# Using the Difficult Intravenous Access Score to Reduce Peripheral Intravenous Cannula Attempts

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## Abstract

**Problem:** Critically ill ICU patients frequently experience unsuccessful peripheral intravenous catheter (PIVC) placement attempts, resulting in pain, complications, and delays in care. An analysis of Electronic Health Record (EHR) data from 37 adult ICU patients between 2/12/24 and 2/26/24 showed an average of 2.62 PIVC placement attempts per patient by unit staff. Failed attempts waste nursing time, increase costs, and deplete viable veins. Despite these challenges, no standardized tool is used to identify patients at high risk for difficult IV access. **Methods:** This quality improvement project was conducted in a 24-bed surgical intensive care unit (SICU) in a large urban academic medical center. The aim was to reduce unsuccessful PIVC attempts by implementing the DIVA tool. The process goal was to ensure 100% of eligible patients had a documented DIVA score in the EHR, while the outcome goal was a 100% reduction in patients requiring more than two PIVC attempts. A QR code in patient rooms allowed nurses to complete the DIVA survey before the first PIVC attempt, with documentation shared during handoff. **Results:** Over 15 weeks, 332 ICU patients were assessed, and 283 (84%) required a PIVC. The outcome goal was met, with a 100% reduction in patients requiring more than two PIVC attempts. However, the process goal was not met, as only 37% of patients who received a PIVC had a documented DIVA score. **Conclusion:** A key facilitator in reducing PIVC attempts was the increased use of ultrasound-guided PIVC placement, with over 65% of SICU nurses trained in ultrasound use, leading to many bypassing the DIVA tool. The addition of a high-definition ultrasound further supported success. The DIVA score contributed to fewer PIVC attempts and was simple and quick to use.

*Keywords:* catheterization, peripheral, difficulties

# Using the Difficult Intravenous Access (DIVA) Score to Reduce PIVC Insertion Attempts

## Problem

Critically ill patients often required multiple peripheral intravenous cannulas (PIVCs) and lab draws during their stay. In an Intensive Care Unit at a large, urban, academic hospital, there had been an increase in the number of unsuccessful attempts at PIVC placement, resulting in additional pain and complications for patients. Electronic Health Record (EHR) data from 37 adult ICU patients between 2/12/24 and 2/26/24 showed an average of 2.62 attempts per PIVC placed by unit staff. This number was likely underestimated, as nurses may not have documented all placement attempts—particularly when multiple nurses paused or rotated due to challenges with insertion. Although many ICU patients experienced difficulty with PIV access, no tool had been used to identify patients at greatest risk.

Repeated PIVC placement attempts may cause delays, such as late medication administration (Morrell, 2020), and incur costs from wasted nursing time and supplies (Steere et al., 2019). Additionally, frequent attempts damage veins, ultimately depleting viable sites for venipuncture (Rodriguez-Calero et al., 2023). The rising number of PIVC attempts has been linked to chronic conditions in ICU patients—many of whom present with edema, poor vasculature, or fragile skin (Rodriguez-Calero et al., 2023)—as well as high staff turnover, excessive lab draws, and limited access to ultrasound-guided PIV training. The DIVA tool addressed the root issue by identifying patients with difficult IV access (see Figure 1 for Root Cause Analysis Diagram).

**Available Knowledge**

Prior to implementation, a comprehensive literature search was performed through the University of Maryland's HS/HSL database using the keywords "catheterization, peripheral" and "difficulties," resulting in 462 articles that were narrowed down to 7 relevant studies (see Figure 2 for Prisma Diagram). All supporting evidence for the proposed change was rated level II-III, with A or B ratings per the Johns Hopkins Evidence-Based Practice Model (see Tables 1 and 2 for Evidence Review and Synthesis Tables).

One notable study, Operation STICK (OSTICK) by Bahl et al. (2024), found that utilizing the DIVA questionnaire in conjunction with targeted education significantly increased first-attempt PIVC success rates and improved PIVC longevity. OSTICK PIVCs remained functional for a median of 92% of the patient's hospital stay, compared to 74% for non-OSTICK PIVCs ($p < 0.001$). Other studies by van Loon et al. (2019), Civetta et al. (2019), Sallaras-Duran et al. (2020), and Rodriguez-Calero et al. (2020) identified DIVA risk factors and created scoring tools to improve the assessment of PIVC attempts. Additionally, Paterson et al. (2022) and Carr et al. (2017) evaluated various DIVA tools, primarily used in Emergency Department settings before 2017.

The evidence review indicated strong and consistent findings to support a practice change. Most studies were prospective observational designs that identified factors contributing to failed PIVC placement and tested the reliability of these assessment tools across diverse patient populations.

### Specific Aims

By introduction of the DIVA scale, a validated tool for identifying patients at risk of difficult intravenous access (van Loon et al., 2019), reductions in the number of PIVC attempts could be made by identifying difficult access patients. This DNP quality improvement project aimed for a 100% reduction in patients requiring more than two PIVC attempts and targeted universal DIVA scoring for all eligible patients.

### Rationale

The Promoting Action on Research Implementation in Health Services (PARIHS) framework included three elements: evidence (stakeholder knowledge sources), context (environmental quality), and facilitation (behavioral change techniques). In this QI project, evidence consisted of Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores and the average number of PIVC insertion attempts. The ICU's strong leadership and experienced staff provided a supportive context, while facilitation was enhanced through access to ultrasound technology and USG-PIVC training, which encouraged compliance with the intervention. See Figure 3 for details on the PARIHS framework.

## Methods

### Context

The Organizational Culture Assessment Questionnaire (OCAQ) was conducted to evaluate readiness for change in the ICU, yielding a score of 78%, which indicated a high level of functionality in aligning with the organization's values. The OCAQ assessed five domains: managing change, achieving goals, coordinated teamwork, customer orientation, and cultural strength.

In "Managing Change," the ICU scored 25/30, reflecting staff flexibility and confidence that their concerns were considered during transitions. The unit achieved 24/30 in "Achieving Goals," indicating strong alignment with the organization's mission through clearly defined objectives. The score for "Coordinated Teamwork" was 23/30, highlighting the nursing staff's emphasis on collaboration. The unit also scored 23/30 in "Customer Orientation" and an impressive 29/30 in "Cultural Strength."

Overall, the OCAQ results signified that organization members believed they could influence their environment and were therefore willing to invest in a change that would have a positive impact, such as reducing patient pain and complications from failed PIVC attempts. See Figures 4 and 5 for pre-implementation and post-implementation process maps.

**Intervention**

The structure goals for this initiative were as follows: to develop a policy for PIVC escalation by June 8th, 2024, and to develop materials for a PIVC workshop with the ICU RN Educator for new RN graduates by July 1, 2024. The main process goal w to develop documentation process for DIVA tool by July 8th, 2024 (see Appendix A for the Gantt Chart).

This initiative aimed for a 100% reduction in patients requiring more than two PIVC attempts and targeted universal DIVA scoring for all eligible patients by December 1, 2024 .The project lead introduced the DIVA tool as a QR code survey accessible in every patient's room, enabling RNs to assess PIVC difficulty before each placement.

Before the implementation phase, efforts to secure buy-in for the initiative began with discussions during morning huddles about the need to reduce peripheral intravenous catheter (PIVC) attempts. Additionally, eight educational sessions were conducted on-site to inform staff about the risks of patient injury associated with failed access attempts, the DIVA score tool, and

the importance of documenting all PIVC attempts in the EHR. Attendance at these educational sessions was tracked through staff signatures. Out of a total of 72 registered nurses (RNs) and 9 patient care technicians (PCTs), 58 signatures were collected, indicating that 73% of the staff received training on the DIVA tool.

**Measures**

The main outcome goal was decreased attempts per PIVC. This was calculated by the number of all attempts by staff to place a PIVC divided by the number of PIVCs placed. Second, the process goal of eligible patients who obtain a DIVA score, was measured by the number of all ICU patients who received a PIVC placed in the ICU, divided by the number of RNs who filled out a DIVA score survey. All patients admitted to the ICU who required peripheral access were eligible for this intervention. Patients who had clinical limb restrictions will have eligibility based on available upper limbs. The DIVA tool was not intended for external jugular veins or lower extremities.

To ensure intervention equity, computer monitors in patient rooms had a card containing a QR code with the label “DIVA tool, use before the first time you stick” and was to be completed by the bedside RN prior to obtaining the first PIVC. The score was documented in the Charge Nurse handoff for each patient, which allowed staff to see that the assessment had already been completed. This ensured that if the patient required another PIVC, staff did not need to repeat the survey. The DIVA score only needed to be completed prior to obtaining the first PIVC (see Appendix B for the DIVA measurement tool). Verbal reminders to complete the survey before placing PIVCs were at shift change huddles and monthly meetings held by senior clinical nurses. Compliance checks were maintained every week via EHR monitoring and using

the secure web-based application called Research Electronic Data Capture (REDCap) by the project lead.

**Analysis**

All data was expressed in frequencies, percentages and means and medians. The primary outcome metric was calculated weekly and tracked over 15 weeks using a run chart to identify shifts, trends, or cycles in performance (See Figure 8). Statistical control processes were applied to detect special cause variation and determine whether observed changes were attributable to the intervention rather than to normal process fluctuations.

For the process goal, completion of the DIVA tool prior to initial PIVC attempt, the proportion of eligible ICU patients with documented DIVA scores was calculated weekly (See Figure 6). The patients who received PIVCs were extracted from the electronic health record (EHR) bench reports and compliance was tracked by the PL looking at the date the PIVC was placed, the room and correlating this to the REDCap report.

In addition, for qualitative data, informal feedback was collected from frontline RNs during staff meetings and shift huddles to understand barriers and facilitators to DIVA tool use. This provided insight into the perceived value of the intervention.

