

IMPACT OF EXTENDED-HOURS EMERGENCY DEPARTMENT PHARMACY SERVICE ON HOSPITAL LENGTH OF STAY FOR HIGH-NEEDS PATIENTS

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ABSTRACT

OBJECTIVE

To evaluate the effect of an extended-hours emergency department (ED) clinical pharmacy service (8am–9pm, seven days a week) on hospital length of stay (LOS) for high medication needs (high-needs) general medicine unit (GMU) patients.

METHODS

This retrospective cohort study was conducted across three EDs within the same health network from March to September 2022. The study compared high-needs GMU patients who were provided a best possible medication history (BPMH) by an ED pharmacist (ED-BPMH) versus BPMH completed on the ward by a GMU inpatient ward pharmacist (GMU-BPMH). Primary outcome was inpatient LOS. Secondary outcomes included ED and total LOS. Data collected included patient demographics (age, sex), home medications, discharge disposition and Charlson Comorbidity Index (CCI), derived from ICD-10 coded records.

RESULTS

Analysis of 3,277 patients (1,597 ED-BPMH, 1,680 GMU-BPMH) revealed balanced groups with respect to age, CCI and number of home medications with a median of 83.3 vs 83.2 years; 4.0 vs 4.0; 10.0 vs 10.0, respectively. However, the GMU-BPMH group contained a higher proportion of male sex (48.4% vs. 45.1%). After adjustment for confounders, the estimated median difference for LOS was -0.71 days (-17.0 hours) lower in the ED-BPMH group (95% CI: -1.10, -0.32; $p < 0.001$). Median differences in ED and total LOS between groups were +0.32 days (95% CI: 0.29, 0.35; $p < 0.001$) and -0.49 days (95% CI: -0.88, -0.10; $p = 0.01$), respectively.

KEY FINDINGS:

- ED pharmacist review was associated with a 7.9% (0.49 days) reduction in total length of stay compared to ward pharmacist review of similar patients.
- The ED pharmacy service also resulted in a 12.5% (0.71 days) reduction in inpatient length of stay, although patients reviewed by ED pharmacists had a longer ED stay.

CONCLUSIONS

In high-needs GMU patients with a high medication burden, the extended-hours ED clinical pharmacy service was associated with shorter inpatient and total LOS, despite longer ED stay.

KEYWORDS

emergency medicine, clinical pharmacy, length of stay, access to health care

INTRODUCTION

The Australian healthcare system provides universal coverage for all residents and aims to deliver fair, accessible, safe and high-quality healthcare services to the populace.[1] Additionally, it is reported that up to one-third of all Australians aged 18 years or over access healthcare via the public health sector.[2] Over the past decade, the demand for hospital services has continued to grow and during the 2020-21 period, healthcare expenditure surged to a record high of \$220.9 billion.[3] Rising emergency departments (ED) presentations, partly exacerbated by the global pandemic, have contributed to this growth.[4] Despite recent increased funding, the Australian healthcare system has struggled to meet the demands of equitable access to healthcare, including timely access to emergency and inpatient beds.[5] To address these challenges, innovative solutions and targeted healthcare policies have been implemented to improve access to hospital services.

The World Health Organisation (WHO) defines hospital 'access' in several ways, including 'waiting times' for services, geographical distribution and the number of available services and hospitals.[6] ED access reflects these factors, with metropolitan hospitals often having longer waiting times compared to outer regional areas.[7] Improving access requires more than simply increasing supply; factors such as workforce distribution are equally important. Several systematic reviews have explored various mechanisms to improve patient hospital access and balance demand and capacity, with most pointing towards multifaceted 'whole-system' approaches. [8,9] These include medication management strategies, particularly for patients with high medication burden[10], as well as interventions aimed at reducing length of stay.

