Effect of prehospital ultrasound on the time of helicopter emergency transfers: cross-sectional study

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Document version

Version	Alterations
01	Initial version

1 ABBREVIATIONS

- CI: confidence interval
- pRBC:
- SD: standard deviation

2 CONTEXT

2.1 Objectives

To determine the effect of a mobile ultrasound device on the time of care in helicopter emergency transfers.

3 METHODS

The data procedures, design and analysis methods used in this report are fully described in the annex document **SAP-2023-027-HK-v01**.

This analysis was performed using statistical software R version 4.3.0.

4 RESULTS

4.1 Study population and follow up

In total, data from 439 participants were included in the study. Most participants included were male (64%), aged between 10 and 93 years with an average (SD) of 57 (19) years. Table 1 shows the participants' characteristics by group.

Table 1 *Participant characteristics by exposure to prehospital ultrasound.*

Characteristic	Unexposed, N = 197	Exposed, N = 242
Time at bedside (min), Mean (SD)	32 (23)	48 (33)
Missing	0	1
Age, Mean (SD)	59 (18)	55 (19)
Missing	0	1
Gender, n (%)		
Female	68 (35%)	89 (37%)
Male	129 (65%)	153 (63%)
Type of transfer, n (%)		
Interfacility	170 (86%)	147 (61%)
Scene	27 (14%)	95 (39%)
Other	0 (0%)	0 (0%)
Type of call, n (%)		
Medical	145 (74%)	140 (58%)
Trauma	51 (26%)	102 (42%)
Other	1 (0.5%)	0 (0%)
Air/ground, n (%)		
Air	193 (98%)	224 (93%)
Ground	4 (2.0%)	18 (7.4%)
pRBC, n (%)	15 (7.6%)	48 (20%)
Vasopressor, n (%)	31 (16%)	106 (44%)
Fluids during flight, n (%)	43 (22%)	125 (52%)
Intubation, n (%)	56 (28%)	116 (48%)
Disposition, n (%)		
ED	89 (45%)	123 (51%)
ICU	72 (37%)	78 (32%)
Floor	5 (2.5%)	0 (0%)
Expired	5 (2.5%)	16 (6.6%)
Other	26 (13%)	25 (10%)
Specialty call, n (%)	4 (2.0%)	5 (2.1%)

Average (SD) time at bedside for participants not exposed to prehospital ultrasound was 32 (23) minutes, whereas for those exposed time was 48 (33) minutes (Figure 1). The distribution densities of time for each group show a large accumulation of participants at the lower end of the observed range, with a small proportion requiring much larger amounts of time for the overall procedures. These distributions resemble a log-normal distribution, so it is worth considering a logarithm transformation for the analysis (see next section).

