpe, A. K. P., Amaral, F. C. F., Avila, R. B. de, Vasconcelos, V. T. de, Guedes Neto, H. J., Amorim, J. E. de, & Nakano, L. C. U. (2020). Peripherally inserted central catheter versus central venous catheter for intravenous access: A protocol for systematic review and meta-analysis. *Medicine, 99*(30). https://doi.org/10.1097/MD.0000000000020352

Schuster, C., Stahl, B., Murray, C., Keleekai, N. L., & Glover, K. (2016). Development and testing of a short peripheral intravenous catheter insertion skills checklist. *Journal of the Association for Vascular Access*, *21*(4), 196–204. https://doi.org/10.1016/j.java.2016.08.003

Tobii Pro Lab Analyzer Edition User Manual. Version PDF Free Download. (n.d.). Docplayer.net. Retrieved January 17, 2024, from www.vinis.co.kr/TPL_manual.pdf

Vickers, J. N. (1996). Visual control when aiming at a far target. *Journal of Experimental Psychology. Human Perception and Performance, 22*(2), 342–354. https://doi.org/10.1037/0096-1523.22.2.342

Vickers, J. N. (2007). *Perception, cognition, and decision training: The Quiet Eye in action*. Human Kinetics.

Vickers, J. N. (2016). Origins and current issues in Quiet Eye research. Current Issues in Sport Science, 1:101. https://doi.org/10.15203/CISS_2016.101

Woolley, N. N., & Jarvis, Y. (2007). Situated cognition and cognitive apprenticeship: A model for teaching and learning clinical skills in a technologically rich and authentic learning environment. *Nurse Education Today*, *27*(1), 73–79. https://doi.org/10.1016/j.nedt.2006.02.010

Yalçınlı, S., Akarca, F. K., Can, O., Sener, A., & Akbinar, C. (2019). Factors affecting the first attempt success rate of intravenous cannulation in older people. *Journal of Clinical Nursing, 28*(11–12), 2206–2213. https://doi.org/10.1111/jocn.14816

Zingg, W., Barton, A., Bitmead, J., Eggimann, P., Pujol, M., Simon, A., & Tatzel. J., (2023). Best practice in the use of peripheral venous catheters: A scoping review and expert consensus. *Infection Prevention in Practice, 5*(2), 100271. https://doi.org/10.1016/j.infpip.2023.100271

Zingg, & Pittet, D. (2009). Peripheral venous catheters: An under-evaluated problem. *International Journal of Antimicrobial Agents, 34*, S38–S42. https://doi.org/10.1016/S0924-8579(09)70565-5

Appendix A

Model Informed Consent Form

TITLE: Peripheral Intravenous Cannulation First Attempt Success Trial (PICFAST)

SPONSOR: Faculty of Nursing, University of Calgary

INVESTIGATORS: [List here]

INTRODUCTION

This consent form is only part of the process of informed consent. It should give you a basic idea of what the research is about and what your participation will involve. If you would like more details about something mentioned here, or information not included here, please ask. Take the time to read this carefully and to understand any accompanying information. You will receive a copy of this form for your records. You were identified as a possible participant in this study. Your participation in this research study is voluntary.

WHY IS THIS STUDY BEING DONE?

Peripheral intravenous cannulation (PIVC) is a complex skill commonly taught in nursing education. Peripheral intravenous cannulation first attempt success rates (FASRs) vary widely between novice and expert nurses resulting in patients enduring multiple painful procedures, treatment delays, and increased mortality. There is evidence that expert surgeons and athletes use a specific gaze, the Quiet Eye (QE), which is essential to successful motor performance. However, the link between gaze, skill acquisition, and motor performance has not been examined in nursing practice.

This study aims to investigate the effectiveness of QE training, compared to technical training, on the procedural excellence of undergraduate student nurses learning PIVC. It is expected to identify an effect such that QE training in comparison to traditional technical training will result in increased FASRs in undergraduate student nurses learning PIVC. Secondly, an additional expected effect is such that QE training in comparison to traditional technical training will result in increased PIVC procedural

performance.

HOW MANY PEOPLE WILL TAKE PART IN THIS STUDY?

About 44 people will take part in this study through the University of Calgary.

WHAT WILL HAPPEN IF I TAKE PART IN THIS STUDY?

Each participant will complete a survey to gather demographic data including prior experience with IV cannulation or phlebotomy attempts. Gaze data will be collected using the Tobii Pro eye tracker (Tobii Technology, Danderyd, Sweden) that records gaze and motor movements using small camera lenses that are mounted into the glasses. Participants will wear glasses weighing 45 gram and attached to a pocket-sized recording unit that saves data on a SD (Secure Digital) card throughout the procedure. Each participant will attempt three PIVCs using a mannikin intravenous training arm (Laerdal Medical, product number 270-00001). The entire training phase will be repeated once per week over a four-week period. Standard PIVC equipment, including gloves, will be available for each participant. Eye tracker fitting and calibration will be completed for each participant before starting the trial.

WHERE WILL THIS STUDY TAKE PLACE?

This study will be conducted at the Faculty of Nursing Clinical Simulation Learning Center, at the University of Calgary. Participants will be recruited at the University of Calgary from the Faculty of Nursing Undergraduate Degree.

HOW LONG WILL I BE IN THIS STUDY?

It is expected each session, during which the participant will attempt PIVCs on the training arm, will take about 60 minutes. The entire training phase will be repeated once per week over a four-week period.

ARE THERE ANY POTENTIAL RISKS OR DISCOMFORTS I CAN EXPECT FROM THIS STUDY?

It is possible participants may experience fatigue or accidental needle puncture during the PIVC attempts.

ARE THERE ANY POTENTIAL BENEFITS IF I PARTICIPATE?