Hospital length of stay (LOS) is a validated metric for efficient hospital management and can act as a proxy for access.[10] In addition to correlations with healthcare costs, increased LOS has been linked to negative patient and staff experience and preventable patient complications.[11,12] Despite these known adverse effects, evidence surrounding the use of interventions aimed at reducing LOS is conflicting, with many struggling to produce impactful change, even in high-risk patient groups.[10] Recent studies, including a 2024 meta-analysis, have investigated the link between pharmacist-provided interventions and modest reductions in LOS (SMD -0.09 days; 95% CI -0.49 to -0.15)[13,14], although many included studies had substantial design limitations. The effect may be greater when such services are delivered early in the hospital journey (i.e., in ED) and directed towards patients with high medication burden. However, evidence on the impact of extended-hours ED pharmacy services on LOS in high-needs general medicine patients is limited.

Pharmacists are integral members of the emergency department and have a significant role in ensuring patient safety, quality of care and hospital access.[15] Potential mechanisms through which pharmacists can help improve patient flow include creating timely and accurate medication histories, reconciling medications, optimising pharmacotherapy, ensuring prompt medication supply and facilitating discharge planning.[16] Notably, in 2024, we published a paper highlighting that ED clinical pharmacy services can substantially reduce admission medication errors[17], which are known to contribute to prolonged hospital stays.[18] Early identification and prevention of medication errors through ED-based pharmacy services may therefore help prevent unnecessary prolongation of hospital stays. The aim of the current study was to evaluate the effect of an extended-hours ED clinical pharmacy service on hospital LOS for high medication needs (high-needs) general medicine patients.

METHODS

STUDY SETTING AND DESIGN

This retrospective study was conducted across three EDs within the Eastern Health network from March to September 2022 (Box Hill Hospital: 61,674 admissions per year; Maroondah Hospital: 34,450 admissions per year; Angliss Hospital: 22,807 admissions per year). Two EDs provided a comprehensive seven-day extended-hours clinical pharmacy service (8am to 9pm), while the third ED provided service from 8am to 5pm. Services were prioritised for high-needs medical patients based on referrals and clinical indicators, in accordance with Advanced Pharmacy Australia (AdPha; formerly known as SHPA) standards for pharmacy practice.[15] Ethical approval was obtained from the Eastern Health Office of Research and Ethics (LR21-032-79058).

The study compared high-needs General Medicine Unit (GMU) patients who received a Best Possible Medication History (BPMH) by an ED pharmacist (ED-BPMH) versus BPMH completed on the ward by a GMU inpatient ward pharmacist (GMU-BPMH). For all patients a clinical pharmacist documented the BPMH in the patient's Electronic Medical Record (EMR) as per standard procedures. As part of standard practice, the pharmacist also documented whether patients were presenting from private residence or a Residential Aged Care Facility (RACF), the person responsible for administering medications (patient, carer or RACF staff), non-English-speaking status (requiring interpreter) and whether medication non-adherence was suspected or reported.

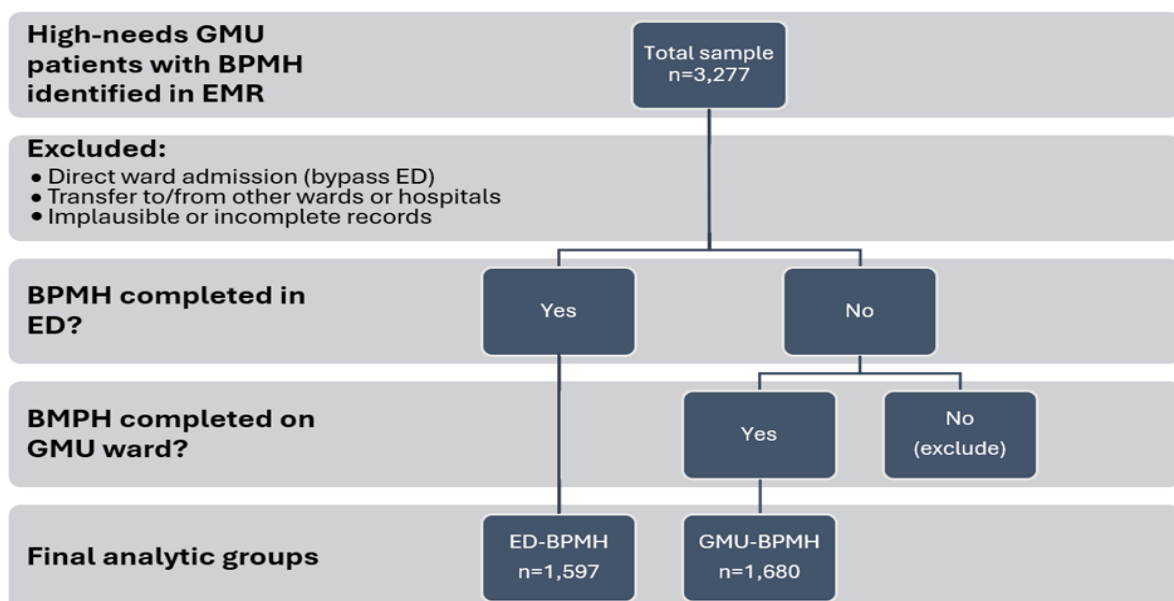
Patient allocation to ED or ward pharmacist review was based on routine service workflows and service availability. Although this approach minimised selection bias within the high-needs cohort, ED pharmacists may have prioritised patients with more complex medication histories or longer ED stays.

