Difficult Intravenous Access

Definition:

Intravenous access for the infusion of medications and solutions requires timely assessment, planning, insertion and assessment. Traditional intravenous access is reactive, painful and ineffective, often resulting in the exhaustion of peripheral veins prior to consideration of other access options. Evidence suggests clinical pathways improve outcomes by reducing variations and establishing processes to assess and coordinate care. Implementation of an intravenous access clinical pathway leads to the intentional selection of the best vascular access device for the pediatric patient specific to the individual diagnosis, treatment plan, current medical condition, and the patient's vessel health. Initiation of an intravenous access program at Dell Children's Medical Center provides a systematic pathway to improve intravenous access selection and patient care while increasing positive patient outcomes and satisfaction.[1] We aim at providing a proactive patient focused approach to intravenous access.

Epidemiology/Etiology:

Intravenous access is the most common invasive procedure in healthcare. Every day, clinicians insert intravenous access devices into patients as it is the gateway to healthcare delivery. However, achieving intravenous access in infants and pediatrics can be physically and emotionally challenging for both the patient and clinician. Therefore, every attempt to mitigate unnecessary venous access should be considered.

Failure rates for first-time peripheral cannulation attempts are surprisingly high. Findings for pediatric patients reveal that up to half -51% - of first-insertion attempts fail across diverse settings.[2] On average, a child requires 2 sticks to achieve venus access.[4] Current evidence of unused PIVC rates for patients admitted via the Emergency Department (ED) setting range from 25–50%.[(17)] Over 12 risk factors have been reported to predict insertion failure in the emergency care setting. These include: age, gender, race, body mass index, history of chemotherapy, dialysis patients, swelling, sickle cell disease, patient size, limited and suitable veins contributing to a difficult intravenous access, previous history of failed attempts and recent hospital admission, diabetes, and patient anxiety (needle phobia).[3] The use of Ultrasound Guided Peripheral Intravenous Catheters (USG PIVC) is particularly important in patients with (DIVA) Difficult Intravenous Access; it increases the first-attempt success rate from 25-30% without ultrasound to 90% with it.[11]

Guideline Inclusion Criteria:

Child from infancy *(28 days)* to adolescent *(18 Years)* presenting with difficult vascular access both in the acute and inpatient setting.

Guideline Exclusion Criteria:

Neonates *(birth to 27 days)*

Vascular Access-Related Anatomical, Physiological and Developmental Variations by Age Group:

Throughout all stages of development, parents and other primary caregivers should be recognized as partners with the clinicians when planning, inserting, and managing vascular access devices. The anatomical, physiological and developmental differences between children, adolescents, and adults impact the way illnesses and diseases present. These differences determine what type of healthcare is provided at different times for the growing child. These differences however small, might have an impact on how vessel health and preservation is supported.

Neonatal (<28 Days)
A range of vascular access devices (VADs) are utilized for neonates in the special care of neonatal intensive care settings to facilitate therapies associated with preterm delivery, low birth weight, congenital disease, or to treat infection. The neonatal vascular network continues to mature throughout the first year of life. Clinicians need to use smaller, size-appropriate catheters for both peripheral and central devices.

Infancy (28 days - 1 Year)
At this stage, the infant's immature vascular network, immune system, skin structure, and circulating blood volume continues to develop. The infant's rapid growth and development may necessitate changes in pediatric vascular access practices. Rapid growth, including increased adiposity during infancy and toddler years, can make it difficult to visualize and palpate veins, making insertion of VAD's challenging.

Toddler (1-3 Years)
During these years, the child has experienced increased mobility and social interaction. For vascular access, this provides new challenges regarding procedural compliance. A specialized care team (Child Life) should be engaged to provide resources to reduce anxiety and promote compliance during VAD insertion. It is important to provide a positive first experience for a child to reduce anxiety and improve experiences associated with potentially painful and stressful procedures such as peripheral vein cannulation. Strategic and appropriate placement should be well thought out so as to avoid dislodging a VAD by a newly mobile toddler.

Preschool to School-Age Children (3-12 Years)
Procedural compliance varies between children. As communication improves, it is important to involve the child in consultation of their vascular access decision making. Continued involvement of the Child Life specialist is important at this age. Distraction therapies continue to be useful in this age group to assistant in reducing anxiety and promoting procedural success.

Adolescents (13-18 Years)
As emerging adults, adolescents are able to participate in the decision making about their own care. Clinicians should ensure that the adolescent is sufficiently involved in his/her vascular access decision making including choices surrounding device type, location, and insertion procedure. Another consideration of this age group is children who may present with chronic illness. These children may have exhausted many of the traditional vascular access routes by this age. This may necessitate management of alternate insertion sites.

Diagnosis:
Placement of an adequate and stable intravenous device is very important in admitted patients. Just as important, but more critical, are those patients admitted to the emergency department (ED). Peripheral intravenous cannula (PIVC) insertion is one of the most common clinical interventions performed in emergency care worldwide.[3] PIV placement could be challenging in this setting due to hemodynamic instability, low volume state, edema or poor venous asset.[5]

Diagnostic Evaluation:

Physical Examination:
Traditionally, patients with DIVA are identified after numerous failed PIVC insertion attempts, but prospectively identifying these patients can reduce the cannulation failure rate and improve their care experience. See Risk Factors.

