Analytical Plan for Efficacy of a novel medical device to aid in ultrasound-guided intravenous cannulation: randomized controlled non-clinical trial

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Document version

Version	Alterations
01	Initial version

1 ABBREVIATIONS

- CI: confidence interval
- SD: standard deviation

2 CONTEXT

2.1 Objectives

To determine the efficacy of a novel medical device for aiding in ultrasound-guided intravenous cannulation procedures.

2.2 Hypotheses

The average time of cannulation using the device is different from the control group.

3 DATA

3.1 Raw data

Upon study start the raw data will be collected in a raw table, that will be processed before analysis. Data collection will be conducted with the instrument described in **SAR-2023-020-IJ-v01**. The raw dataset to be collected will have 11 variables.

Level of experience will be recorded as a continuous variable, measured in years. Time until successful cannulation will be measured in the raw data as hours, minutes, seconds. If the participant takes an unreasonable amount of time to perform the procedure, the time measurement will be stopped and recorded at the last observed time. This

censored measurement will be reported “as is” in the descriptive analysis (described in section 5.1.1) and treated as a missing value for the efficacy analysis (section 5.1.3).

3.2 Analytical dataset

Age will be calculated as the number of whole years between the date of birth and the date of the experiment with calendar accuracy. Time until cannulation will be converted to seconds for analysis.

The raw data table will be reshaped to a long format in which each row represents one single measurement from a single individual participant, thus each individual will contribute with two rows in the analytic dataset.

After the cleaning process 7 variables will be included in the analysis. The total number of observations excluded due to incompleteness and exclusion criteria will be reported in the analysis. Table 1 shows the structure of the analytical dataset.

Table 1 *Analytical dataset structure after variable selection and cleaning.*

id	sex	age	experience	exposure	outcome	easy
1						
1						
2						
2						
…						
2N						

All variables in the analytical set were labeled according to the raw data provided and values were labeled according to the data dictionary for the preparation of production-quality results tables and figures.

4 STUDY PARAMETERS

4.1 Study design

Randomized controlled non-clinical trial, with two arms paired at the individual level. The measure of efficacy is defined as the average in the difference between groups of the time until successful cannulation.

Participants will be recruited from the healthcare professional force, that would perform the ultrasound-guided intravenous cannulation in patient management. The procedure will be performed on a synthetic test subject, so no patients will be exposed to procedural risks in this study.

The procedure will be performed in a standardized manner, defined in the study Protocol and receive the same instructions, regardless of prior experience (see section

6). All participants will perform the procedure twice, both using and not using the device, always using the same test subject. As such the participants are paired with themselves, contributing with one measurement in each group. The order in which they perform the procedures will be randomized.

4.2 Inclusion and exclusion criteria

N/A

4.3 Exposures

Exposed test group will be using the medical device under investigation, whereas the control group will perform the unaided procedure.

4.4 Outcomes

Specification of outcome measures (Zarin, 2011):

1. (Domain) ultrasound-guided intravenous cannulation
2. (Specific measurement) Time until successfully finding the vein
3. (Specific metric) End-value
4. (Method of aggregation) Mean

Primary outcome

Average time of ultrasound-guided intravenous cannulation until successfully finding the vein.

4.5 Covariates

- Level of experience, in years;
- Participant id (as a random effect term, see section 5.1.3).

5 STATISTICAL METHODS

5.1 Statistical analyses

5.1.1 Descriptive analyses

The epidemiological profile of the study participants will be described. Demographic will be described as mean (SD) or as counts and proportions (%), as appropriate. The distributions of participants' characteristics will be summarized in tables and visualized in exploratory plots.

5.1.2 Inferential analyses

All inferential analyses will be performed in the statistical models (described in the next section).

5.1.3 Statistical modeling

The efficacy measure of effect will be estimated from a multiple linear mixed-effects model using the participant id as a random term to account for the paired design of the study, and control for the experience. We plan to test for interactions between the group and experience, and if significant, those will be reported as the main effect of efficacy.

5.1.4 Missing data

No missing data imputation will be performed. All evaluations will be performed as complete case analyses. Missing data counts and proportions will be reported in tables.

5.2 Significance and Confidence Intervals

All analyses will be performed using the significance level of 5%. All significance hypothesis tests and confidence intervals computed will be two-tailed.

5.3 Study size and Power

Participant recruitment effort is planned to achieve 20 participants in each of three levels of experience in performing the procedure (inexperienced, experienced and expert), for a total of 60 participants.

5.4 Statistical packages

This analysis will be performed using statistical software R version 4.3.0.

6 OBSERVATIONS AND LIMITATIONS

Independence of observations

To assess the impact of prior experience in performing the cannulation it is important that all participants are subject to the same experimental conditions. One way of ensuring this is to standardize the procedure in the Study Protocol, so everyone that performs it does so following the same steps. Whether this includes a warm up session or practice runs before the actual measurement, everyone should be exposed to the same instructions and proceed according to the protocol. This way time will be comparable between subjects and experience will modulate the length of the procedure.

Recommended reporting guideline

The adoption of the EQUATOR network (http://www.equator-network.org/) reporting guidelines have seen increasing adoption by scientific journals. All clinical trials are recommended to be reported following the CONSORT guideline (Schulz K F, Altman D G, Moher D., 2010).

7 REFERENCES

- **SAR-2023-020-IJ-v01** – Data collection instrument for Efficacy of a novel medical device to aid in ultrasound-guided intravenous cannulation: randomized controlled non-clinical trial
- Zarin DA, et al. The ClinicalTrials.gov results database – update and key issues. N Engl J Med 2011;364:852-60 (https://doi.org/10.1056/NEJMsa1012065).
- Gamble C, et al. Guidelines for the Content of Statistical Analysis Plans in Clinical Trials. JAMA. 2017;318(23):2337–2343 (https://doi.org/10.1001/jama.2017.18556).
- Schulz K F, Altman D G, Moher D. CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials BMJ 2010; 340 :c332 (https://doi.org/10.1136/bmj.c332).

8 APPENDIX

This document was elaborated following recommendations on the structure for Statistical Analysis Plans (Gamble, 2017) for better transparency and clarity.

8.1 Availability

All documents from this consultation were included in the consultant's Portfolio.

The portfolio is available at:

https://philsf-biostat.github.io/SAR-2023-019-IJ/

8.2 Associated analyses

This document is part of a larger project and is supported by other analyses, linked below.

Data collection instrument for Efficacy of a novel medical device to aid in ultrasound-guided intravenous cannulation: randomized controlled non-clinical trial

https://philsf-biostat.github.io/SAR-2023-020-IJ/

The analysis will be done and the study results described in a future report. A link to the report page will be included in the link above, in the consultant's Portfolio.