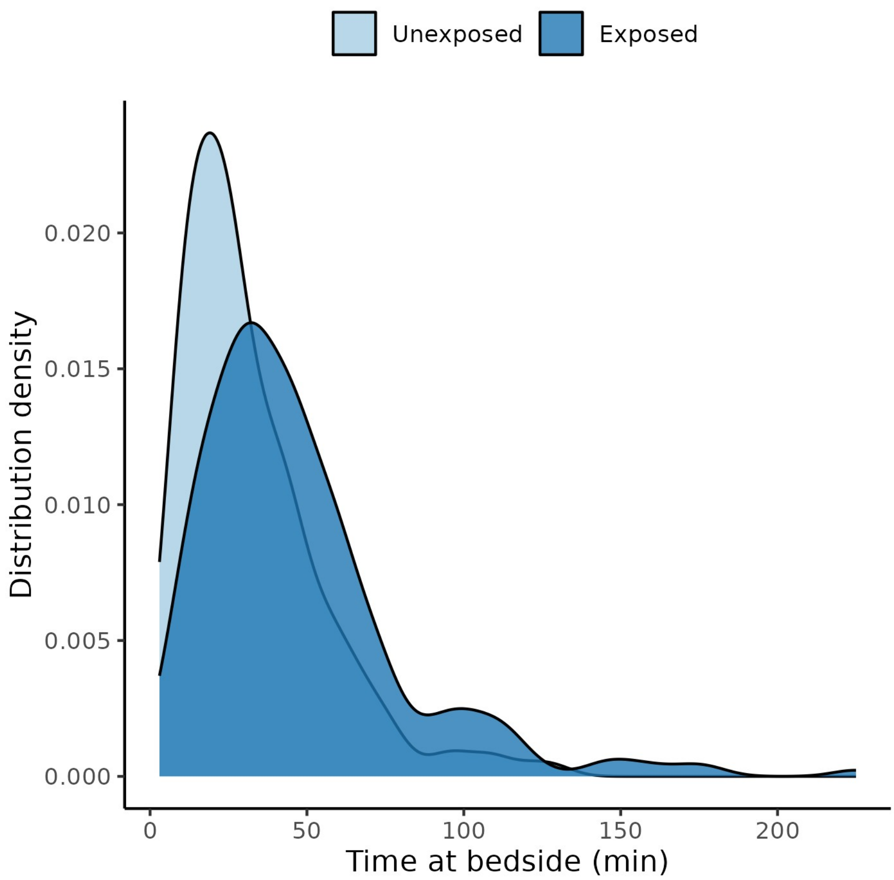

***Figure 1** Distribution of time at bedside, by exposure to prehospital ultrasound.*

One participant had a non-standard coding of Vasopressor (encoded as 2 in the raw data). That value was assumed to be 1 (yes) and corrected accordingly.

4.2 Effect of prehospital ultrasound on the time at bedside

The logarithm of time was fit to the data, controlling for all covariates (see section 8.2).

The intercept of the model fit to the full dataset was 3.097 log-minutes which corresponds to a basal average of 22 minutes, before adding the effects of individual variables. Participants who were exposed to a prehospital ultrasound procedure experienced times 21% significantly longer (CI: 9% to 34% minutes), than those who weren't (Table 2). This model was fit with 437 participants and its adjusted R^2 is 56.6%.

***Table 2** Effect of prehospital ultrasound on the logarithm of time at bedside.*

	Full dataset			Period-matched dataset		
Characteristic	**Beta**[1]	**95% CI**[2]	**p-value**	**Beta**[1]	**95% CI**[2]	**p-value**
Prehospital ultrasound						
Unexposed	—	—		—	—	
Exposed	0.19	0.09 to 0.29	**<0.001**	0.09	-0.05 to 0.23	0.225

[1]Adjusted for age, sex, type of transfer, type of call, air ground, pRBC, vasopressors, fluids, intubation, disposition and whether it was a specialty call

[2]CI = Confidence Interval

When considering only the 2022 data (N = 290, adjusted R^2 = 56.0%), the basal average was 3.046 log-minutes (21 minutes). The impact of using prehospital ultrasound was 9% longer than not using it, but it cannot be consistently detected in that dataset (CI: -5% to 26% minutes).

The difference in magnitude of effects between datasets is large. The analysis matching the time period differs 46% from the full data, and it can be presumed that there is still unmeasured confounding. Conversely, the model fit (measured by the adjusted R^2) does not differ by a large margin between models. As such, the analysis on the matched data will be chosen as a better estimate of the true effect of the usage of a prehospital ultrasound procedure on the time at bedside.

Under this assumption, the predicted extra time required to perform the procedure is around 2 minutes. It should be noted that, while the estimate is not significantly higher, the upper limit of confidence in the additional time required is around 5 minutes.

5 OBSERVATIONS AND LIMITATIONS

Risk of bias

There is the risk of selection bias in the study sample. Data from the exposed span the period between 2018 to 2023, whereas the unexposed group only has observations from 2022. This is important especially considering that the critical period of the COVID-19 pandemic was included only in the exposed group. The sensitivity analysis planned is intended to look for evidence of bias in the study sample. If the estimates obtained from both datasets differ by a large amount, selection bias will be assumed to be present and the period-matching estimates will be reported as the less biased estimate for the true effect.