If you agree to participate in this study, there may or may not be a direct benefit to you. Your ability to insert an IV catheter on the first attempt may be improved during the study, but there is no guarantee that this research will help you. The information we get from this study may help us to provide better education in the future for student nurses.

WHAT OTHER CHOICES DO I HAVE IF I CHOOSE NOT TO PARTICIPATE?

You are free to choose not to participate in the study. If you decide not to take part in this study, there will be no penalty to you. Your decision will not affect the standard medical care you receive or your education or employment.

CAN I STOP BEING IN THE STUDY?

Participation in this study is voluntary and you may withdraw from the study at any time until data analysis is complete, by contacting the investigator or research assistant. You may request your data be withdrawn prior to data analysis. Although data may be withdrawn from the study analyses, the raw data must be kept for at least five years after the study ends.

WILL I BE PAID FOR PARTICIPATING, OR DO I HAVE TO PAY FOR ANYTHING?

[If applicable, list remuneration here.]

WILL INFORMATION ABOUT ME AND MY PARTICIPATION BE KEPT CONFIDENTIAL?

The researchers will do their best to make sure that your private information is kept confidential. Information about you will be handled as confidentially as possible, but there is always the potential for an unintended breach of privacy. The research team will handle data according to the Data Management Plan as outlined below: appointments will be arranged, conducted in a private space, recorded, and de-identified by a research assistant.

Only the principal investigator, co-investigators, and research assistants will have access to the data. Identifiers, such as names, units, and hospitals, will be removed where necessary to ensure that

anonymity of participants is protected. The primary investigator and co-investigators will not have access to or knowledge of the participants' identifying information, to protect privacy and confidentiality.

All identifiable information about you will be replaced with a code. A master list linking the code and your identifiable information will be kept separate from the research data. The master list will be kept in a locked filing cabinet in the office of the principal investigator (PI). All electronic research data will initially be stored on a password protected computer and will be transferred to a secure network with password protection. All research data and records will be maintained in a secure location at the University of Calgary. Only authorized individuals will have access to it.

HOW LONG WILL INFORMATION FROM THE STUDY BE KEPT?

The researchers intend to keep the de-identified research data indefinitely for future research.

Data collected for this study may be shared with other researchers for future studies that are unknown. Any data shared with other researchers will not include your name or other personal identifying information. Any future use of this research data must be reviewed by a research ethics board.

USE OF DATA FOR FUTURE RESEARCH

It is your choice to let researchers share your data for research in the future. If you agree, you can change your mind later, but your data may still be used if they have already been shared. My de-identified research data may be kept for use in future research to learn about, prevent, or treat other health-related problems. (YES / NO)

CONTACT FOR FUTURE RESEARCH

University of Calgary researchers may contact me in the future to ask me to take part in other research studies. (YES / NO)

IF I SUFFER A RESEARCH-RELATED INJURY, WILL I BE COMPENSATED?

It is important that you tell the researchers if you believe that you have been injured because of taking part in this study. In the event that you suffer injury as a result of participating in this research, no

compensation will be provided to you by the Faculty of Nursing, the University of Calgary, or the Researchers. You still have all your legal rights. Nothing said in this consent form alters your right to seek damages.

WHOM MAY I CONTACT IF I HAVE QUESTIONS ABOUT THIS STUDY?

The Research Team: [List here].

Conjoint Health Research Ethics Board (CHREB): If you have any questions concerning your rights as a possible participant in this research, please contact the Chair, Conjoint Health Research Ethics Board, University of Calgary at 403-220-7990.

HOW CAN I FIND OUT ABOUT THE STUDY RESULTS?

[List contact here].

WHAT ARE MY RIGHTS IF I TAKE PART IN THIS STUDY?

Taking part in this study is your choice. You can choose if you want to participate. Whatever decision you make, there will be no penalty for you. You have a right to have all your questions answered before deciding whether to take part. Your decision will not affect the standard medical care you receive or your education or employment. If you decide to take part, you may leave the study at any time.

HOW DO I INDICATE MY AGREEMENT TO PARTICIPATE?

Your signature on this form indicates that you understoodto your satisfaction the information regarding your participation in the research project and agree to take part in the study. In no way does this waive your legal rights nor release the investigators or involved institutions from their legal and professional responsibilities.

SIGNATURE OF STUDY PARTICIPANT

_____

Name of Participant

_____ _____

Signature of Participant Date

SIGNATURE OF PERSON OBTAINING CONSENT

_____ _____

Name of Person Obtaining Consent Contact Number

_____ _____

Signature of Person Obtaining Consent Date

SIGNATURE OF THE WITNESS

_____

Name of Witness

_____ _____

Signature of Witness Date

A signed copy of this consent form has been given to you to keep for your records and reference.

Appendix B

Participant Schedule

Stage	Quiet Eye (QE) training		Technical training (TT)
Pre-intervention test	Complete three trials		
Training phase	1.	Viewed standardized instruction about the task	
	2.	Provided with Quiet Eye instruction based on previous literature	Provided with technical instruction based normal training
	3.	Viewed video of an expert model (with eye movements) during procedure	Viewed video of an expert model (without eye movements) during procedure
	4.	Viewed a video of themselves (with eye movements) from the pre-intervention test to compare with the expert model	Viewed a video of themselves (without eye movements) from the pre-intervention test to compare with the expert model
	5.	Three practice PIVC attempts	
	Repeat Steps 1-5 over 4-week period (Videos in Step 4 updated after each training phase)		
Post-intervention test	Complete three trials		
1-week retention test	Complete three trials		
Transfer	Collect performance data from PIVC attempts on dark-skinned manikin arm		

Note. Experimental procedure timeline for both the QE and TT groups.
PIVC = peripheral intravenous cannulation.