**Ethical Considerations**

The only conflict of interest arises from the project lead's employment in the unit. As a quality improvement project, informed consent from patients is not required (U.S. Department of Health and Human Services [HHS], 2023). The data was accessed in a secure, restricted-access room within the hospital unit to ensure confidentiality and privacy. To protect participant privacy and data, information will be captured and stored in REDCap. Prior to implementation, a Non-

Human Subject Research determination was obtained from the Human Research Protections Office (HPRO) of the UMSOM Institutional Review Board (IRB).

## Results

The process measure for this project was to ensure that every patient receiving a Peripheral Intravenous Catheter (PIVC) would be assigned a Difficult Intravenous Access (DIVA) score. Over the implementation period, a total of 332 patients were admitted to the ICU, and 283 of these patients (84%) received a PIVC on the unit. However, only 37% of those patients had a documented DIVA score prior to catheter placement. According to the run chart, no shifts or trends were identified; five runs were observed, which is acceptable for 15 data points and does not indicate special cause variation. See Figure 6 for the DIVA Utility Score run chart.

Week 1, which was the designated "kick off" week, had 8 educational sessions for the staff, which featured pizza, a PIVC placement bootcamp and small incentives that appeared to increase engagement with the tool. This correlates with the highest compliance of 76 %. In weeks 2 and 3, compliance with the tool decreased (28% and 45%, respectively) possibly because there was a lower census and decreased patient turnover, meaning that many patients already had a PIVC in place with an existing DIVA score, contributing to reduced documentation activity during those periods. The nadir in week 12 of 8% was countered with an article in the Surgical ICU newsletter and reminders during the morning huddles. Utilization of the DIVA score increased again in week 13, corresponding to these progress updates.

For the outcome measure, the goal of maintaining an average of fewer than two attempts per PIVC placement was achieved 100% of the time. A total of 4 runs, with no shifts, trends or runs was identified, as seen in Figure 8. In week 3, a patient requiring 9 PIVC attempts increased the mean, however, all weeks had an average of less than 2 attempts per PIVC.

The median and mean DIVA scores were 2.06 and 2.21, indicating that most participants would use an ultrasound machine to proceed with PIVC insertion as they scored over 2 on the DIVA tool.

## Discussion

To better understand the results, it is helpful to compare them to the existing body of literature on DIVA tool implementation and analyze the contextual factors that may influence utilization on this unit. Most experimental studies involving the DIVA score focus on validating risk factors and measuring the number of PIVC attempts, with minimal emphasis on tool utilization. Additionally, these studies are often conducted in emergency departments or medical-surgical settings, rather than in ICUs. However, a recent quality improvement project conducted in another ICU within the same hospital reports a similar utilization rate of 31.7% among RN users (Hernandez, 2024), suggesting that adoption barriers may be setting-specific.

Despite low overall utilization, the outcome measure of maintaining an average of fewer than two attempts per PIVC placement is achieved 100% of the time. This finding aligns with existing literature from Bahl et al. (2024), van Loon et al. (2019), Civetta et al. (2019), Sallaras-Duran et al. (2020), and Rodriguez-Calero et al. (2020), which demonstrates the DIVA tool's effectiveness in reducing the number of insertion attempts when used in combination with education and targeted intervention.

Several key barriers likely contributed to the lower-than-expected DIVA tool utilization rate on this unit. First, the unit acquires a high-resolution ultrasound (US) machine shortly before implementation. Although this technology facilitates the achievement of the outcome goal, which is fewer than two PIVC attempts—it may inadvertently discourage initial DIVA scoring, as nurses increasingly default to asking a colleague to place the PIVC under US guidance rather

than attempting traditional insertion. Second, over 65% of ICU nurses are already US-trained, and many likely bypass the DIVA scoring step altogether, relying instead on their well-developed "gut feeling".

A notable limitation of the project is the use of self-reported data to track attempts per PIVC, leading to the exclusion of 31 PIVCs that were not recorded in the electronic health record (EHR). To mitigate this loss, real-time reminders are sent via TigerConnect by the project lead to encourage proper documentation. Another limitation is that some RNs did not enter the DIVA score into the Charge RN Update section of the EHR, which limits visibility and communication of the patient's vascular access needs to other staff members. An additional source of measurement bias may stem from RNs potentially underreporting the actual number of PIVC attempts in their documentation.

A strength of the project is the simplicity and efficiency of the DIVA scoring tool (see Appendix B), with several RNs reporting that it required only a few minutes to complete and is easy to integrate into their workflow. Another notable strength is the engagement of DIVA champions and leadership on the unit, who consistently reinforced use of the tool, provided peer support, and helped normalize DIVA scoring as part of routine vascular access assessment. By reducing the number of failed attempts, the DIVA tool decreases nursing time and the incidence of phlebitis, infiltration, or infections, which can lead to longer hospital stays and increased treatment costs.

For future implementation, integrating the DIVA score into new graduate nurse orientation and competency pathways may promote more consistent use by emphasizing its role in clinical judgment prior to ultrasound-guided placement. Embedding this step early in training could help establish it as a routine part of practice. Implementation of the DIVA tool may be

more impactful in units where ultrasound access is limited, as immediate availability of this technology may inadvertently reduce reliance on preliminary risk stratification. It could be used in settings where US and US-trained staff are unavailable, and the DIVA tool used as a step before escalating to outside assistance with placing PIVCs.

The PARIHS Framework for Implementation also serves as an instrumental guide in this process by addressing the complex interplay between evidence (validity of the DIVA tool), context (unit readiness and unit leadership), and facilitation (unit ultrasound and collective nursing staff experience). These components work synergistically to influence both the uptake and sustainability of the intervention.

**Conclusion**

This DNP quality improvement project demonstrated the usefulness of the DIVA score in reducing PIVC insertion attempts and achieving the outcome goal of fewer than two attempts per PIVC. The tool provided a structured, evidence-based method to identify patients likely to experience difficult IV access, supporting more efficient and patient-centered care.

Embedding DIVA scoring into nurse orientation may further enhance adoption and long-term integration into ICU culture. Given its simplicity, evidence base, and adaptability, the DIVA score holds promise for broader application across other high-acuity settings where vascular access is frequently challenging. These may include emergency departments, oncology units, and surgical step-down units. The process measure revealed variability in DIVA score utilization, highlighting the need for contextual awareness and ongoing staff engagement to support consistent practice change. These findings suggest the importance of implementation strategies that consider unit culture and workflow.

Next steps include formalizing the inclusion of the DIVA score in electronic

documentation and expanding ultrasound-guided PIVC training to align with DIVA score risk levels. Aligning implementation with frameworks such as PARIHS can guide effective facilitation and context-sensitive rollout to ensure success across different units.

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van Loon, Fredericus H. J., van Hooff, Loes W. E., de Boer, Hans D., Koopman, Seppe S. H. A., Buise, Marc P., Korsten, Hendrikus H. M., Dierick-van Daele, Angelique T. M. &

Bouwman, Arthur R. A. (2019). The Modified A-DIVA Scale as a Predictive Tool for Prospective Identification of Adult Patients at Risk of a Difficult Intravenous Access: A Multicenter Validation Study. *Journal of Clinical Medicine, 8*(2), 144.

**Table 1.**

*Evidence Review Tables*

| **Citation #1:** van Loon, Fredericus H. J., van Hooff, Loes W. E., de Boer, Hans D., Koopman, Seppe S. H. A., Buise, Marc P., Korsten, Hendrikus H. M., Dierick-van Daele, Angelique T. M. & Bouwman, Arthur R. A. (2019). The Modified A-DIVA Scale as a Predictive Tool for Prospective Identification of Adult Patients at Risk of a Difficult Intravenous Access: A Multicenter Validation Study. *Journal of Clinical Medicine, 8*(2), 144. https://doi.org/10.3390/jcm8020144 | | | | | **Level and Quality:** III-A |
|---|---|---|---|---|---|
| **Purpose or Hypothesis** | **Type of Evidence and Research Design** | **Sample (population, size, setting)** | **Intervention Procedures** | **Primary Outcomes/Measures** | **Results** |
| This trial aimed to determine variables that would accurately predict the number of attempts a patient would need for IV placement, or if an ultrasound would be required. | Multi-site, prospective, non-blinded, observational study | **Setting:** Inpatient hospital<br>**Sampling;** convenience<br>**Inclusion:** 3587 participants were recruited from five different hospitals in the Netherlands, all from ED, perioperative, and L& D departments. All participants had to give verbal and written consent to be included and had to have stable hemodynamic conditions and be older than 18.<br>**Exclusion**: Hemodynamic instability, pressor and inotropic infusion indications<br>**Power analysis:** Sample size calculation was based on the first-attempt failure rate of 17%, as based on a previous study by van Loon et al., (2016).<br>**Achieved:** yes<br>**Control (to make DIVA scale):** 1255 participants<br>**Intervention**: 2332 participants | **Intervention Protocol:** Use of the 5 variable DIVA scale to place patients in low-, moderate- and high-risk DIVA categories.<br><br>Then patients were tested in their categories to see how many PIV attempts would result successfully in a PIV. | **DV:** Defined as failed peripheral intravenous cannulation on the first attempt. Intravenous cannulation was considered successful if the practitioner was able to inject a saline flush without signs of infiltration.<br>**DV measure:** One attempt was determined as a percutaneous needle puncture, regardless of the amount of subcutaneous exploration from the single puncture site, as observed by another study-trained practitioner.<br>**Treatment fidelity:** Observers and PIV-inserters were trained in study protocol and had at least one year of placing PIVs on a daily basis. | **Statistical results:** A practitioner's expectation of difficult intravenous access before PIV placement correlated with the outcome of a failed first attempt upon intravenous cannulation (Spearman's Rho correlation coefficient $\rho = 0.68$, $p < 0.001$). A difficult intravenous access was expected in 711 participants (20%), of which 483 participants (68%) had a failed first attempt ($\chi 2 = 1591.75$, $df = 1$, $p < 0.001$).<br>**Conclusions:** The DIVA scale is reliable and consistent tool to determine the possibility of difficult access for a patient. |