Recommended reporting guideline

The adoption of the EQUATOR network (http://www.equator-network.org/) reporting guidelines have seen increasing adoption by scientific journals. All observational studies are recommended to be reported following the STROBE guideline (von Elm et al, 2014).

In particular when a retrospective study is conducted using hospital records, it is recommended that the RECORD extension of the STROBE guideline is considered (Benchimol et al, 2015).

6 CONCLUSIONS

There is no significant increase in the total time at bedside when a prehospital ultrasound procedure is included. The predicted additional time required to perform the procedure is 2 minutes with an upper limit of confidence of 5 minutes.

7 REFERENCES

- **SAP-2023-027-HK-v01** – Analytical Plan for Effect of prehospital ultrasound on the time of helicopter emergency transfers: cross-sectional study
- von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. Int J Surg. 2014 Dec;12(12):1495-9 (https://doi.org/10.1016/j.ijsu.2014.07.013).
- Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM; RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement. PLoS Med. 2015 Oct 6;12(10):e1001885 (https://doi.org/10.1371/journal.pmed.1001885).

8 APPENDIX

8.1 Exploratory data analysis

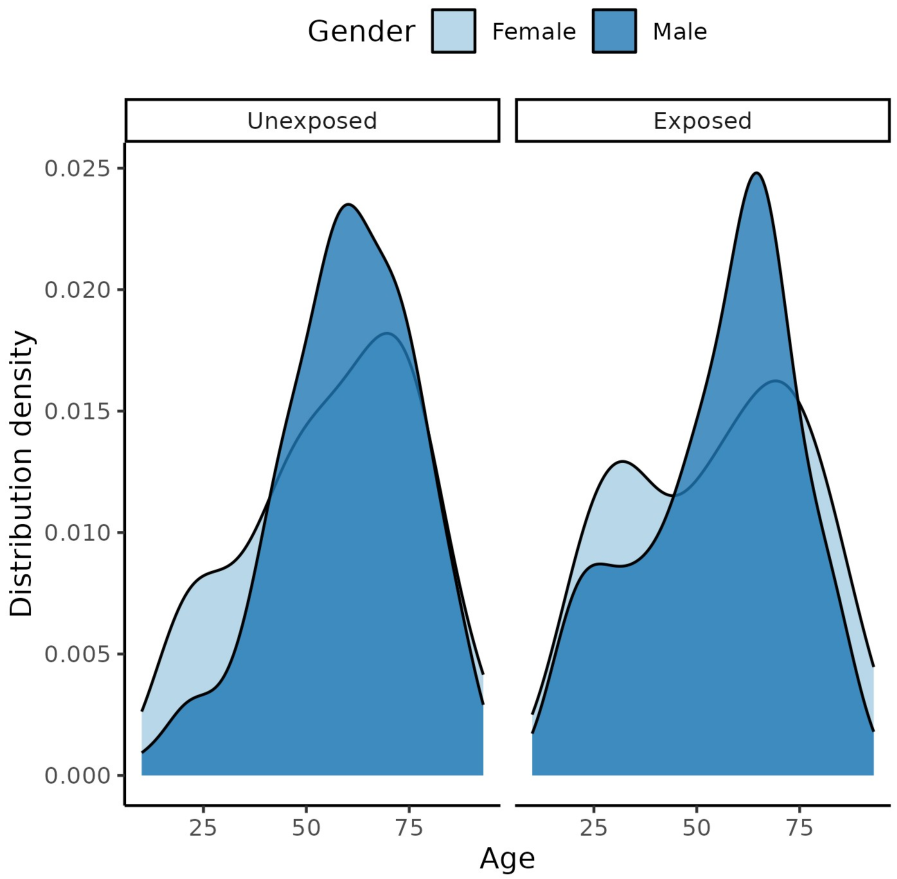

Figure A1 *Distribution of age in the study population.*

8.2 Modeling strategy

Figure A2 shows various perspectives on the residuals of the model fit with the full dataset. The QQ plot (upper-right panel) shows a strong deviation and the normality assumption on the residuals can be rejected. Additionally there is a perceivable trend in the scale-location plot (lower-left panel). By transforming the outcome with the logarithm (Figure A3) the deviation is no longer apparent and no trends are apparent in other plots.

