



Preferences for powered intraosseous access systems and features that enhance safety, reliability, and ease-of-use: results from two studies involving emergency medical providers

Drew Jones, MD¹; Kimberly Alsbrooks, BSN, RN, RT (R), VA-BC²; Andrew Little, DO²

¹Department of Emergency Medicine, AdventHealth East Orlando, Orlando, FL, USA; ²Becton, Dickinson and Company, Franklin Lakes, NJ, USA

Background and Objective

Background

- Intraosseous (IO) access is a method for obtaining rapid indirect vascular access during emergent situations when peripheral or central venous catheterization are difficult or unattainable.¹⁻³
- Battery-powered IO systems have demonstrated superiority over other IO systems (i.e., manual, spring-loaded);⁴ however, these systems have received little innovation since their introduction.
- A novel powered IO system with features that improve safety, reliability, and ease-of-use was recently introduced.

Objective

- This study aims to compare provider preferences and satisfaction rankings for the most commonly used (traditional) powered IO system, and a novel powered IO system featuring innovative design elements, including a passive safety needle, snap-securement/skin attachment, and a multi-light battery life indicator.

Methods

Study Design

- Two simulation and cross-sectional survey-based studies were completed to compare the novel (BD™ Intraosseous Vascular Access System; Beckon, Dickinson, and Company, NJ, USA) and traditional (EZ-IO Intraosseous Vascular Access System; Teleflex Medical, NC, USA) IO systems (**Table 1**).

Table 1: Participants and outcomes of the two featured studies

	Study One	Study Two
Participants	Emergency department (ED) physicians	Emergency medical services (EMS) providers
Outcomes	User preferences and reasoning for each IO system	Satisfaction rankings (maximum score: 100, lowest score: 0)

- In both studies, participants completed a training session and an IO-simulation with each system, and a post-simulation questionnaire featuring multiple-choice, 11-point Likert-like satisfaction ranking, and free-text answers.
- Participants assessed various design features of the two IO systems (**Table 2**).
- Statistical significances were evaluated using a two-sided Z test or a Wilcoxon signed rank-sum test.

Table 2: Traditional and novel IO system design features

	Traditional IO system ^a	Novel IO system ^b
Powered driver	Non-rechargeable/irreplaceable lithium battery Single LED light battery life indicator	Rechargeable battery Multi-LED light battery life indicator
IO needle	Manual sharps securement block for needle safety 3 needle length options: 15 mm, 25 mm, and 45 mm	Passive safety mechanism that is automatically engaged to surround the needle stylet 5 needle length options: 15 mm, 25 mm, 35 mm, 45 mm, and 55 mm
Snap-securement/skin attachment	Telescoping securement/dressing that must be placed prior to extension set attachment	Dynamic snap-securement/dressing that can open and close around the needle hub

Abbreviations: LED, light-emitting diode
^a Traditional IO system: EZ-IO Intraosseous Vascular Access System; Teleflex Medical, NC, USA
^b Novel IO system: BD™ Intraosseous Vascular Access System; Beckon, Dickinson, and Company, NJ, USA

Results

Study One

- 20 of 22 ED physicians preferred the novel IO system (91.0%; p=0.0001; **Figure 1**) and cited the system's passive safety needle and snap-securement/skin attachment as top rationales (**Table 3**).
- The majority of ED physicians also preferred the novel IO system's powered driver (n=17; 77.3%), IO needle with passive safety (n=18; 81.8%), and snap-securement/skin attachment (n=22; 100.0%; **Figure 1**).

Figure 1: Preferred powered IO system (n=22)

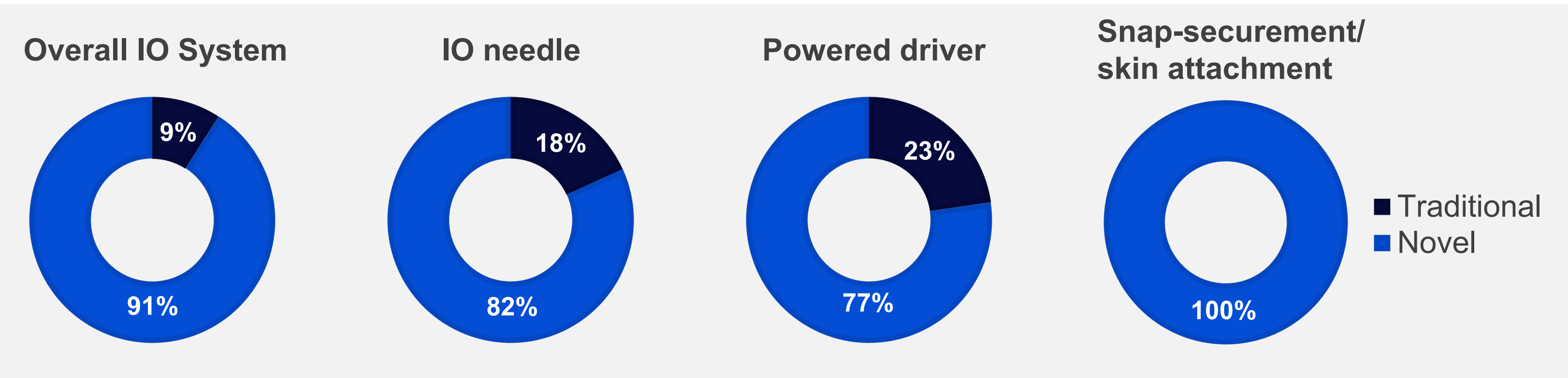


Table 3: Most common reasons for preference (n=22)