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| **Citation #2:** Civetta, G., Cortesi, S., Mancardi, M., De Pirro, A., Vischio, M., Mazzocchi, M., Scudeller, L., Bottazzi, A., Iotti, G. A., & Palo, A. (2019). EA-DIVA score (Enhanced Adult DIVA score): A new scale to predict difficult preoperative venous cannulation in adult surgical patients. *The Journal of Vascular Access, 20*(3), 281–289. https://doi-org.proxy-hs.researchport.umd.edu/10.1177/1129729818804994 | | | | | **Level:** III-A |
| **Purpose or Hypothesis** | **Type of Evidence and Research Design** | **Sample (population, size, setting)** | **Intervention Procedures** | **Primary Outcomes/Measures** | **Results** |
| The purpose of this trial was the identification of parameters that could detect peripheral difficult intravenous access. | Single site, prospective observational study design | **Setting:** OR department in a 1200-bed hospital in Pavia, Italy<br>**Sampling:** Consecutive and Convenient<br>**Inclusion:** Patients with stable hemodynamic status, mentally competent, and without altered mental status, able to consent, and over the age of 18, a total of 1006.<br>**Exclusion:** younger than 18, requiring pressor infusions, or already had PIV.<br>**Power analysis:** 1000 patients were required, based on AUC-ROC of the multivariate logistic model of 0.95 (vs an alternative model with AUC-ROC 0.85), approximately 15% of patients with difficult venous access, 99% power, 5% alpha error.<br>**Achieved:** yes | **Intervention Protocol:** A triage nurse evaluated patients before venous puncture, applying a tourniquet to both arms and administering the A-DICAVE and numeric rating scales (both arms were evaluated because difficulty may exist in only 1 arm in some people). The triage nurse recorded this data, informed the patient about the study, and asked for their written informed consent. Patients were taken to an examination room for venous puncture by the | **DV:** Defined as cases in which more than three attempts were necessary to obtain successful, stable PIV access using short peripheral cannulas.<br>**DV measure:** An attempt was defined as any instance in which the needle was inserted through the skin, and was defined as "successful" when a short peripheral cannula was inserted and a saline flush could be infused without signs of subcutaneous injection, as observed by another trained observer included in the study.<br>**Treatment fidelity:** Nurses in the study had at least one year of experience routinely | **Statistical Results:** . Sensitivity (85.5%) and specificity (89.2%) in detecting difficult peripheral intravenous access, with a positive predictive value of 56% and a negative predictive value of 97.5%<br>**Conclusions:** The EA-DIVA tool is recommended to determine which patients need advanced techniques (i.e. ultrasound) to get IV access. |

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| | | | nurse in charge, who afterward recorded the number of attempts. | placing IVs and were trained in study protocol. | |

| **Citation #3:** Salleras-Duran, L., Fuentes-Pumarola, C., Ballester-Ferrando, D., Congost-Devesa, L., Delclós-Rabassa, J., & Fontova-Almató, A. (2020). Development, Diagnostic Sensitivity, and Prognostic Accuracy of the Adult–Difficult Venous Catheterization Scale for Emergency Departments. *Journal of Emergency Nursing, 46*(6), 827–837. https://doi-org.proxy-hs.researchport.umd.edu/10.1016/j.jen.2020.06.013 | | | | | **Level:** III-A |
|---|---|---|---|---|---|
| **Purpose or Hypothesis** | **Type of Evidence and Research Design** | **Sample (population, size, setting)** | **Intervention Procedures** | **Primary Outcomes/Measures** | **Results** |
| The purpose of this trial was to determine if the A-DICAVE tool would accurately determine the difficulty of intravenous access in ED patients. | Single, site, prospective observational study design | **Setting:** Level I community hospital<br>**Sampling:** Consecutive and Convenient<br>**Inclusion:** Patients with stable hemodynamic status, mentally competent, and without altered mental status, able to consent, and over the age of 18<br>**Exclusion:** younger than 18, requiring pressor infusions.<br>**Power analysis:** Considering a 25% rate of DVA among the study participants, 303 participants were needed to take into account a 5% attrition rate.<br>**Achieved:** yes | **Intervention Protocol:** A triage nurse evaluated patients before venous puncture, applying a tourniquet to both arms and administering the A-DICAVE and numeric rating scales (both arms were evaluated because difficulty may exist in only 1 arm in some people). The triage nurse recorded this data, informed the patient about the study, and asked for their written informed consent. Patients were taken to an examination room for venous puncture by the nurse in charge, who | **DV:** The number of attempts by the nurse to insert a PIV.<br>**DV measure:** One attempt was determined by a single needle puncture, as observed by another trained observer included in the study.<br>**Treatment fidelity:** Nurses in the study had at least one year of experience routinely placing IVs and were trained in study protocol. | **Statistical Results:** the concurrent and predictive validity scores pointed to relationships with the numeric scale($r = 0.82$; $P < 0.001$) and the number of access attempts ($r = 0.5$; $P < 0.001$), respectively. Sensitivity and specificity values for the Adult–Difficult Venous Catheterization scale were good, at 93.75% and 78.99%, respectively, as were internal consistency (Cronbach alpha 0.81) and interobserver reliability (Cohen kappa 0.75)<br>**Conclusions:** The DIVA scale is a consistent and |

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| | | | afterward recorded the number of attempts. | | reliable tool to determine a patient's risk for difficult intravenous access. |

| **Citation #4:** Rodriguez-Calero, M. A., 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.proxy-hs.researchport.umd.edu/10.3390/jcm9030799 | | | | | **Level:** III-B |
|---|---|---|---|---|---|
| **Purpose or Hypothesis** | **Type of Evidence and Research Design** | **Sample (population, size, setting)** | **Intervention Procedures** | **Primary Outcomes/Measures** | **Results** |
| This study aims to consider DIVA risk factors to the ability to place PIVs in patients. | Multi-site, blinded prospective observational study design | **Setting:** Inpatient, 48 units of eight public hospitals in Spain<br>**Sampling:** Consecutive and Convenient<br>**Inclusion:** Patients with stable hemodynamic status, mentally competent, and without altered mental status, able to consent, and over the age of 18<br>**Exclusion:** younger than 18, requiring pressor infusions, life-threatening situations and pregnant women in labor.<br>**Power analysis:** A minimum sample size of 2070 patients would be required, with at least 207 patients in the case group, based o an alpha risk of 0.05 and a beta risk of 0.2. There was a final sample of 2662 patients, | **Intervention Protocol:** RNs would chart various DIVA risk factors and then proceed to attempt to place PIVs. Patients who required more than 2 attempts would be analyzed for various risk factors by bivariate logistic regression analysis. | **DV:** Two or more failed punctures; the need for auxiliary techniques (ultrasound, infrared, or transillumination) when accessible vessels could not be identified; the need for central access after failure to achieve peripheral access or the decision not to implement it.<br>**DV measure:** As observed by another trained observer included in the study.<br>**Treatment fidelity:** Nurses had to have at least one year of PIV-placement experience, were trained in the study, and were blinded to the over-arching goals of the study. | **Statistical Results:** Patients with a previous history of DIVA presented the highest OR in our sample (OR 4.92, 95% CI 3.17 to 7.63) for requiring auxiliary techniques.<br>**Conclusions:** This study concludes that four independent risk factors can be incorporated into algorithms to identify DIVA. Furthermore, it would be useful to record this variable in the patient's chart history as an alert indicator. |

| | | | | | |
|---|---|---|---|---|---|
| | | **Achieved:** yes | | | |

| **Citation #5:** Bahl, A., Mielke, N., Xing, Y., DiLoreto, E., Zimmerman, T., & S. Matthew Gibson. (2024). A standardized educational program to improve peripheral vascular access outcomes in the emergency department: A quasi-experimental pre-post trial. *The Journal of Vascular Access, 2024;0*(0). https://journals-sagepub-com.proxyhs.researchport.umd.edu/doi/full/10.1177/11297298231219776 | | | | | **Level:** II-B |
|---|---|---|---|---|---|
| **Purpose or Hypothesis** | **Type of Evidence and Research Design** | **Sample (population, size, setting)** | **Intervention Procedures** | **Primary Outcomes/Measures** | **Results** |
| The aim was to demonstrate the success of a program (Operation (O) STICK) on improving vascular access outcomes in DIVA patients. | Quasi-experimental pre-post interventional study | **Setting:** large suburban academic tertiary care center with 1100 patient beds and the ED has an annual census of more than 120,000 visits and 160 treatment beds in southeastern Michigan<br>**Sampling:** Consecutive and Convenient<br>**Inclusion:** Patients who are mentally competent, able to consent, and over the age of 18, who required inpatient admission<br>**Exclusion:** younger than 18 and mental competence to sign consent<br>**Power analysis:** The achieved statistical power was calculated to be 0.95 with a significance level of 0.05 given the sample size, but no numbers were given. 1343 patients required inpatient admission, of which 654 (48.7%) were OSTICK (post-intervention) | **Intervention Protocol:** OSTICK is a formalized, comprehensive vascular access training program which includes the use of VAS (Vein Assessment Score) to judge if patient requires an ultrasound placed PIV. The program consists of a video didactic series, in-person workshop with simulation, and precepted bedside training. | **DV:** PIVC functionality, secondary outcomes included first stick success, number of attempts, inserter credentials, and adherence to best insertion practices.<br>**DV measure:** As observed by another trained observer included in the study.<br>**Treatment fidelity:** Nurses had to have at least one year of PIV placement experience, were trained in the study, and were blinded to the over-arching goals of the study. | **Statistical Results:** Among OSTICK-specific variables, 84.6% of PIVCS were placed on the first attempt, with 94.8% of PIVCs successfully placed within two attempts. VAS was most commonly 5 (76.8%) followed by 4 (14.3%) and 3 (8.9%)<br>**Conclusions:** The implementation of Operation OSTICK, a formalized ED-based vascular access program, has substantially improved outcomes for DIVA patients. This program includes VAS in an escalation pathway for auxiliary techniques. |