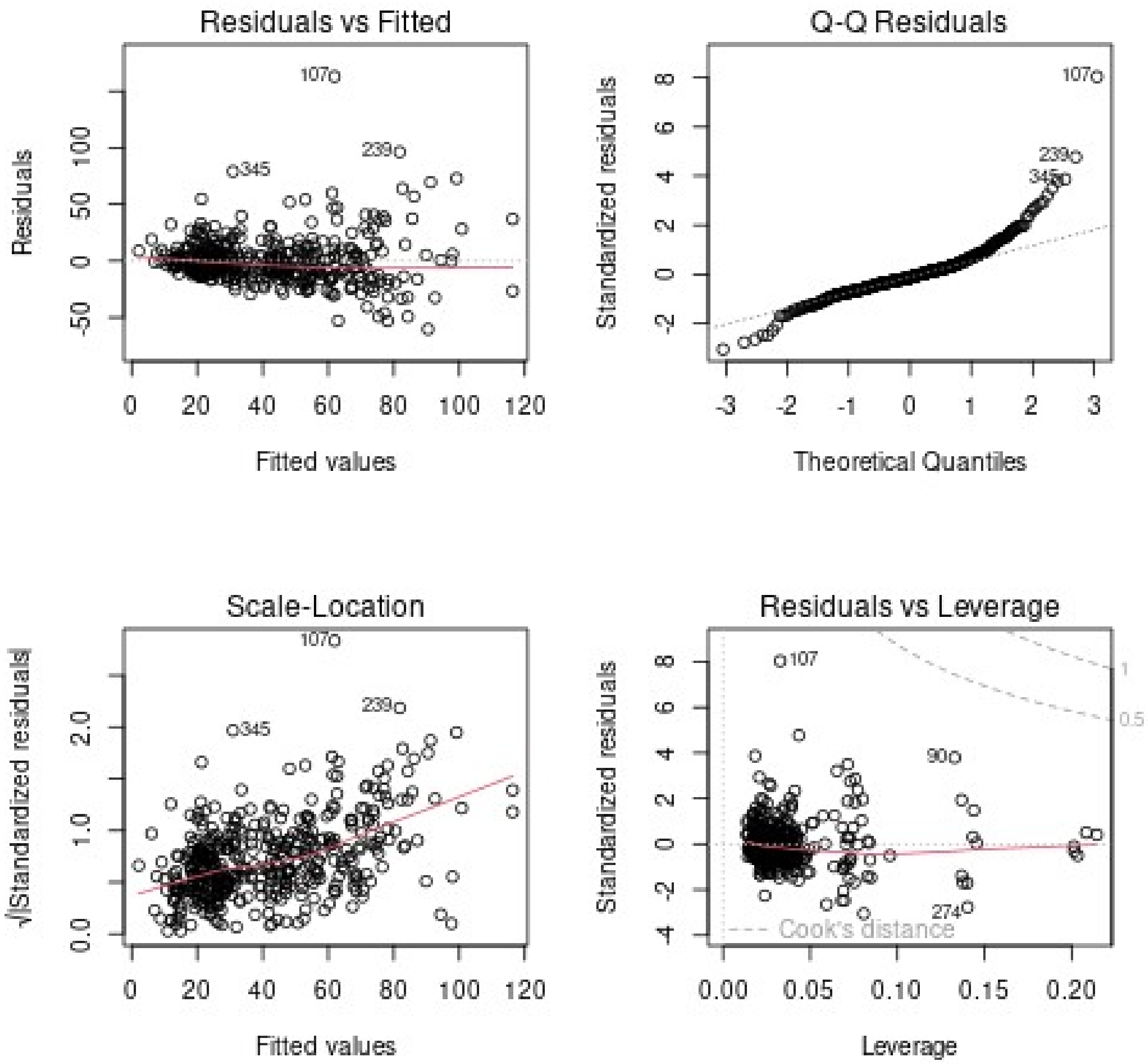

Figure A2 *Residual analysis of time at bedside.*

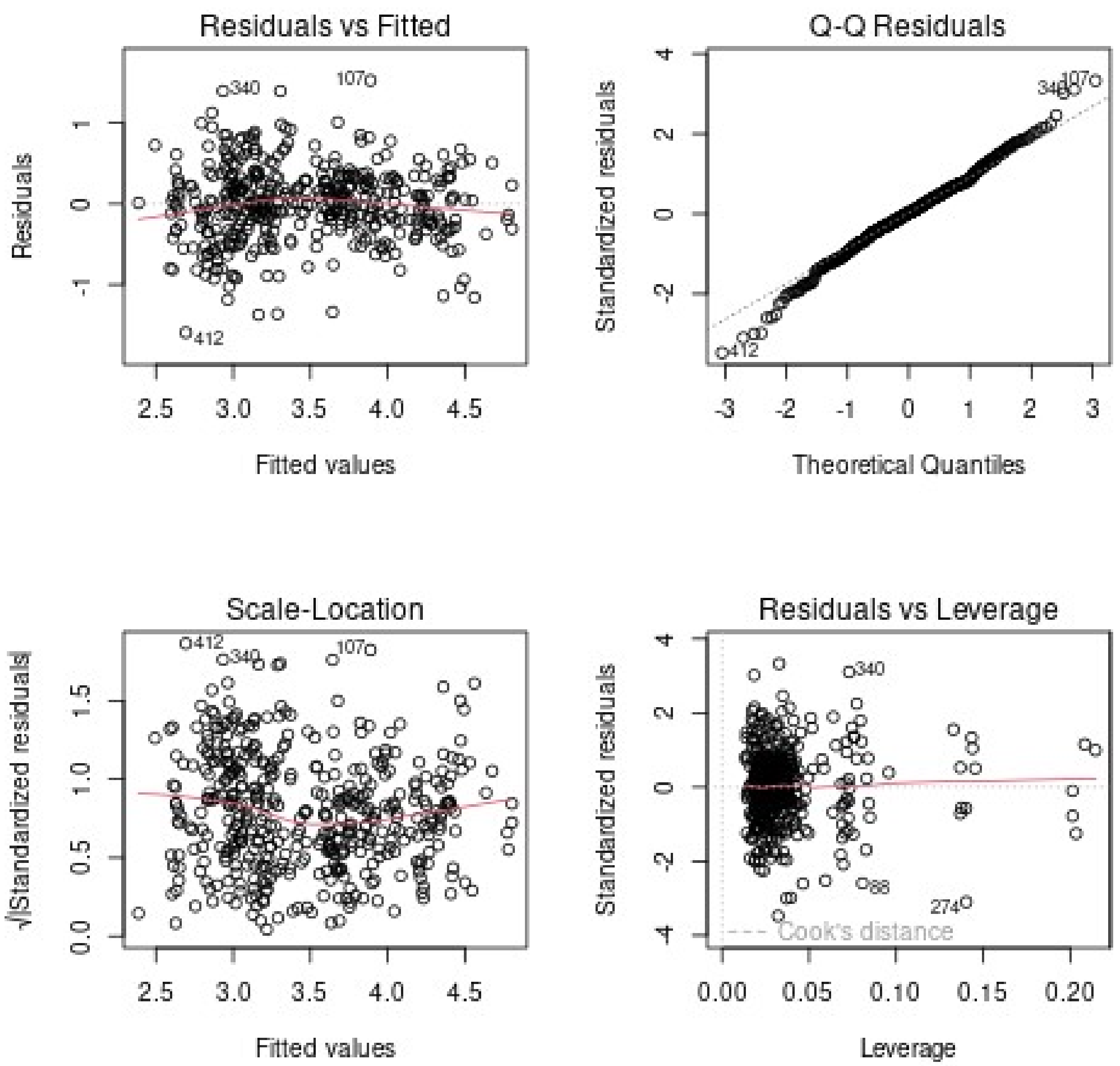

Figure A3 *Residual analysis of log-transformed time at bedside.*

Table A1 Alternative version of Table 2, showing the coefficients for all covariates.

	Full dataset			Period-matched dataset		
Characteristic	**Beta**	**95% CI**[1]	**p-value**	**Beta**	**95% CI**[1]	**p-value**
Prehospital ultrasound						
Unexposed	—	—		—	—	
Exposed	0.19	0.09 to 0.29	**<0.001**	0.09	-0.05 to 0.23	0.225
Gender						
Female	—	—		—	—	
Male	-0.14	-0.23 to -0.04	**0.005**	-0.23	-0.35 to -0.12	**<0.001**
Age	0.00	0.00 to 0.00	0.239	0.00	0.00 to 0.00	0.545
Type of transfer						
Interfacility	—	—		—	—	
Scene	-0.24	-0.37 to -0.12	**<0.001**	-0.27	-0.44 to -0.11	**0.001**
Type of call						
Medical	—	—		—	—	
Trauma	0.15	0.01 to 0.29	**0.038**	0.21	0.04 to 0.38	**0.013**
