Development & Implementation of a Nurse-Led Ultrasound-Guided Peripheral IV Access Program Using a Novel DIVA Scoring Tool

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Department of Emergency Medicine · Jamaica Hospital Medical Center · Queens, New York · A Quality Improvement Initiative

448	88.3%	0	↓81%	AUC 0.76	9→18
Total USGPIV Placements (Phases I & III)	First-Attempt Success (Mean 1.16 attempts)	Major Complications (Across all procedures)	Failed IV Attempts (Phase I → III (p<0.001))	DIVA Score Discrimination (vs. M-DIVA AUC 0.68)	Credentialed Nurses (Doubled in 6 months)

INTRODUCTION & PURPOSE

BACKGROUND

Difficult intravenous access (DIVA) affects an estimated **10–24% of all emergency department patients**, contributing to significant treatment delays, procedural complications, increased patient pain, and unnecessary escalation to more invasive central venous access devices. This challenge is particularly acute in high-volume urban EDs managing patients with diverse comorbidities and acuities.

Ultrasound-guided peripheral IV (USGPIV) placement is a well-established, evidence-based solution to DIVA; however, at Jamaica Hospital Medical Center (JHMC), this procedure was historically **restricted exclusively to physicians**. This policy created significant operational bottlenecks in a 120,000-visit/year ED staffed by approximately 30 nurses versus only 6–8 physicians per shift, severely limiting timely patient access to this critical procedure.

Furthermore, existing DIVA prediction tools — notably the A-DIVA and M-DIVA scales — were developed and validated using data from predominantly **European patient populations**. These models may not accurately reflect the unique high-comorbidity, ethnically diverse urban patient population served by JHMC in Queens, New York, potentially limiting their predictive accuracy and clinical utility in our specific setting.

PROBLEM STATEMENT

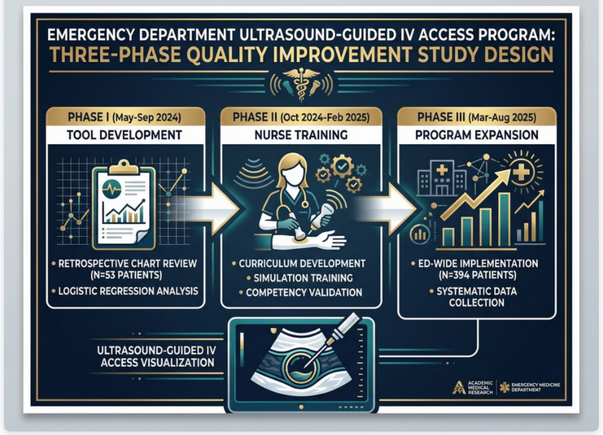
The absence of a formally structured, nurse-led USGPIV program and a locally validated DIVA prediction tool resulted in **avoidable delays in vascular access**, increased patient discomfort, and a disproportionate procedural burden on a limited number of physicians. Prior to this initiative, no systematic process existed to prospectively identify DIVA patients at triage, and credentialing pathways for nurses were informal, inconsistent, and lacked standardized competency validation.

OBJECTIVES OF THIS INITIATIVE

- Develop and rigorously validate a **locally-informed DIVA prediction scoring tool** calibrated to the unique demographic and clinical characteristics of the JHMC patient population through retrospective chart review and multivariable logistic regression analysis.
- Establish a **structured, formalized nurse training and competency validation program** for USGPIV placement, incorporating didactic education, hands-on simulation, and supervised clinical placements.
- Implement a **sustainable, scalable, nurse-led USGPIV service** with defined credentialing standards, key performance metrics, and a robust quality assurance framework.
- Evaluate the **clinical safety, procedural effectiveness, and program adoption** over a comprehensive six-month implementation period (March–August 2025).
- Compare the diagnostic performance of the novel JHMC DIVA Score against the established **M-DIVA benchmark** using ROC curve analysis.

STUDY DESIGN

This project was conducted as a three-phase quality improvement (QI) initiative, incorporating a retrospective chart review for tool development and a prospective observational cohort for implementation evaluation at a single high-volume urban academic medical center. The JHMC IRB reviewed the protocol and provided a QI exempt determination.



MATERIALS & METHODS

SETTING & POPULATION

Setting: Jamaica Hospital Medical Center, Queens, NY — a 424-bed safety-net hospital serving over 120,000 ED patients annually, designated Level I Trauma Center. The patient population is characterized by high acuity and significant ethnic and socioeconomic diversity, with elevated rates of diabetes, hypertension, chronic kidney disease, and obesity.

Phase I Population (Tool Development): Retrospective chart review of 53 adult ED patients with documented difficult IV access (≥2 failed traditional PIV attempts), May–September 2024, followed by prospective pilot testing in 54 patients to refine scoring variables and weights.