| | | | | | |
|---|---|---|---|---|---|
| | | and 689 (51.3%) were non-OSTICK (pre-intervention).<br>**Achieved:** N/A | | | |

| **Citation #6:** Paterson, R. S., Schults, J. A., Slaughter, E., Cooke, M., Ullman, A., Kleidon, T. M., Keijzers, G., Marsh, N., & Rickard, C. M. (2022). Review article: Peripheral intravenous catheter insertion in adult patients with difficult intravenous access: A systematic review of assessment instruments, clinical practice guidelines, and escalation pathways. *Emergency Medicine Australasia : EMA*, *34*(6), 862–870. https://doi-org.proxy-hs.researchport.umd.edu/10.1111/1742-6723.14069 | | | | | **Level:** III-B |
|---|---|---|---|---|---|
| **Purpose or Hypothesis** | **Type of Evidence and Research Design** | **Sample (population, size, setting)** | **Intervention Procedures** | **Primary Outcomes/Measures** | **Results** |
| The objectives of this review are to identify and evaluate the quality of assessment tools for identifying adult patients with DIVA and CPGs or escalation pathways for managing adult patients with DIVA who require a PIVC. | Systematic review of assessment instruments, CPGs and escalation pathways | **Sampling:** The databases Cochrane Central Register of Controlled Trials (CENTRAL), EBSCO MEDLINE, EBSCO CINAHL, EMBASE (OVID) and PubMed were searched using controlled vocabulary and text words related to PIVC insertion in patients with DIVA.<br>**Inclusion:** 24 studies comprising 16 DIVA assessment tools and nine CPGs or escalation pathways<br>**Power analysis:** Not discussed<br>**Achieved:** N/A | **Intervention Protocol:** 16 different DIVA assessments scales were identified, with 3-10 item checklists. | **DV:** The primary outcomes: a description of the available DIVA assessment instruments, CPGs, and escalation pathways; the psychometric quality of assessment instruments, and methodological quality of available CPGs and escalation pathways, measured according to the Appraisal of Guidelines for Research and Evaluation-II (AGREE-II) instrument criteria. | **Conclusions:** Overall, the EA-DIVA, the A-DIVA scale, the modified A-DIVA scale, and the A-DICAVE42 provided promising psychometric properties.<br>Early identification of DIVA patients and improved first-time insertion success requires adoption of assessment instruments, CPGs and escalation pathways.<br>Additionally, ultrasound- guided PIVC insertion should be used for patients with DIVA. |

| **Citation #7:** Carr, P. J., Higgins, N. S., Cooke, M. L., Rippey, J., & Rickard, C. M. (2017). Tools, Clinical Prediction Rules, and Algorithms for the Insertion of Peripheral Intravenous Catheters in Adult Hospitalized Patients: A Systematic Scoping Review of Literature. *Journal of hospital medicine*, *12*(10), 851–858. https://doi.org/10.12788/jhm.2836 | | | | | **Level:** III-B |
|---|---|---|---|---|---|
| **Purpose or Hypothesis** | **Type of Evidence and Research Design** | **Sample (population, size, setting)** | **Intervention Procedures** | **Primary Outcomes/Measures** | **Results** |
| The purpose of this systematic scoping review was to investigate what PIVC decision-making approaches exist to facilitate first time success of PIVCs in adult hospitalized patients | Systematic review of assessment instruments, CPGs and escalation pathways | **Sampling:** a systematic literature search was performed using the medical subject heading of peripheral catheterization and tool* or rule* or algorithm*<br>**Inclusion:** Out of 36 studies, 13 studies that evaluated identified predictors of successful insertion from observational data to form algorithms were included.<br>**Power analysis:** Not discussed<br>**Achieved:** N/A | **Intervention Protocol:** 13 studies from Europe, Australia, and South America predicted factors that would influence first-time PIVC success in hospitalized patients, analyzed by statistical tests and validated by nursing and phlebotomy. | **DV:** Successful insertions were associated with visible veins (OR, 0.87-3.63; 3 studies) or palpable veins (OR, 0.79-5.05; 3 studies) and inserters with greater procedural volume (OR, 4.4; 95% CI, 1.6-12.1) or who predicted that insertion would be successful (OR, 1.06; 95% CI, 1.04-1.07). | **Conclusions:** Few well-validated reliable clinician aids exist for PIVC insertion. Patients would benefit from a validated, clinically pragmatic clinical aid that matches insertion difficulty with clinician competency**.** |

**Table 2.**

*Evidence Synthesis Table*

**Project Title:** Using the DIVA Tool to Reduce Unsuccessful PIVC Attempts

**PICOT:** Within the Surgical ICU, does using a Difficult Access Venous Tool (DIVA) compared to the current practice of not using a DIVA tool reduce the overall number of PIVC attempts?

| JHNEBP Model Level | Total Number of Sources | Author and Quality Rating of each study | Synthesis of Findings |
|---|---|---|---|
| **Level 1**<br>Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis | | | |
| **Level II**<br>Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis | 1 | Bahl et al., -B | Bahl et al.,(2024)'s intervention of the OSTICK program, increased first-time PIVC cannulation success and increased PIVC longevity. OSTICK's PIVCs last a median time of 92% of the patient's hospital length of stay, compared to non-OSTICK PIVCs at 74% ($p < 0.001$). |
| **Level III**<br>Non-experimental study · Systematic review of a combination of RCTs, quasi-experimental, and non-experimental studies, or non-experimental studies only, with or without meta-analysis · Qualitative study or systematic review of qualitative studies with or without meta-synthesis | 6 | van Loon et al., 2019-A<br>Civetta et al., 2019-A<br>Salleras-Duran et al., 2020-A<br>Rodriguez- Calero et al., 2020-B<br>Paterson et al., 2022-B<br>Carr et al., 2017-B | van Loon et al., (2019), Civetta et al., (2019), Sallaras-Duran et al., (2020) and Rodriguez-Calero et al., (2020) all identified risk factors for DIVA and proposed a score/tool to compare PIVC attempts for reliability and consistency. Paterson et al., (2022) and Carr et al., (2017) identified several other tools (before 2017) that identify DIVA in mostly Emergency Department populations. |
| **Level IV**<br>Opinion of respected authorities and/or reports of nationally recognized expert committees/consensus panels based on scientific evidence | | | |
| **Level V**<br>Evidence obtained from literature reviews, quality improvement, program evaluation, financial evaluation, or case reports · Opinion of nationally recognized expert(s) based on experiential | | | |

| | | | |
|---|---|---|---|
| evidence | | | |

**Recommendations Based on Evidence Synthesis**

As most of the studies were observational studies based on the nature of the intervention (PIVC placement) they are classified as qualitative. All studies indicated that some form of vein assessment tool, whether A-DIVA, modified A-DIVA, EA- DIVA reliably and consistently indicates if a patient has difficult vascular access and should be escalated to an auxiliary technique, such as USG placement or midline. The evidence synthesis shows good and consistent evidence to indicate a practice change.

