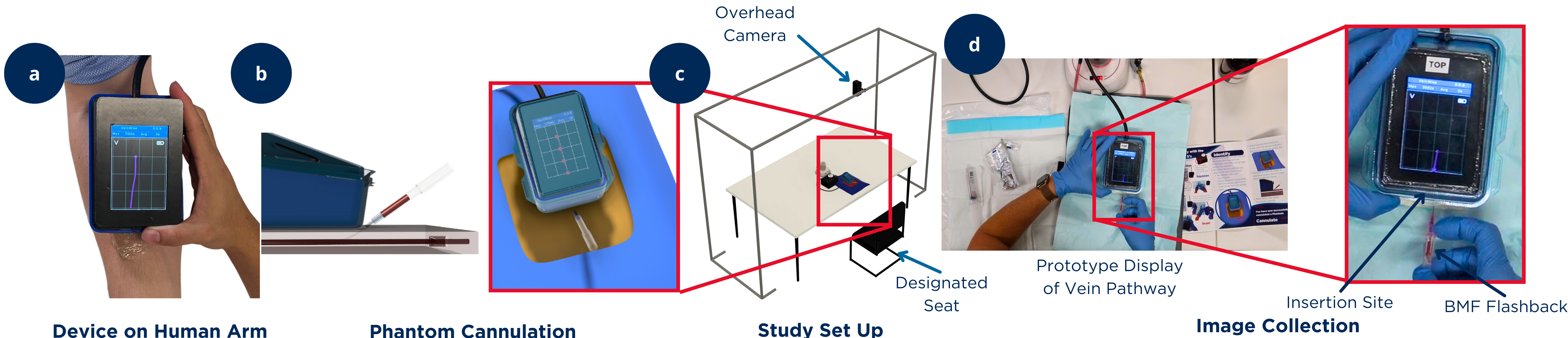


INTRODUCTION

Cannulation is one of the most common invasive medical procedure (1); however, it is well established that standard manual techniques lead to an **average 40% failure rate** (2,3). Here we present a **novel, ultraportable, ultrasound-based vein visualization device**, and a **simulation protocol** to evaluate vein visualization and as a potential cannulation insertion training tool. This study aims to demonstrate the **feasibility, repeatability, and reliability of the protocol** and presents preliminary data on **coronal view visualization usefulness**.

