

Introduction

- Noncompressible hemorrhage is the leading cause of preventable battlefield death, requiring urgent resuscitation, which is best delivered via central vascular access (CVA). CVA is not commonly available in austere environments. [2]
- Acute combat pain (ACP) requires effective analgesia, best accomplished with peripheral nerve block (PNB), which provides localized pain relief without systemic effects. PNB is not commonly available in austere environments. Therefore, ACP is most commonly treated with opioids or ketamine. These carry risks including respiratory depression, delirium, hypotension, and impaired mental function.
- CVA and PNB are not commonly available in austere environments because they require skills in ultrasound interpretation and coordinated needle insertion. [4]
- The AI-GUIDE semi-automates CVA and PNB, upskilling medics in austere environments for the tasks of CVA and PNB.
- With the AI-GUIDE technology originating at MIT-Lincoln Laboratory and Massachusetts General Hospital with funding from DHA Combat Casualty Care Research Program, AutonomUS is transitioning the AI-GUIDE technology from prototype to product.

Capability Description

- AI-GUIDE (Artificial Intelligence Guided Ultrasound Intervention Device) is a handheld, AI-enabled ultrasound-guided robotic system enabling users with limited expertise to obtain central vascular access and administer peripheral nerve blocks in combat trauma care.

Methods / Technical Approach

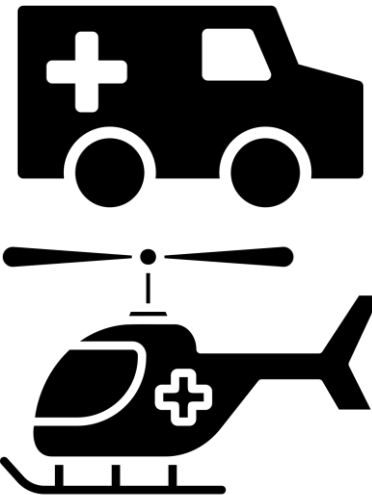
- The latest AI-GUIDE prototype performs near fully automated vascular access. The system integrates real-time machine learning-based computer vision of ultrasound imagery with robotic needle placement, allowing for guidewire advancement.

Results

- Conducted by the original development team at MIT Lincoln Laboratory and the Massachusetts General Hospital - Center for Ultrasound Research and Translation (CURT).
- Phantom studies achieved 100% successful needle placement among 11 user from novice to expert, with novices reaching targets in under 60 seconds.
- Porcine studies showed success rates of 95%, performed by a single experienced operator who was guided only by the simple device display, and blinded to the ultrasound.

Applicability

- AI-GUIDE will address unmet needs in prolonged field care by enabling minimally trained military personnel to perform central vascular access and peripheral nerve block in austere environments across all stages of military care. The technology also applies to civilian mass casualty incidents, rural centers, and high-volume clinical environments.