**Figure 1.**

*Fishbone Diagram*

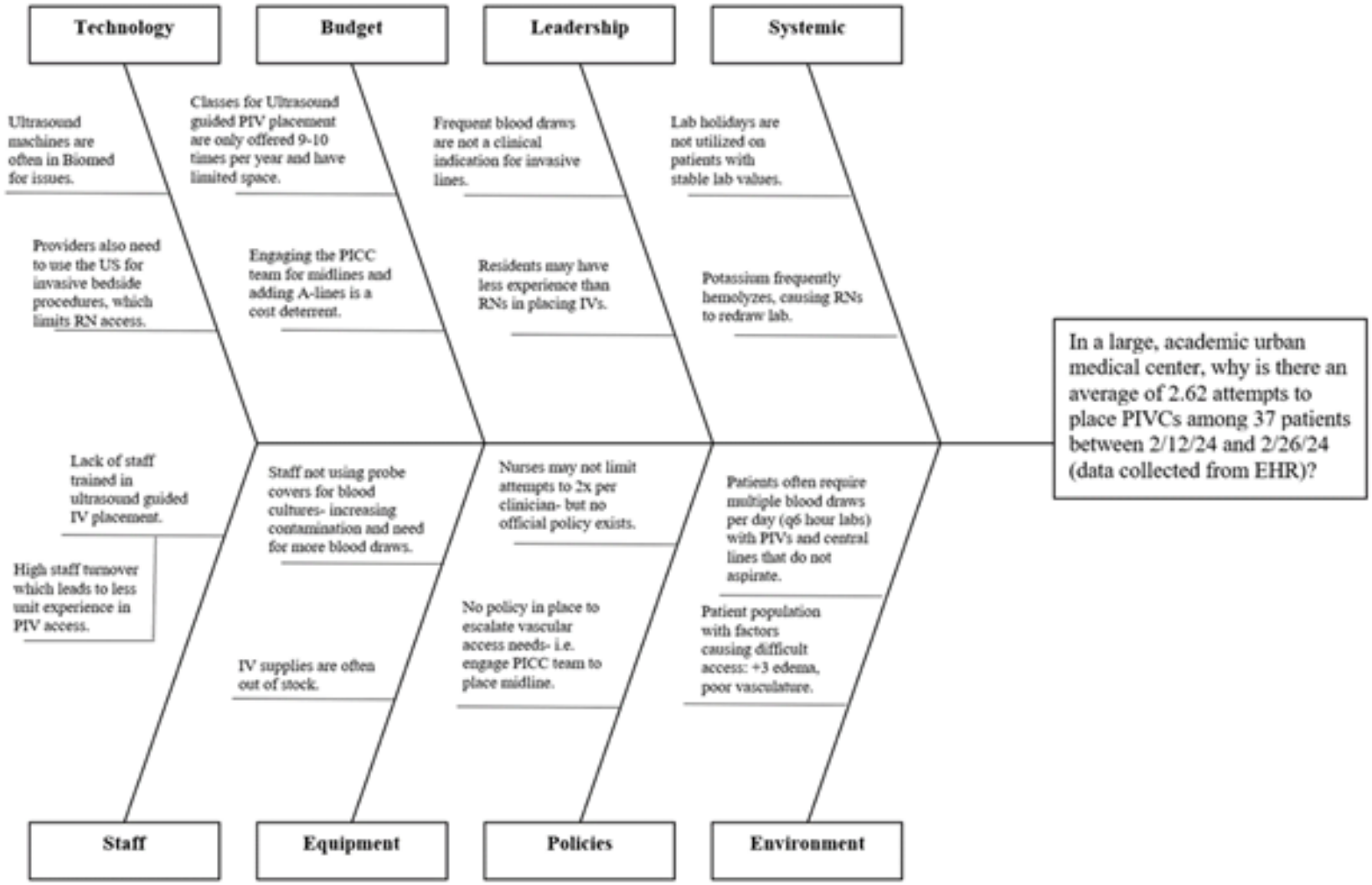


**Figure 2.**

*Prisma Diagram*

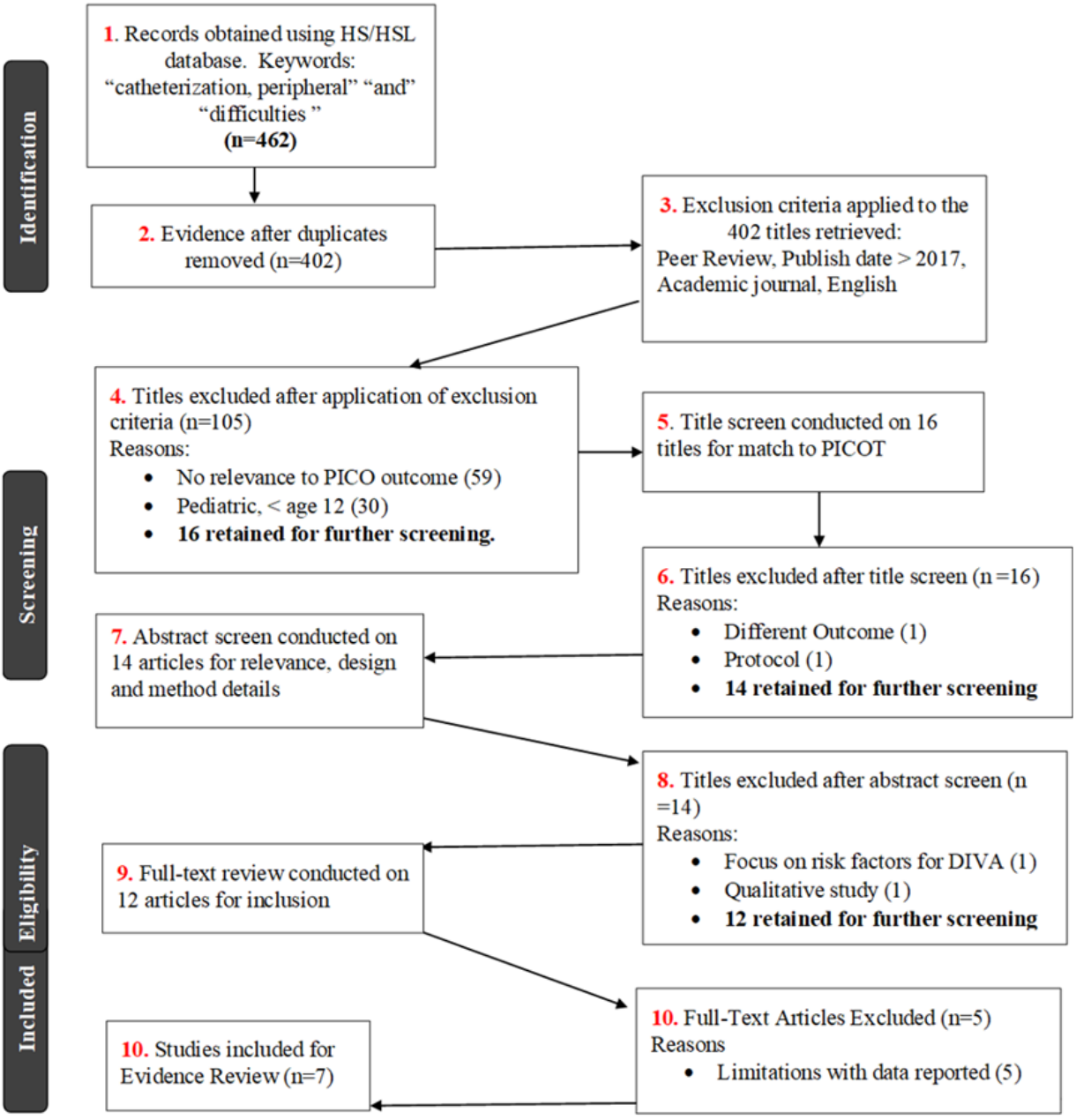


**Figure 3.**

*Promoting Action on Research Implementation in Health Services (PARIHS) Framework*