HISTORY	PHYSICAL	PSYCHOSOCIAL
-Patient's health status, diagnoses, conditions that require repeated or ongoing IV access, such as: Cancer Sickle cell disease Cystic fibrosis Chronic renal failure -Prematurity with prolonged NICU stay -Prolonged hospital admissions with multiple vascular access attempts - Prior difficult IV access history per medical record/family/VAS service - Documented vessel occlusions - Active clot (therapeutic anticoagulation) - History of infiltrations -Congenital heart disease patients	Consider vein quality on assessment Burns Fractures Trauma Congenital anomalies preventing use of limbs Edema Contractures Visibility and palpability of the target vein Dehydration Obesity, extreme values of BMI (>30) Less than 3 available access sites Ultrasound guided IV Access during current admission	- Developmental delay, combative, or other behavioral issues causing frequent loss of peripheral access - Anxiety due to failed catheters during current hospitalization

Critical Points of Evidence

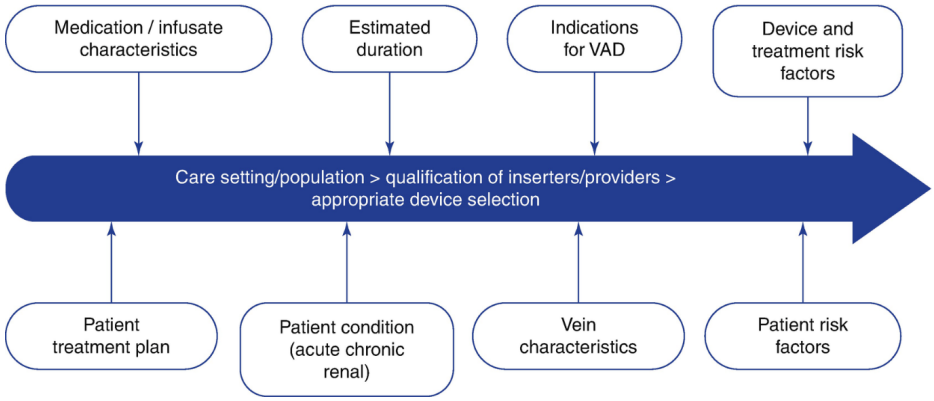
Evidence Supports

- Although it has been demonstrated that ultrasonography improves the cannulation rate of PIVs however, a small percentage (8%) of USG-PIVs infiltrate or dislocate in one hour. A study compared blind short PIVs with US-Long PIVs placement in the ED in DIVA patients. It was found that US-LPIVs have a success rate of 89.3%, significantly higher than PIVs.[5]
    - The benefit of selecting a longer-length PIVC is that it allows at least two-thirds of the catheter length to reside in the vein, making it less likely to irritate the vessel wall, which can cause chemical phlebitis and infiltration[12]
    - Placing a US-LPIV, took less time than a blind search for a vessel with more attempts of cannulation.[5]
- PIVs showed a shorter time of survival, particularly due to dislocations.[9]
- Difficult intravenous access could delay blood testing and therapy administration with negative consequences, especially in the critically ill.[5]
- It has been demonstrated that ultrasound guidance improves the first-attempt success rate and improves the cannulation rate of PIVs.[6] The use of USG PIVC is particularly important in patients with DIVA; it increases the first-attempt success rate from 25-30% without ultrasound to 90% with it.[11]
- Ultrasound guidance resulted in a higher success rate in comparison with the traditional technique of palpation and direct visualisation.[7] This in turn is directly correlated with improved patient satisfaction.[8]
- Ultrasound reduces the search of an adequate vessel to less than a minute for an experienced clinician.[5]
- Reduction of punctures of a vessel leads to reduction of insults and so decreases long term complications, as it happens to central vessels. This is important, as preserving the venous asset in DIVA patients should be of primary importance when placing a intravenous device.[5]
- Refraining from inserting a PIVC that is not clinically indicated would avoid pain, and reduce costs of staff and equipment resources involved.[17]

Practice Recommendations and Clinical Management

Device Selection

Considerations for device selection. The selection and insertion of the most appropriate VAD are based on a number of key considerations. The knowledge of device selection algorithms can help prevent common problems with peripheral devices such as phlebitis and infiltration but also more serious complications that include bloodstream infection and thrombosis.



Selection Criteria for VAD, N. Moureau [13]

DIVA Identification - To ensure vessel health and preservation, a proactive approach to intravenous access is required, rather than a reactive one that can cause pain and damage to vessels, and limit further intravenous-access options. Assessing DIVA patients who require intravenous access in a proactive, timely way results in intentional placement of the right device to reduce vessel damage and preserve vessels for future use. This has the potential to improve patient experience, reduce complications, and reduce frustration for the health professional.