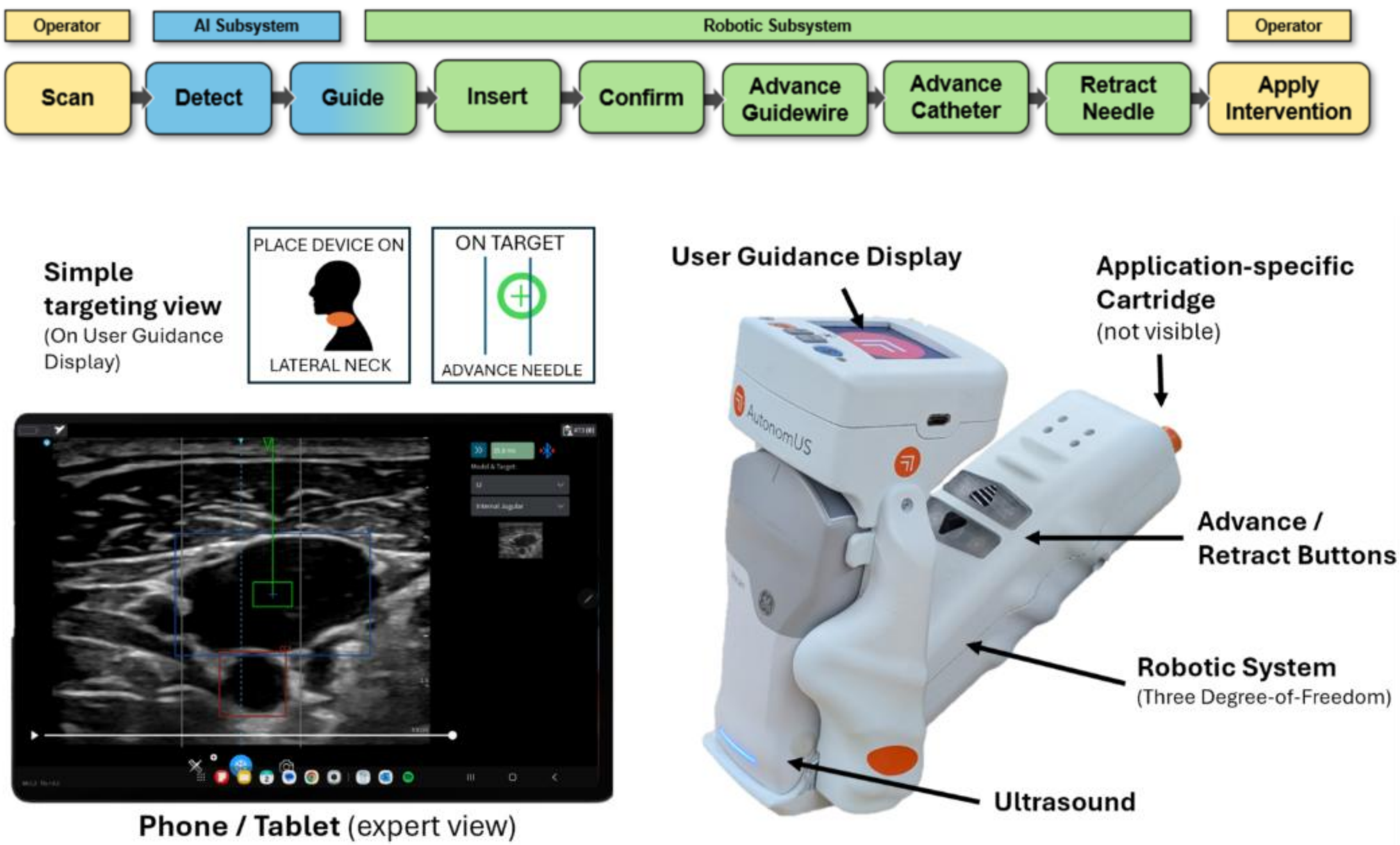


Successful, rapid, and automated vascular access can reduce procedural delays and improve patient outcomes.

Impact

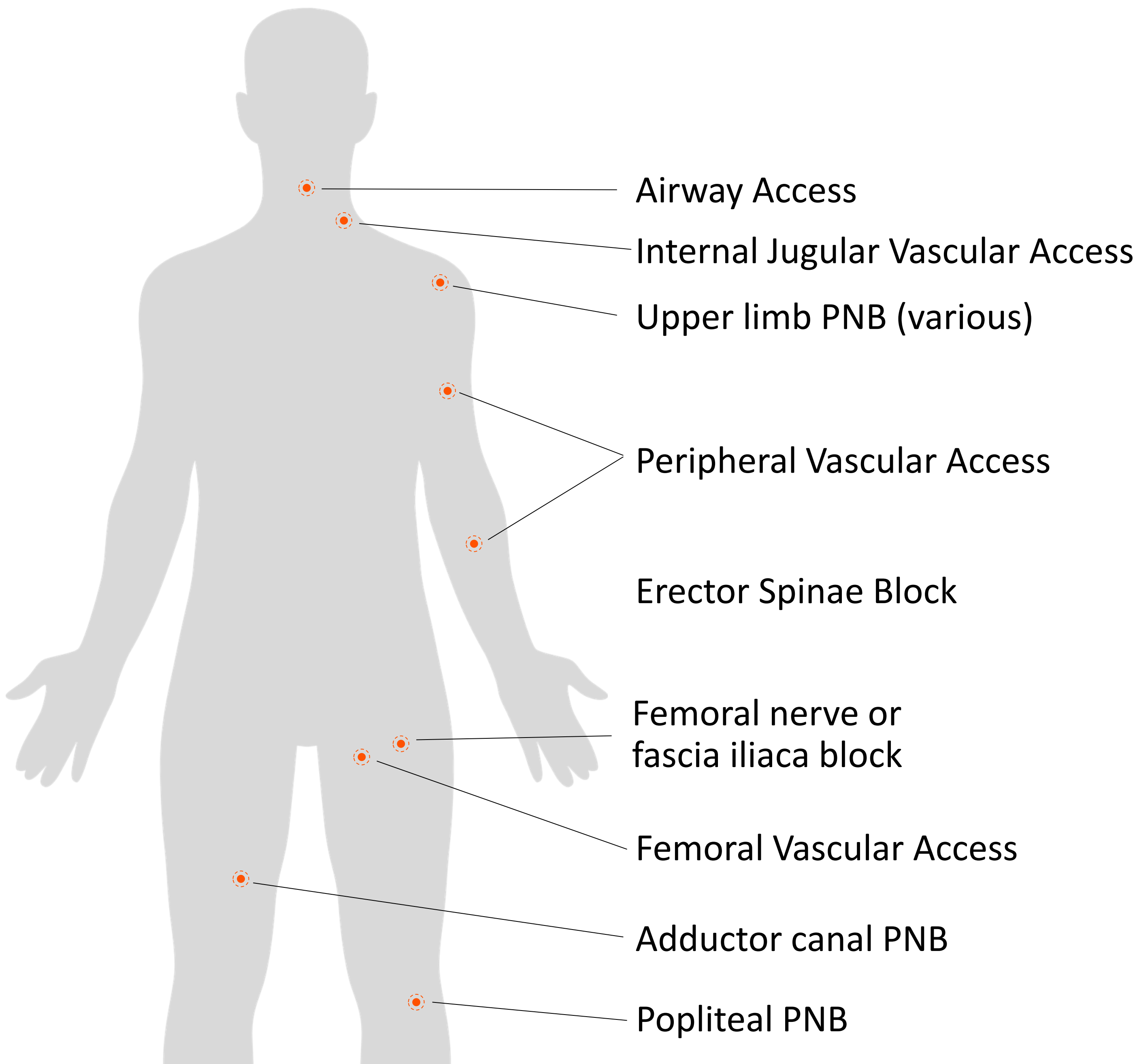
- AI-GUIDE will upskill any medic for the tasks of central vascular access (CVA) and peripheral nerve block (PNB).
- CVA has life-saving potential, as timely fluid and blood replacement reduces mortality associated with noncompressible hemorrhage. [3]
- PNBs offer warfighters targeted, effective pain relief without the cognitive fog, sedation, and respiratory depression that opioids and/or ketamine cause. As a result, PNBs reduce the need for ongoing supervision by medical personnel, and supports earlier mobilization and self-rescue, both critical in tactical settings.