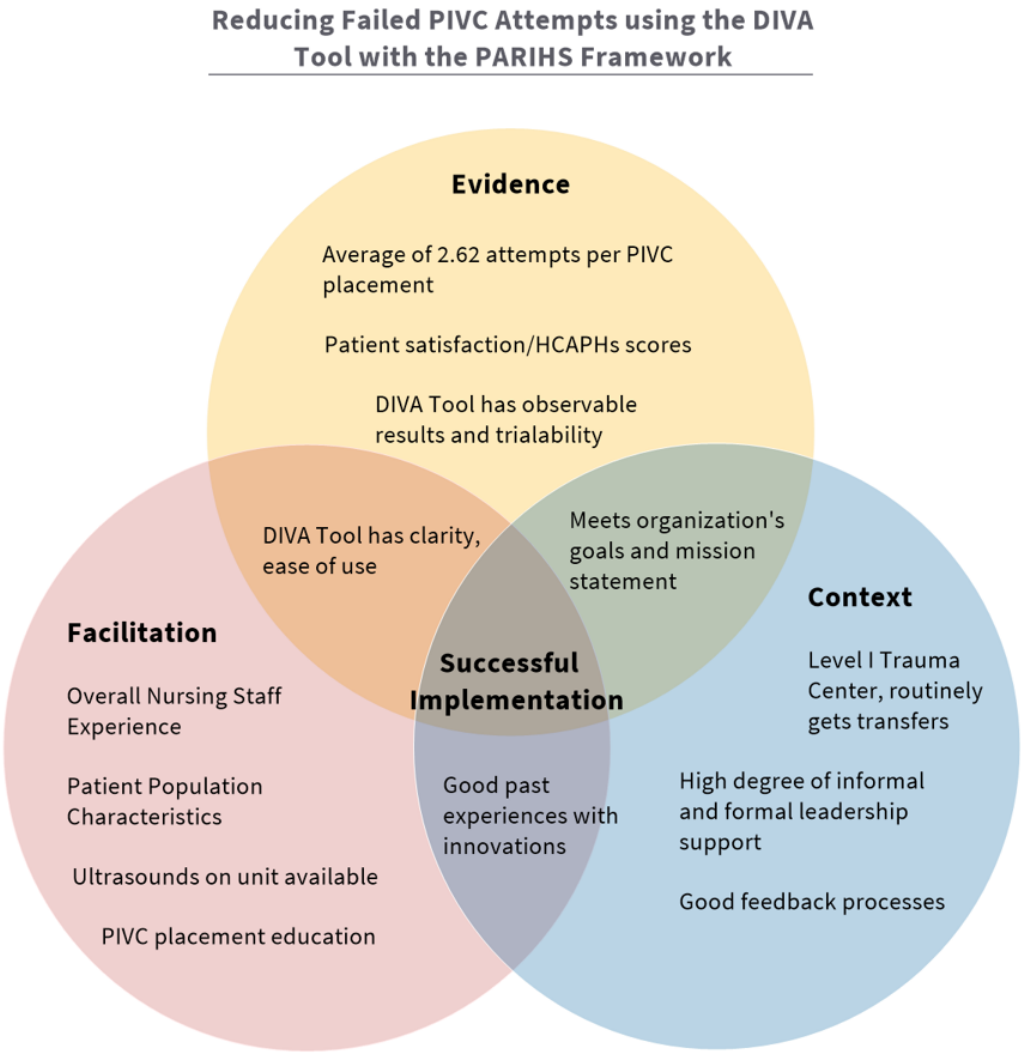


**Figure 4.**

*Pre-Implementation Process Map*

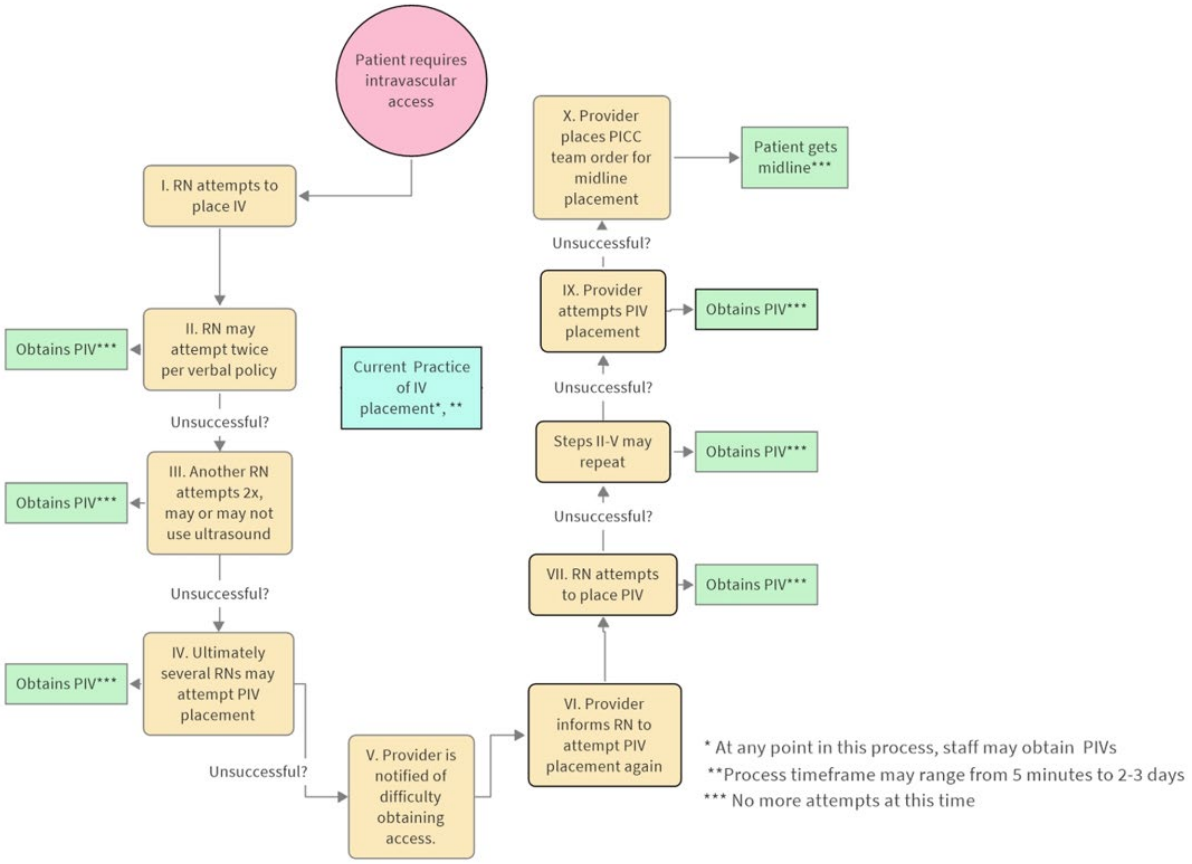


**Figure 5.**

*Implementation Process Map*

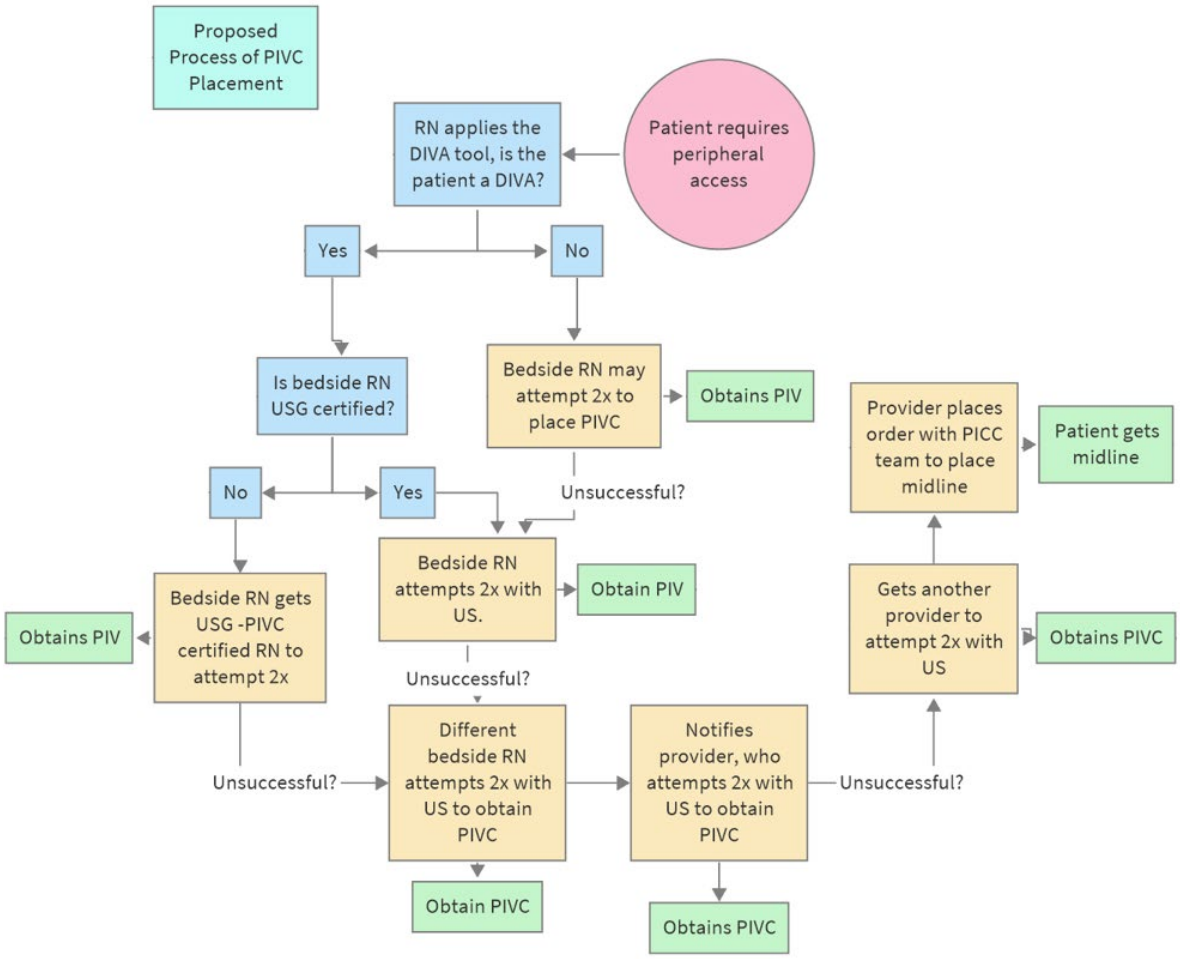


**Figure 6.**

*DIVA Utility Score Run Chart*

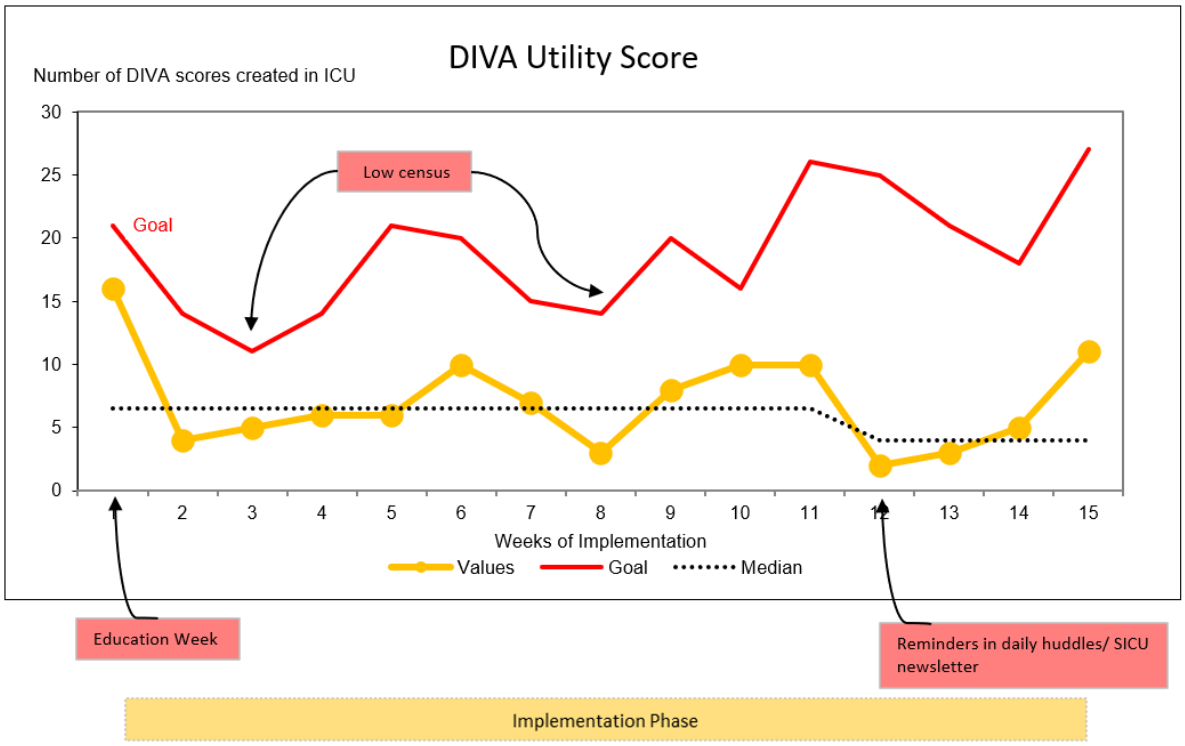


**Figure 7.**

*DIVA Utility Score Bar Chart*

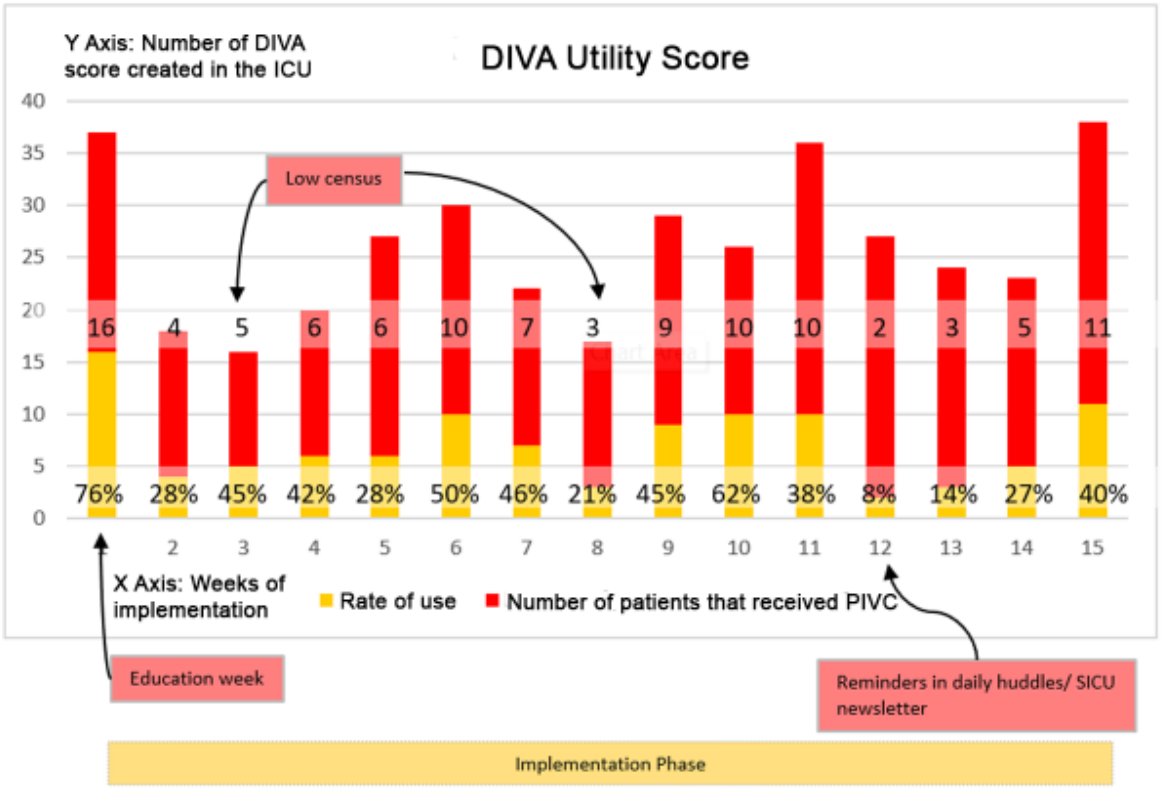
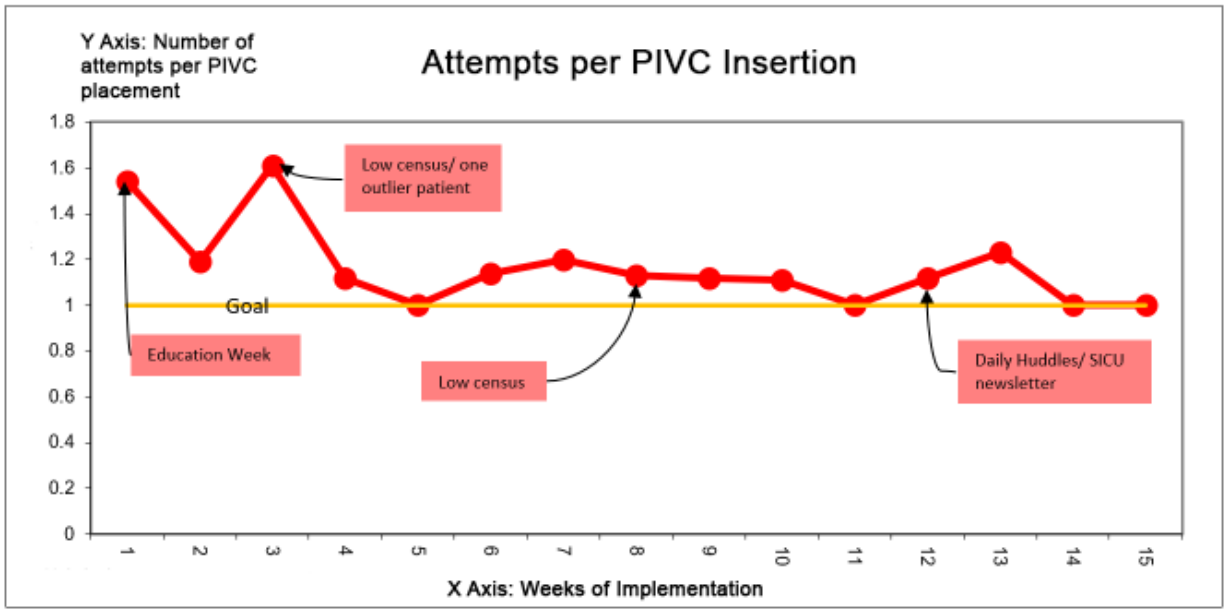


**Figure 8.**

*Attempts per PIVC Run Chart*



# Appendix A

*Gantt Chart*

DNP Project Title: Reducing PIVC Attempts with the DIVA Tool

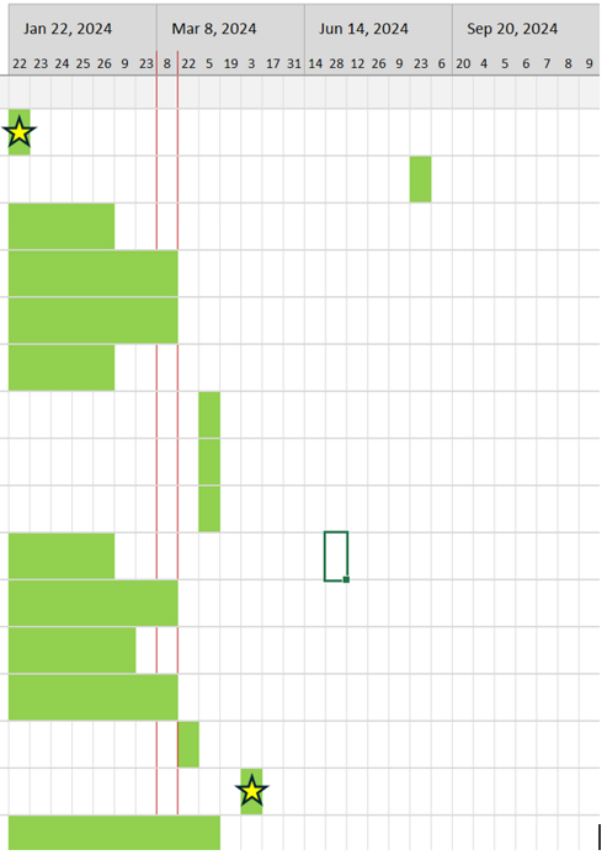
Student: Somer Andries

Project Site: UMMC-SICU

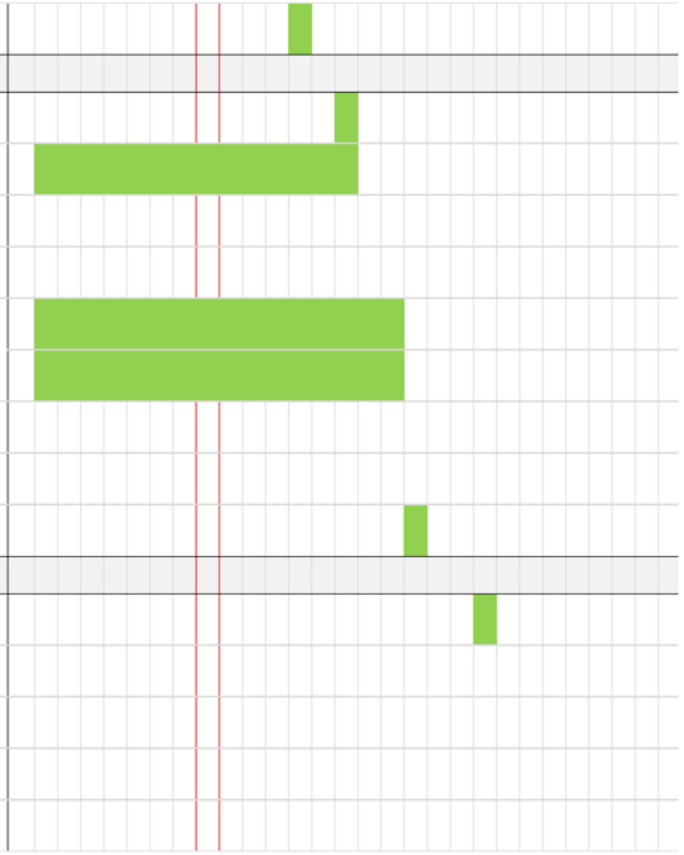
Project Start: Mon, 1/22/2024

Display Week: 1

| Project Identification (NDNP810) | Responsible | START | END |
|---|---|---|---|
| Start of Spring Term | | 1/22/24 | 1/22/24 |
| CITI (enter renewal date as end) | Project Lead-Somer | 8/27/24 | 8/27/24 |