Other	0.27	-0.66 to 1.2	0.565	0.17	-0.79 to 1.1	0.731
Air/ground						
Air	—	—		—	—	
Ground	0.16	-0.06 to 0.37	0.148	0.46	0.15 to 0.78	**0.004**

	Full dataset			Period-matched dataset		
Characteristic	**Beta**	**95% CI**[1]	**p-value**	**Beta**	**95% CI**[1]	**p-value**
pRBC	0.07	-0.07 to 0.21	0.313	0.04	-0.15 to 0.23	0.681
Vasopressor	0.28	0.16 to 0.41	**<0.001**	0.28	0.11 to 0.46	**0.001**
Fluids during flight	0.08	-0.02 to 0.18	0.120	0.08	-0.05 to 0.22	0.217
Intubation	0.59	0.48 to 0.70	**<0.001**	0.61	0.46 to 0.75	**<0.001**
Disposition						
ED	—	—		—	—	
ICU	0.29	0.16 to 0.42	**<0.001**	0.41	0.25 to 0.58	**<0.001**
Floor	0.02	-0.41 to 0.45	0.940	0.12	-0.32 to 0.57	0.589
Expired	0.37	0.15 to 0.60	**0.001**	0.47	0.14 to 0.81	**0.006**
Other	-0.23	-0.40 to -0.07	**0.006**	-0.09	-0.28 to 0.11	0.379
Specialty call	0.25	-0.08 to 0.58	0.139	-0.21	-0.71 to 0.30	0.423

[1]CI = Confidence Interval

8.3 Associated analyses

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

Reliability of prehospital ultrasound in helicopter emergency transfers: cross-sectional study

https://philsf-biostat.github.io/SAR-2023-026-HK/

8.4 Availability

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

The portfolio is available at:

https://philsf-biostat.github.io/SAR-2023-027-HK/

8.5 Analytical dataset

Table A2 shows the structure of the analytical dataset.

Table A2 *Analytical dataset structure*

id	exposure	outcome	age	gender	type_transfer	type_call	air_ground	rbc	vasopressor	fluids	intubation	disposition	specialty	year
1														
2														
3														
…														
N														

Due to confidentiality the data-set used in this analysis cannot be shared online in the public version of this report.