Pain Management /Child Kind:

The 4 evidence-based best practices for reducing needle pain in children - Current evidence supported by guidelines from the multiple pediatric organizations and recently brought forward by science-to-social media campaigns, strongly suggests that 4 bundled modalities should be offered for elective needle procedures to reduce or eliminate pain experienced by children. [15,16]

1. Numb the Skin (use of lidocaine cream, topical anesthetics)
2. Sucrose or breastfeeding (for infants 0-12 months)
3. Comfort positioning. Restraining children for procedures is never supportive, and creates a negative experience.33 For infants, we use swaddling, warmth, skin-to-skin contact, or facilitated tucking. For children 6 months and older, we offer sitting upright, with parents holding them on their laps or sitting nearby.
4. Age-appropriate distraction, such as toys, books, blowing bubbles or pinwheels, stress balls, and using apps, videos, or games on electronic devices.

Consults/Referrals:

Referral or consultation with an Interventional Radiologist/Anesthesiologist or a Senior experienced clinician should be considered for a DIVA patient.

Escalation Criteria:

Team Huddle for IV Escalation - In the team huddle, the clinical team should assess the patient's vascular condition, future treatment needs, identify possible alternatives, discuss overall management and recommendation of PIVC placement and/or discuss removal of devices when they are no longer needed for care to minimize patient discomfort and risk for harm. The PIVC is an invasive device that comes with a variety of risks and it should be dependent upon a well-defined clinical rationale for insertion to proceed. The indiscriminate practice of PIVC without a clinical indication is detrimental to good clinical care. Refraining from inserting a PIVC that is not clinically indicated would avoid patient pain, and reduce costs of staff and equipment resources involved. Research has shown that when intravenous access is required, limited assessment is performed of the most appropriate device to use; PIVCs are often used as the default, despite not being the best device for some patients.[10] They are the most commonly used vascular-access device (VAD) and insertion is often delegated to staff who have the least experience, who may be unclear of when to escalate issues (and to whom) and when to consider an alternative VAD.[10]

Discharge Criteria:

Those factors determining the length of time a patient will remain in an acute care bed include speed of diagnosis, initiation of treatment, consistent administration of treatment and response to treatment plan. Whilst evaluation of the diagnosis and treatment plan is ongoing, factors such as failed intravenous access and delays in administration of medications are variables that impact the evaluation of adequate patient response to the treatment.

Evidence points to the reduced length of stay as an area of cost reduction dependent on reliable drug infusion via a reliable intravenous access device from the onset of therapy resulting in outcome improvement and the potential reduction on length of stay for the hospital.[14]

Outcome Measures:

1) 1st attempt success rate
2) Survival of PIVC from ED to hospital admission
3) PIVC failure - how many times fails before the conclusion of the treatment
4) PIVC insertion un-necessary for Dx or treatment
5) Unscheduled restarts - having to reinsert the PIVC after unforeseen failure.

Methods

Existing External Guidelines/Clinical Pathways

Existing External Guideline/Clinical Pathway	Organization and Author	Last Update
ED Clinical Pathway for Vascular Access	Children's Hospital of Philadelphia (CHOP)	September 2019
Inpatient Clinical Pathway for Vascular Access	Children's Hospital of Philadelphia (CHOP)	October 2019

Any published clinical guidelines have been evaluated for this review using the **AGREE II criteria**. The comparisons of these guidelines are found at the end of this document. **AGREE II criteria** include evaluation of: Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity of Presentation, Applicability, and Editorial Independence.

Review of Relevant Evidence: Search Strategies and Databases Reviewed

Search Strategies	Document Strategies Used
Search Terms Used:	Pediatric Vascular Access, Patient assessment, Vein Assessment, Vascular medicine
Years Searched - All Questions	1990-2020

Language	English
Age of Subjects	0-18 years old
Search Engines	PubMed Google Scholar
EBP Web Sites	UpToDate
Professional Organizations	Association for Vascular Access (www.avainfo.org)
Joint Commission	
Government/State Agencies	None
Other	

Evidence Found with Searches

Check Type of Evidence Found	Summary of Evidence – All Questions
☐	Systematic Reviews
☐	Meta-analysis articles
x	Randomized Controlled Trials
x	Non-randomized studies
x	Review articles
☐	Government/State agency regulations
x	Professional organization guidelines, white papers, ect.

Evaluating the Quality of the Evidence

The GRADE criteria were used to evaluate the quality of evidence presented in research articles reviewed during the development of this guideline. The table below defines how the quality of evidence is rated and how a strong versus a weak recommendation is established.

Recommendation	
Strong	Desirable effects clearly outweigh undesirable effects or vice versa
Weak	Desirable effects closely balanced with undesirable effects
Type of Evidence	
High	Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies
Moderate	Evidence from RCTs with important limitations (e.g., inconsistent results, methodological flaws, indirect evidence, or imprecise results) or unusually strong evidence from unbiased observational studies
Low	Evidence for at least 1 critical outcome from observational studies, from RCTs with serious flaws or indirect evidence
Very Low	Evidence for at least 1 critical outcome from unsystematic clinical observations or very indirect evidence

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