| HIPAA (enter renewal date as end) | Project Lead-Somer | | 1/30/24 |
| Identify stakeholders/team | Project Lead-Somer | | 3/11/24 |
| Identify roles/responsibilities | Project Lead-Somer | | 3/11/24 |
| Identify practice problem/root cause | Project Lead- Somer | | 2/1/24 |
| Meeting with Critical Care Informacist | Somer/Ryan Foster | 4/10/24 | 4/10/24 |
| Meeting with RN Educator to discuss PIVC lab | Somer/Jackie Nolan | 4/15/24 | 4/15/24 |
| Critical operations meeting to dicuss PIVC policy | Somer/ Dr. Tisherman | 4/11/24 | 4/11/24 |
| Context Assessment | Project Lead- Somer | | 2/1/24 |
| Identify scope/goals | Project Lead-Somer | | 3/11/24 |
| Synthesize Evidence | Project Lead-Somer | | 2/11/24 |
| Development project plans | Project Lead -Somer | | 3/11/24 |
| MILESTONE: Submit project proposal | Project Lead-Somer | 4/1/24 | 4/1/24 |
| Site IRB Inquiry | Project Lead-Somer | 5/6/24 | 5/6/24 |
| Adding tools on REDcap | Project Lead-Somer | | 4/12/24 |



