Effect of healthcare interventions on the average number of ER visits: cross-sectional study

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Document version

Version	Alterations
01	Initial version

1 ABBREVIATIONS

- CI: confidence interval
- CV: coefficient of variation
- ER: emergency room
- SD: standard deviation

2 CONTEXT

In the context of Hospital Quality, there is an incentive to reduce the number of unnecessary ER visits that patients might need. This study explores whether a set of interventions performed by the nursing department are associated with an effect on the average number of ER visits.

2.1 Objectives

To assess whether the use of various nursing interventions in healthcare are associated with a change in the average number of emergency care visits by patients in Atrium Health Cabarrus hospital.

3 METHODS

The data procedures, design and analysis methods used in this report are fully described in the annex document **SAP-2023-013-DB-v01**.

This analysis was performed using statistical software R version 4.2.1.

4 RESULTS

4.1 Study population and follow up

A total of 26 participants were enrolled between 2022-10-17 to 2023-01-09. Of those, 19 (73%) were women and the average (SD) age of the study sample was 52 (19) years.

Overall the average (SD) number of ER visits at baseline was 3.12 (1.60) visits. This appears to drop to an average (SD) of 2.27 (2.15) visits at the end of the study period, regardless of interventions used. Given the reduced sample size, the observed variability was too large to allow for precise estimations, particularly in the outcome measure. The CV of baseline number of visits was 51.1%, the CV of end of study was 94.6% and the CV of the difference was 242.5%. This makes it hard to estimate small changes at the end of study, and it might be impractical to estimate small changes in the difference between time points.

Table 1 *Epidemiological and clinical characteristics of study participants.*

Characteristic	N = 26
Age (years), Mean (SD)	52 (19)
Sex, n (%)	
F	19 (73%)
M	7 (27%)
Number of ER visits at baseline, Mean (SD)	3.12 (1.60)
Number of ER visits at end of study, Mean (SD)	2.27 (2.15)
Insurance, n (%)	
Public	24 (92%)
Self-Pay	2 (7.7%)
Appointment made fo PCP or specialists, n (%)	20 (77%)

Characteristic	N = 26
Reminders via phone call or text, n (%)	12 (46%)
Education, n (%)	3 (12%)
Referral to community paramedicine or home health, n (%)	3 (12%)
Connection to availible community resources, n (%)	2 (7.7%)
Referral to existing disease specific navigation programs, n (%)	4 (15%)
Transportation arrangement to and from appointments, n (%)	4 (15%)
Urgent care utilization as a bridge to primary care, n (%)	1 (3.8%)
Telepresence at specified appointments, n (%)	1 (3.8%)
Medication and pharmacy, n (%)	0 (0%)

Besides the large variability in outcomes relative to their average, the allocation to exposures was highly unbalanced. The most frequently used intervention was Appointment made fo PCP or specialists which was performed on 20 (77%) participants, while the least frequently used intervention was Medication and pharmacy, performed in 0 (0%). Both Urgent care utilization as a bridge to primary care and Telepresence at specified appointments were used in only one participant, so the calculation of the SD of the number of visits was not possible.

Figure 1 shows how the number of ER visits changed between time points for individual participants. The average change between participants exposed and not exposed to each intervention will be tested in the next section. No obvious trend can be assessed in any intervention that had at least a few participants.