AI-GUIDE™ - The Pocket Interventionalist™



- Application-specific cartridge designed for multiple interventions
- Handheld ultrasound transducer attachment for real-time, point-of-care imaging
- State-of-the-art robotic needle intervention system with AI-based sonoanatomical recognition
- Coordinated operator–AI–robotic system interaction enabling accurate needle insertion and guidewire placement

One Device – Many Applications



Learning Objective 1

- Describe the capabilities of AI-GUIDE, including its role in enabling central vascular access and peripheral nerve blocks using AI-guided ultrasound combined with robotic intervention.

Learning Objective 2

- Discuss the impact of AI-GUIDE on trauma care delivery, including improved procedural success and enhanced survivability in military and civilian resource-limited settings.

Learning Objective 3

- Evaluate the AI-GUIDE phantom and porcine performance outcomes including 95% porcine success rates and novice user acquisition times to determine readiness for field deployment.

Developmental Status

- TRL Level 5

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References

- [1] Brattain LJ, Pierce TT, Gjestebj LA, Johnson MR, DeLosa ND, Werblin JS, Gupta JF, Ozturk A, Wang X, Li Q, Telfer BA, Samir AE. AI-Enabled, Ultrasound-Guided Handheld Robotic Device for Femoral Vascular Access. Biosensors (Basel). 2021 Dec 18;11(12):522. doi: 10.3390/bios11120522. PMID: 34940279; PMCID: PMC8699246.
- [2] Shackelford SA, Del Junco DJ, Riesberg JC, Powell D, Mazuchowski EL, Kotwal RS, Loos PE, Montgomery HR, Remley MA, Gurney JM, Keenan S. Case-control analysis of prehospital death and prolonged field care survival during recent US military combat operations. J Trauma Acute Care Surg. 2021 Aug 1;91(2S Suppl 2):S186-S193. doi: 10.1097/TA.0000000000003252. PMID: 34324473
- [3] Nadler R, Gendler S, Benov A, Shina A, Baruch E, Twig G, Glassberg E. Intravenous access in the prehospital settings: What can be learned from point-of-injury experience. J Trauma Acute Care Surg. 2015 Aug;79(2):221-6. doi: 10.1097/TA.0000000000000723. PMID: 26218689.
- [4] Malchow RJ, Black IH. The evolution of pain management in the critically ill trauma patient: Emerging concepts from the global war on terrorism. Crit Care Med. 2008 Jul;36(7 Suppl):S346-57. doi: 10.1097/CCM.0b013e31817e2fc9. PMID: 18594262.

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