Phase III Population (Implementation): Prospective cohort of 394 adult ED patients requiring IV access, screened using the JHMC DIVA Score during March–August 2025. All patients triaged during this period were eligible for inclusion.

THREE-PHASE QI INITIATIVE

I	II	III
Tool Development	**Training**	**Expansion**
May–Sep 2024	Oct 2024–Feb 2025	Mar–Aug 2025
Retrospective review (n=53), logistic regression, pilot testing (n=54)	Curriculum, simulation, 5 supervised placements required	ED-wide implementation, systematic data collection (n=394)

JHMC DIVA SCORING TOOL DEVELOPMENT

Eight clinical variables demonstrating statistically significant association with DIVA (p<0.05) on multivariable logistic regression were incorporated into the final scoring tool. Point values were assigned proportional to adjusted odds ratios from the regression model and rounded to whole integers to maximize ease of use and reduce cognitive load at the bedside. Final risk stratification cut-points were established from predicted probability curves to optimize sensitivity and specificity.

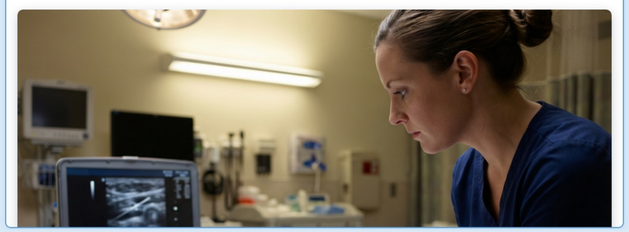
JHMC DIVA SCORE — 8 EVIDENCE-BASED RISK FACTORS

1 pt — Age ≥ 70 Years	1 pt — Hypertension
1 pt — Diabetes Mellitus	1 pt — BMI > 30
2 pts — History of Difficult IV Access *(patient-reported or ≥2 documented failed ED attempts)*	
1 pt — IV Drug Use History	1 pt — ESRD / Dialysis
1 pt — Active Cancer / Chemotherapy	

0–3	4–6	≥7
🟢 Low Risk	🟡 Moderate	🔴 High Risk
<15% DIVA	15–45% DIVA	>45% DIVA
Proceed with standard IV technique	Consider USGPIV after one failed attempt	USGPIV as first-line approach

TRAINING PROGRAM & STATISTICAL ANALYSIS

- **Didactic Training:** A comprehensive 4-hour evidence-based curriculum covering ultrasound physics, vascular anatomy, sterile technique, and complication recognition was mandatory for all participants.
- **Simulation Practice:** Trainees engaged in hands-on practice using gel phantom models and advanced task trainers under direct faculty oversight to develop essential psychomotor skills.
- **Clinical Credentialing:** A minimum of 5 supervised USGPIV placements on live patients with direct physician or credentialed nurse preceptor sign-off was required for independent practice privileges.
- **Ongoing QA:** Mandatory monthly case review, continuous complication tracking, and annual competency reassessment were implemented to ensure program fidelity and patient safety.
- **Statistical Analysis:** Multivariable logistic regression for tool development; ROC curve analysis with DeLong's test for AUC comparison; Chi-square trend test for risk stratification; one-way ANOVA for temporal success rate analysis. SPSS v28; α=0.05.



RESULTS

DIVA SCORE VALIDATION

The JHMC DIVA Score demonstrated **superior discriminative ability** compared to the M-DIVA scale. ROC analysis revealed an AUC of 0.76 (95% CI 0.71–0.81) for the JHMC score versus AUC 0.68 for M-DIVA (DeLong's test, p=0.021). Inter-rater reliability was substantial (Cohen's κ=0.73).

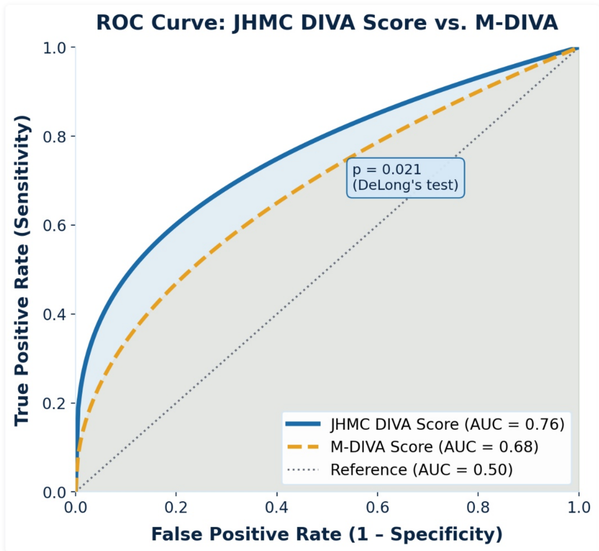


Fig. 1 — ROC Curves: JHMC DIVA Score (AUC 0.76) outperforms M-DIVA (AUC 0.68) in this urban ED population (p=0.021, DeLong's test).