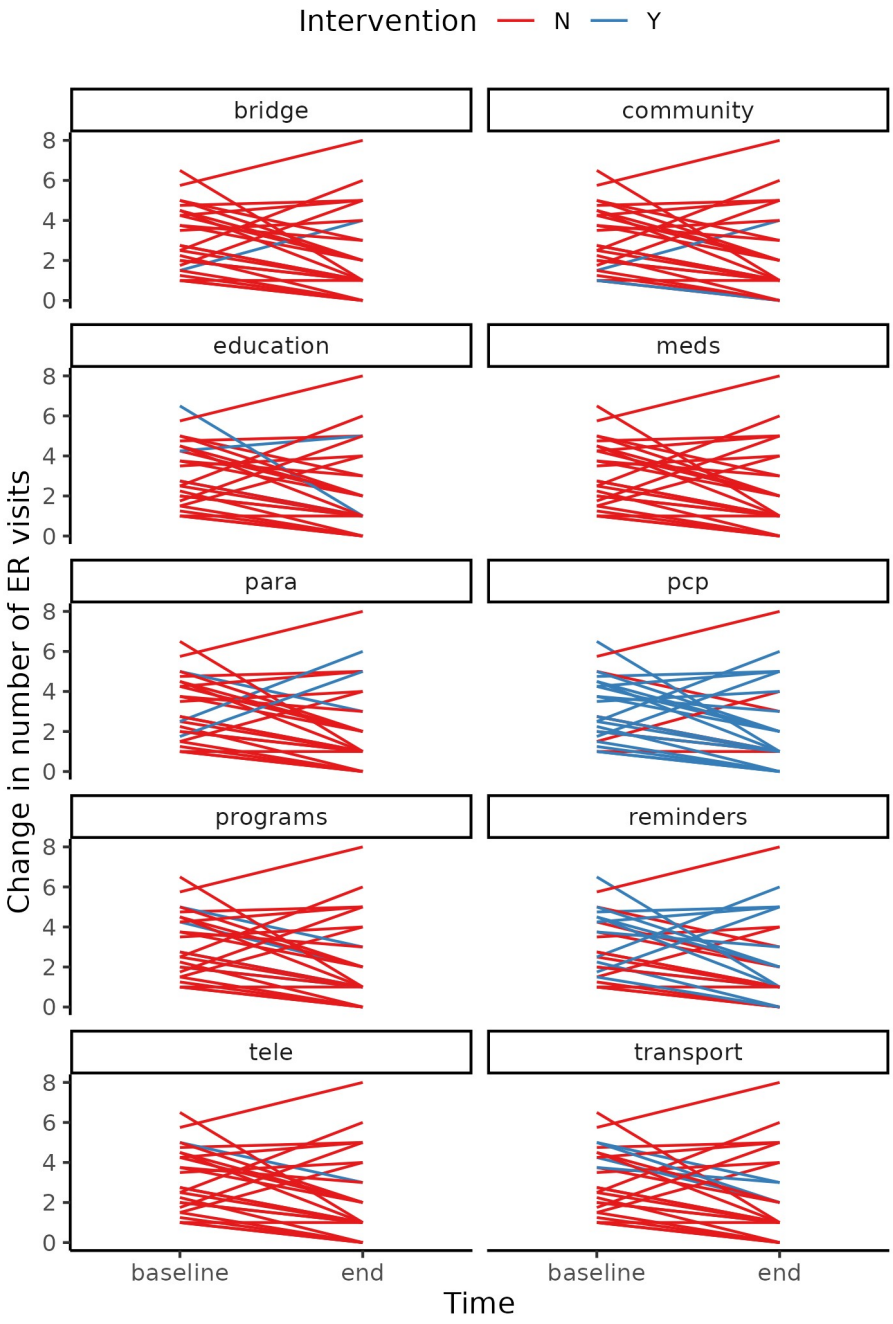

Figure 1 *Change in number of ER visits in study participants.*

4.2 Effect of interventions on ER visits

The interventions bridge, tele and meds were not evaluated for possible effects, due to lack of samples. Both bridge and tele had only a single participant, so the calculation of the SD was not possible. The meds intervention did not have any, so neither the average nor the SD were calculated.

Table 2 shows the observed effects of each intervention under investigation. The Education intervention had the largest point estimate in the direction of reducing the average number of visits by -1.5. The true change in average number of visits can fall between -8.8 to 5.9 change in visits. This was followed by Transportation arrangement to and from appointments, which is associated with a reduction of -1.4 visits in the study sample. This estimate can fall between -2.8 to 0.11 visits.

Table 2 *Effect of interventions on ER visits.*

Characteristic	**Y**, N = 24	**N**, N = 26	**Difference**[1]	**95% CI**[1,2]	**p-value**[1]
pcp, Mean (SD)	-1.11 (2.08)	0.00 (1.97)	-1.1	-3.2 to 1.0	0.263
reminders, Mean (SD)	-1.02 (2.66)	-0.71 (1.51)	-0.31	-2.1 to 1.5	0.728
education, Mean (SD)	-2.17 (3.15)	-0.68 (1.93)	-1.5	-8.8 to 5.9	0.503
para, Mean (SD)	1.58 (3.11)	-1.17 (1.76)	2.8	-4.6 to 10	0.261
community, Mean (SD)	0.75 (2.47)	-0.99 (2.04)	1.7	-16 to 20	0.497
programs, Mean (SD)	-1.75 (0.54)	-0.69 (2.21)	-1.1	-2.2 to 0.07	0.065
transport, Mean (SD)	-2.00 (0.94)	-0.65 (2.17)	-1.4	-2.8 to 0.11	0.066
bridge, Mean (SD)	2.50 (NA)	-0.99 (2.00)			
tele, Mean (SD)	-2.00 (NA)	-0.81 (2.10)			
meds, Mean (SD)	NA (NA)	-0.86 (2.08)			

[1]Welch Two Sample t-test

[2]CI = Confidence Interval

In the other direction, Referral to community paramedicine or home health was associated with the largest negative effect, associated with an increase in the average by 2.8 visits (95% CI: -4.6 to 10). The Connection to availible community resources was associated with an average increase of 1.7 visits (95% CI: -16 to 20).