| | | | |
|---|---|---|---|
| End of Spring Term | | 5/10/24 | 5/10/24 |
| **Project Development (NDNP811)** | | | |
| Start of Summer Term | | 6/3/24 | 6/3/24 |
| Develop PIVC escalation policy | | 1/22/24 | 6/4/24 |
| Develop implemenation plans | | | |
| Develop teaching plan | | | |
| Develop PIVC skills lab materials | | 1/22/24 | 7/1/24 |
| Develop and finish appropriate DIVA documentation | | 1/22/24 | 7/8/24 |
| MILESTONE: Site Presentation and Approval | | | |
| MILESTONE: IRB Determination | | | |
| End of Summer Term | | 7/19/24 | 7/19/24 |
| **Project Implementation (NDNP812)** | | | |
| Start of Fall Term | | 8/26/24 | 8/26/24 |
| MILESTONE: Project go-live (implement) | | | |
| Educaton/Training | | | |
| Monitor tactics and progress | | | |
| Communicate with stakeholders | | | |



DNP Project Title: Reducing PIVC Attempts with the DIVA Tool

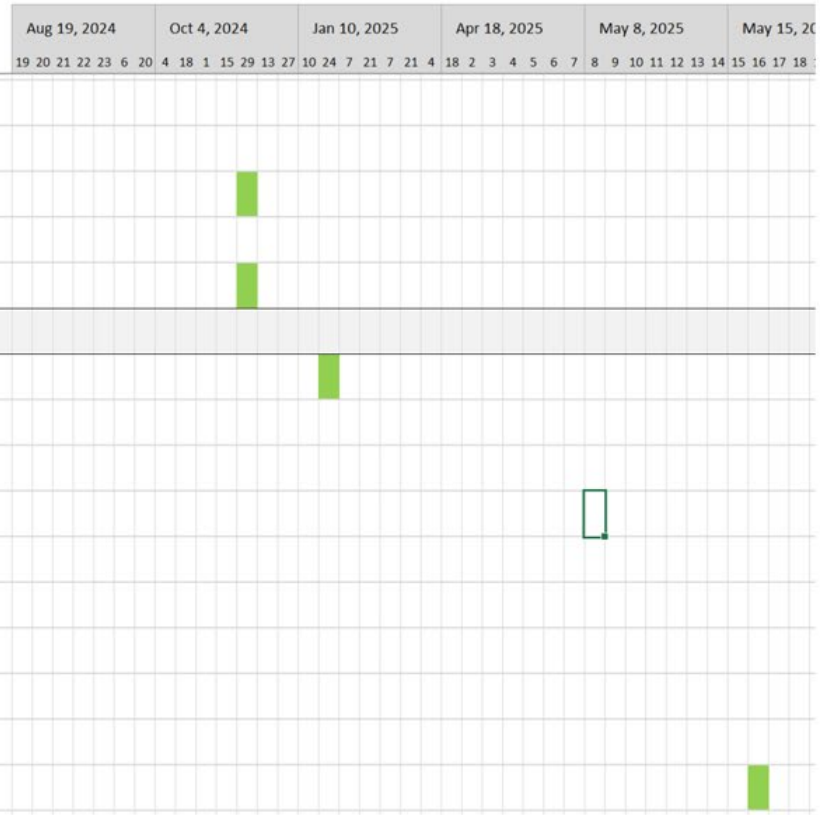
Student: Somer Andries

Project Site: UMMC-SICU

Project Start: Mon, 1/22/2024

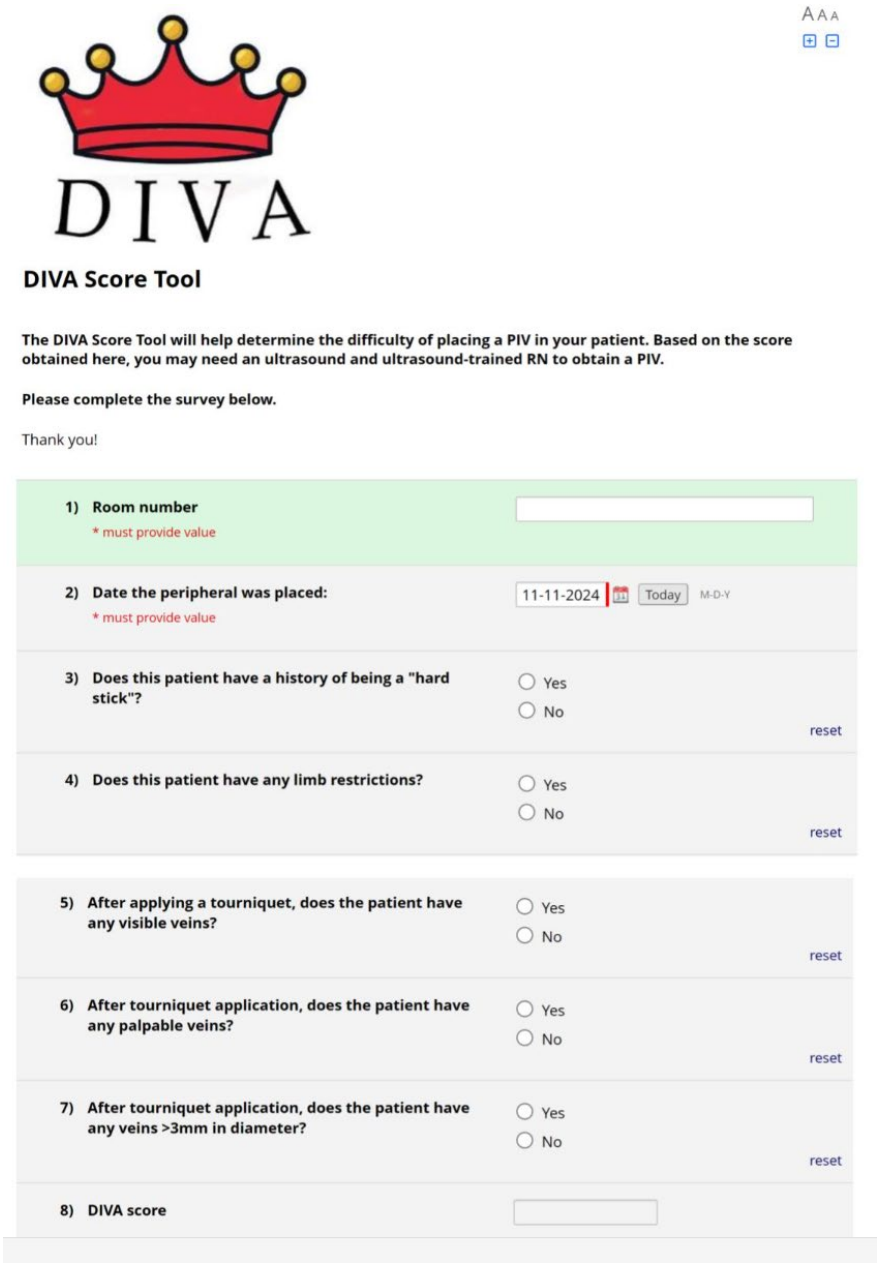
Display Week: 8

| | | | |
|---|---|---|---|
| Data Collection | | | |
| Dissemination Plan | | | |
| Outcome goal of > 30% of patients requiring >2 sticks | | 12/1/24 | 12/1/24 |
| MILESTONE: Manuscript | | | |
| End of Fall Term | | 12/6/24 | 12/6/24 |
| **Project Evaluation and Dissemination (NDNP813)** | | | |
| Start of Spring Term | | 1/27/25 | 1/27/25 |
| Analyze, synthesize & evaluate results | | | |
| Sustainability Plan | | | |
| MILESTONE: Develop Poster | | | |
| MILESTONE: Site Presentation | | | |
| MILESTONE: Extrernal Dissemination | | | |
| MILESTONE: Final Manuscript | | | |
| MILESTONE: UMSON Poster Day | | | |
| Project Closure w/site | | | |
| End of Spring Term | | 5/16/25 | 5/16/25 |



# Appendix B

*Measurement Tool*



A A A

DIVA

**DIVA Score Tool**

**The DIVA Score Tool will help determine the difficulty of placing a PIV in your patient. Based on the score obtained here, you may need an ultrasound and ultrasound-trained RN to obtain a PIV.**

**Please complete the survey below.**

Thank you!

1) **Room number**
* must provide value

2) **Date the peripheral was placed:**
* must provide value
11-11-2024 Today M-D-Y

3) **Does this patient have a history of being a "hard stick"?**
Yes
No
reset

4) **Does this patient have any limb restrictions?**
Yes
No
reset

5) **After applying a tourniquet, does the patient have any visible veins?**
Yes
No
reset

6) **After tourniquet application, does the patient have any palpable veins?**
Yes
No
reset

7) **After tourniquet application, does the patient have any veins >3mm in diameter?**
Yes
No
reset

8) **DIVA score**