	Traditional IO system ^a Reason, n (%)	Novel IO system ^b Reason, n (%)
Overall IO system	Ease-of-use: 1 (4.5) Familiarity: 1 (4.5)	Safety: 12 (54.5) Snap-securement/skin attachment: 6 (27.2)
IO needle	Ease-of-use: 3 (13.6) Familiarity: 1 (4.5)	Safety: 14 (63.6) Ease-of-use: 4 (18.2)
Powered driver	Ergonomics: 3 (13.6) Ease-of-use: 3 (13.6)	Ergonomics: 6 (27.3) Rechargeability: 5 (22.7)
Snap-securement/skin attachment	N/A	Ease-of-use: 10 (45.5) Snap-on feature: 4 (13.6)

Abbreviations: N/A, not applicable
^a Traditional IO system: EZ-IO IO Access System; Teleflex Medical, NC, USA
^b Novel IO system: BD™ Intraosseous Vascular Access System; Becton, Dickinson, and Company, NJ, USA

Study Two

- The 42 participating EMS providers were primarily paramedics, basic and advanced emergency medical technicians, and military medics, with a mean of 9.5 ± 8.0 years of experience operating IO systems.
- EMS providers identified safety and powered driver performance to be the most important considerations when selecting a powered IO device.
- Participants showed significantly higher satisfaction scores for the novel IO system in IO needle safety, battery life indicator, snap-securement/skin attachment, and overall system satisfaction, safety, and ease-of-use (**Table 4**).

Table 4: Mean satisfaction scores between the traditional and novel IO systems (n=42)

Feature satisfaction rating,* Mean ± SD	Traditional IO system ^a	Novel IO system ^b	P-value ^c
Overall Satisfaction	68.3 ± 19.6	83.6 ± 15.4	<0.001
Overall IO System Safety	66.4 ± 23.9	92.1 ± 17.5	<0.001
Overall IO System Ease-of-Use	75.0 ± 20.5	90.7 ± 18.4	<0.001
IO Needle Safety	57.9 ± 22.4	87.9 ± 20.3	<0.001
Variety of IO Needle Length Options	73.6 ± 17.1	90.0 ± 17.1	<0.001
Battery Life Indicator ^d	62.4 ± 26.3	92.6 ± 15.8	<0.001
Battery Type ^e	50.5 ± 31.5	91.7 ± 22.3	<0.001
Securement/Skin Attachment	61.0 ± 27.1	90.2 ± 20.5	<0.001
Powered Driver Ergonomics	81.2 ± 18.2	88.6 ± 16.2	0.022
IO Needle Performance	83.8 ± 15.8	88.6 ± 14.6	0.092
Powered Driver Performance	87.1 ± 15.3	88.1 ± 18.2	0.421

* 0 = lowest satisfaction, 100 = highest satisfaction
^a Traditional IO system: EZ-IO IO Access System; Teleflex Medical, NC, USA
^b Novel IO system: BD™ Intraosseous Vascular Access System; Becton, Dickinson, and Company, NJ, USA
^c Differences in distribution of variables across the two devices were examined by Wilcoxon signed rank sum test
^d i.e., multi-light, single light
^e i.e., rechargeable, non-rechargeable

Conclusions

- Provider preferences regarding IO device features may influence the efficiency and success of an IO procedure, which may impact patient care and related outcomes.
- These findings illustrate that ED physicians prefer a novel IO system with enhanced safety and ease-of-use, and EMS providers are more satisfied with a novel IO system featuring a passive safety needle, multi-light battery life indicator, and snap-securement/skin attachment.
- Collectively, these results highlight the importance of safety and ease-of-use in powered IO systems, as well as the value of clinician input when evaluating novel medical equipment.
- Future studies regarding IO system performance and impact on procedures are warranted for continued innovation.

References

- Leidel BA, Kirchhoff C, Bogner V, Stegmaier J, Mutschler W, Kanz KG, et al. Is the intraosseous access route fast and efficacious compared to conventional central venous catheterization in adult patients under resuscitation in the emergency department? A prospective observational pilot study. *Patient Saf Surg.* 2009;3(1):24.
- Merchant RM, Topjian AA, Panchal AR, Cheng A, Aziz K, Berg KM, et al. Part 1: Executive Summary: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation.* 2020;142(16_suppl_2):S337-S57.
- Perkins GD, Graesner JT, Semeraro F, Olasveengen T, Soar J, Lott C, et al. European Resuscitation Council Guidelines 2021: Executive summary. *Resuscitation.* 2021;161:1-60.
- Weiser G, Hoffmann Y, Galbraith R, Shavit I. Current advances in intraosseous infusion - a systematic review. *Resuscitation.* 2012;83(1):20-6.