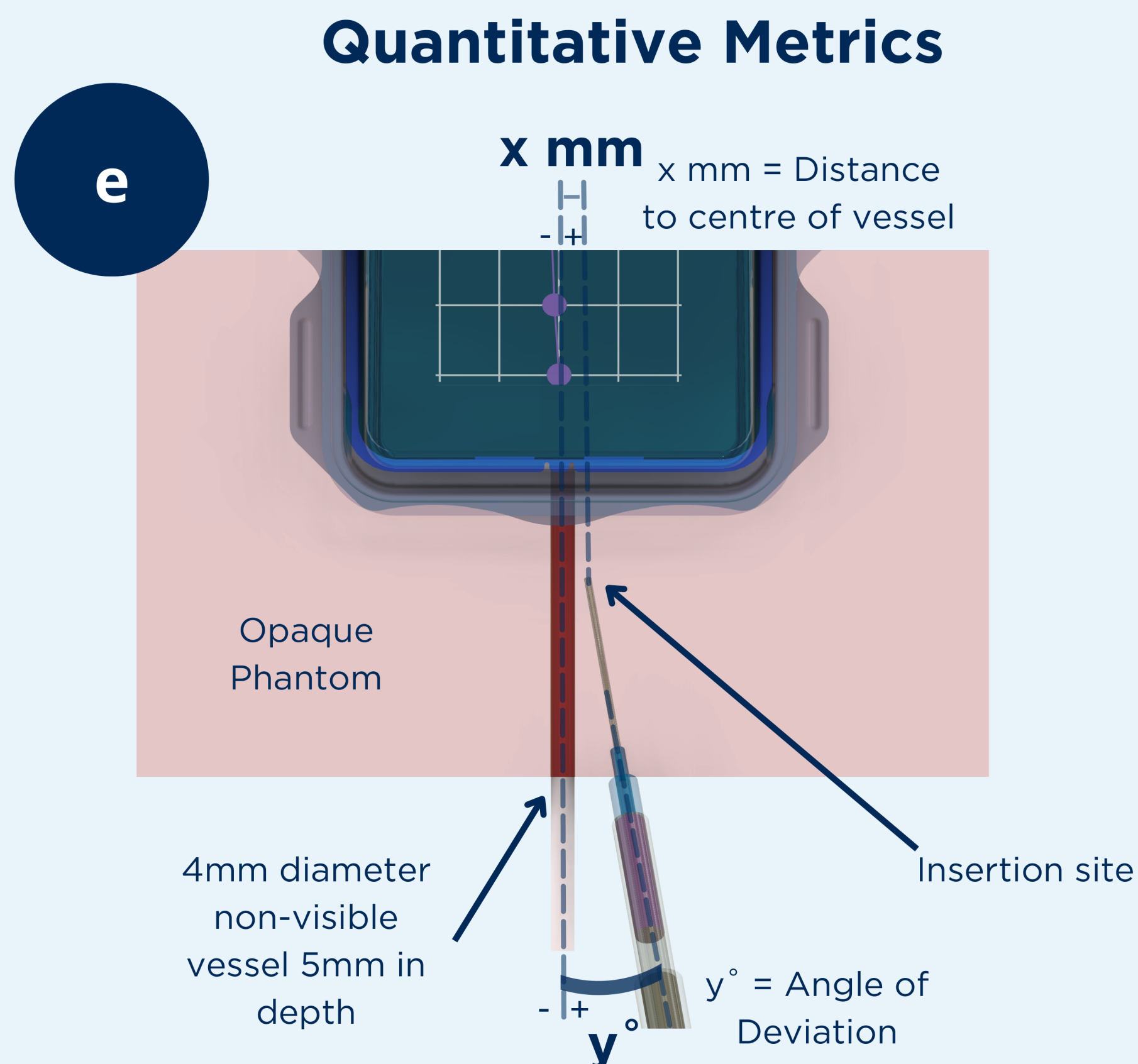
METHODS

First, we developed a prototype which detects well-perfused veins at depth and provides the coronal view of vein pathways (Fig. a). A protocol was developed using aspects from similar pilot studies (4,5). Ten consenting clinicians were instructed to prepare the prototype using aseptic technique, to find a **non-visible** and **non-palpable vein** in a phantom (diameter = 4mm; depth = 5mm), to then cannulate and achieve stable flashback. Fig. b highlights some of the diagrams used to train the clinicians. The procedure was recorded using the set-up illustrated in Fig c, producing the view highlighted in Fig d. This **methodology was used to assess quantitative metrics** (Fig e), and surveys evaluated usability metrics. We assessed the protocol's feasibility across participants.



RESULTS

When completed as intended (80%), **all** users could locate a non-visible vein using the prototype, rating it as easy to use and integrate into the aseptic cannulation workflow. **Stable flashback** was achieved on first pass 80% of the time and the cannula was **placed 0.12mm±1.30mm** (mean difference ±STD) to the left of the known centre of the vessel (illustrated in Fig. e as the distance to the centre of the vessel). When compared to the coronal pathway of the vessel, the cannula **approached at an angle of 0.03°±2.87°** (mean angle ±STD; illustrated in Fig. e as the angle of deviation).



Scan Me to View
the Training
Video

CONCLUSION

We have developed a robust protocol that could be used for **research and easy-of-use assessment**, as well as a **potential training tool**. Analysing the techniques performed by experienced clinicians in the video provides clear instructions on placing an intravenous cannulas and can help new clinicians self-evaluate and improve. The protocol was **repeatable and feasible**, with the 20% discrepancy primarily due to camera calibration and training limitations. Further, preliminary data on vessel visualization and procedural workflow shows promise on the reliability of the protocol to **assess the usefulness** of the device ahead of **clinical trial evaluation** and as a **cannulation insertion training tool**. The protocol provided feedback that coronal view visualization is simple to understand resulting in improved placement. The device **form factor, user-interface**, and the **display of well-perfused veins at depth in coronal view** could help in **reducing the insertion fail rate** and **improving correct vein selection**.

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