Since all 95% CI include zero, no effects are statistically significant. This means that no intervention can be consistently detected as having an impact on the average number of ER visits in this study sample.

5 OBSERVATIONS AND LIMITATIONS

Study design

The exposures are not mutually exclusive and there was no definition on how participants would be allocated to each available intervention or combination of interventions. Additionally, there was no comparator group where study participants either received none of the interventions under investigation, or have only received the standard of care. Furthermore the allocation to exposures was not balanced. It appears that the intention for this project is to do an exploratory analysis of data the was already available, either on medical records or collected for a different protocol. Since the data made available was not collected according to a protocol designed to test a hypothesis of clinical/healthcare relevance, this analysis will only be able to offer exploratory value on the data collected, assuming an observational study design that attempts to detect association instead of causality. As such, any observed effects should be interpreted with caution, as there should be a high risk of bias and confounding.

As the scope of the research inquiry lies within Healthcare Quality it can be recommended that in future studies a protocol is developed to test a hypothesis with a well-defined and relevant comparator group and the hospital database be queried for data under a balanced design. If the desired hypothesis is to test whether or not of interventions have a causal effect in the outcome, it is recommended that a randomized controlled trial design is used, instead of an observational design. If an exploratory study is still helpful, a protocol could be written to find patterns in ER visits.

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

None of the ten interventions evaluated had a significant effect on the average number of ER visits.

7 REFERENCES

- **SAP-2023-013-DB-v01** – Analytical Plan for Effect of healthcare interventions on the average number of ER visits: 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

N/A

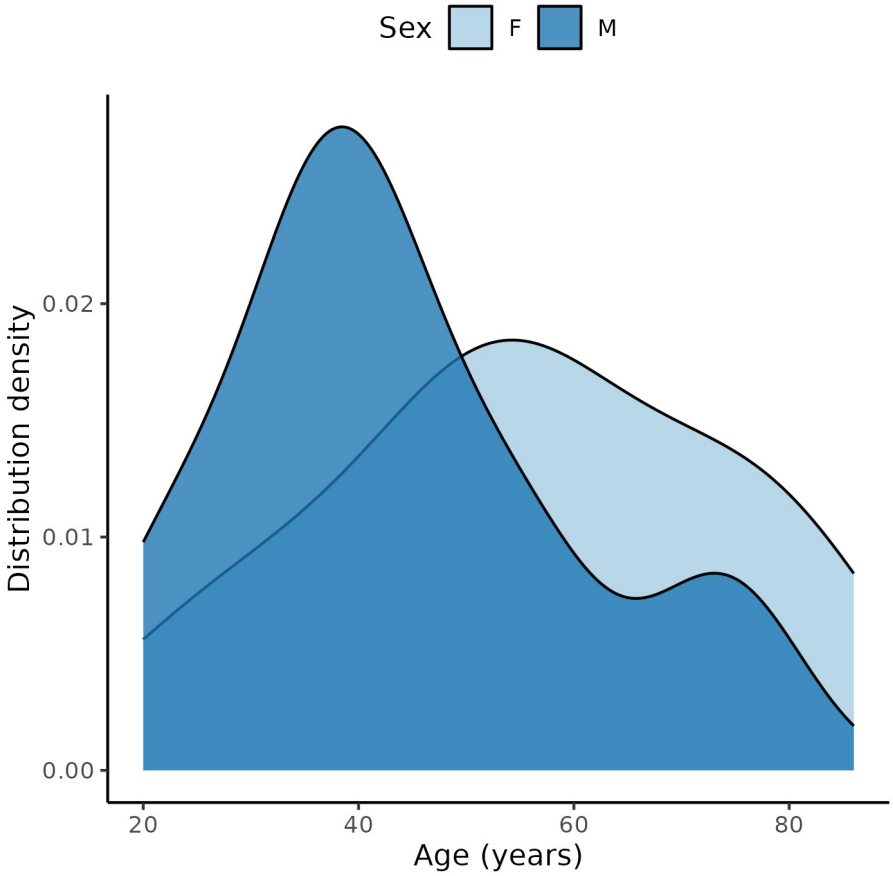

Figure A1 *Distribution of age in the study population.*

8.2 Availability

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

The portfolio is available at:

https://philsf-biostat.github.io/SAR-2023-013-DB/

8.3 Analytical dataset

Table A1 shows the structure of the analytical dataset.

Table A1 *Analytical dataset structure*

id	age	sex	baseline	end	outcome	insurance	pcp	reminders	education	para	community	programs	transport	bridge	tele	meds
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.