RISK STRATIFICATION & PATIENT ACUITY

The DIVA score correctly stratified USGPIV need across all three risk tiers (χ^2 trend=124.3, p<0.001): Low Risk (12.6%), Moderate Risk (34.8%), High Risk (71.1%). USGPIV patients had a **2.1-fold higher hospital admission rate** than the overall ED population (60.5% vs. 28.3%, p<0.001), confirming appropriate targeting of high-acuity patients.

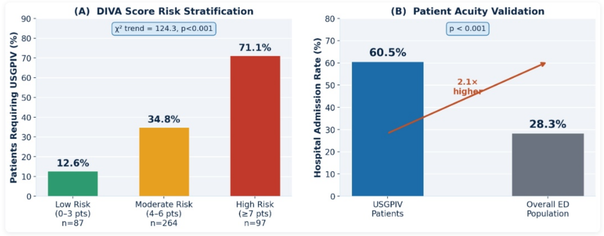


Fig. 4 — (A) DIVA score risk stratification (χ^2=124.3, p<0.001). (B) USGPIV patients had 2.1× higher admission rates, validating appropriate patient targeting.

PROCEDURAL SUCCESS & SAFETY

Across 448 nurse-led USGPIV placements, the **overall first-attempt success rate was 88.3%** (mean 1.16 attempts). **Zero major complications** were recorded. Minor complications occurred in just 3.0% of Phase III cases. No significant temporal variation was observed (ANOVA F=1.39, p=0.24), confirming program stability and safety.

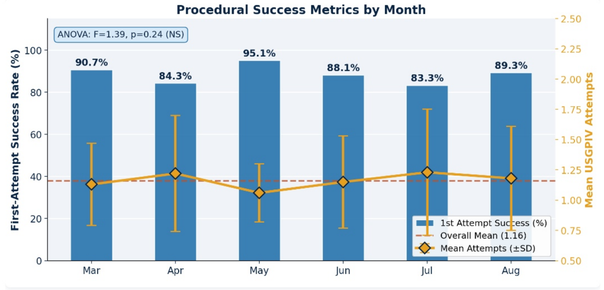


Fig. 3 — First-attempt success rates remained consistently high (83.3–95.1%) across all months (ANOVA F=1.39, p=0.24 NS). Mean attempts ranged 1.06–1.23.

IMPLICATIONS & CONCLUSIONS

PROGRAM GROWTH & PHASE I VS. III IMPACT

Monthly USGPIV volume grew from 43 to 75 procedures (β=+5.8/month, p=0.041). Credentialed nurses expanded from 9 to 18 (β=+1.4/month, p=0.003). Prospective DIVA scoring reduced traditional IV attempts before USGPIV by **81%** (mean 4.2 in Phase I vs. 0.8 in Phase III, p<0.001).

Fig. 2 — Monthly USGPIV volume & nurse credentialing growth.

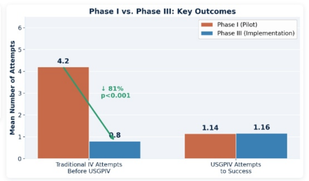


Fig. 5 — Phase I vs. III: 81% reduction in failed IV attempts (p<0.001).

88.3%	0	↓81%	2.1×
1st-Attempt Success	Major Complications	Failed IV Attempts	Higher Admission Rate

KEY FINDINGS

- ✓ **Safe & Effective:** Zero major complications across 448 nurse-led procedures.
- ✓ **Superior Discrimination:** JHMC DIVA Score (AUC 0.76) outperforms M-DIVA (AUC 0.68).
- ✓ **Dramatic Impact:** 81% reduction in failed traditional IV attempts post-implementation.
- ✓ **Scalable Model:** 9→18 credentialed nurses in 6 months demonstrates sustainable capacity.

PRACTICE IMPLICATIONS

- → Nurse-led USGPIV programs should be adopted in high-volume EDs to reduce procedural bottlenecks and improve patient flow.
- → DIVA tools must be **locally validated** — population-specific risk factors are critical for predictive accuracy.
- → Structured training and competency validation are essential for patient safety and institutional confidence in program expansion.
- → Triage integration enables **prospective risk stratification** and early intervention for the most vulnerable patients.

FUTURE DIRECTIONS

- ▸ Full EMR integration with automated DIVA score calculation and clinical decision support at triage.
- ▸ Multi-center validation study across diverse urban emergency departments to assess generalizability.
- ▸ Formal cost-effectiveness analysis comparing nurse-led USGPIV vs. traditional and physician-led models.

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