PARTICIPANT ELIGIBILITY

Adult inpatients aged 18 years or older, who were evaluated as 'high-needs' and who were admitted to GMU via ED were included. High-needs status was assessed using a locally validated tool¹⁹ designed to identify patients at increased risk of medication-related adverse outcomes. The tool considers criteria such as use of high-risk medicines, and patient factors including frailty and comorbidity. Patients meeting at least one criterion are classified as high-needs.

Patients directly admitted to an inpatient ward (i.e., bypassing ED) and patients transferred to or from other wards or hospitals, including those admitted to the Short Stay Unit before transfer to wards were excluded (Figure 1).

FIGURE 1: STUDY FLOW DIAGRAM SHOWING PATIENT INCLUSION AND EXCLUSION PROCESS.



GMU: General Medicine Unit; ED: Emergency Department; BPMH: Best Possible Medication History

DATA SOURCE

Data were collected within a secure cloud-based database, utilising routine EMR-based service activity cards to obtain patient demographics and data related to ED presentations and ward admissions. Other data, such as home medications and medication non-adherence status, were manually obtained from individual patient records. Data collected included patient demographics (age, sex), home medications, discharge destination and Charlson Comorbidity Index (CCI). CCI scores were derived from hospital ICD-10 coded records.

OUTCOMES

The primary outcome was inpatient LOS. Inpatient LOS was determined from the time of ward admission until discharge from the inpatient ward.

Secondary outcomes included ED and total LOS. ED LOS was determined from the time of ED presentation until the patient was admitted to the inpatient ward. Total LOS was determined from the time of ED presentation until the time of discharge from the inpatient ward.

STATISTICAL ANALYSIS

The sample size was calculated based on an average LOS of 6.1 days, derived from 13,145 Eastern Health general medicine inpatients over 12 months (October 2020 to September 2021, unpublished data). A standard deviation (SD) of 3.0 days was adopted from a previously published study by another metropolitan teaching hospital in Melbourne, Australia.[14] Using 80% power and a two-sided significance level of 0.05, the total sample size required to detect a 5% reduction in LOS was estimated to be 3,200. Implausible or incomplete records were managed using listwise deletion, whereby cases with missing or invalid data for any outcome variable were excluded from analysis. Length-of-stay data were summarised using medians and interquartile ranges due to non-normal (right-skewed) distribution, and group differences were expressed as median differences. The primary outcome, LOS, was analysed using quantile regression, with robust standard errors (unadjusted and adjusted) resulting in an estimate of a difference in medians and its 95% CI. Skewed and binary data were analysed using the Wilcoxon rank-sum test and Pearson's chi-squared test, respectively.

RESULTS

PARTICIPANTS AND DESCRIPTIVE DATA

A total of 3,277 patients were identified, of whom 1,597 had an ED-BPMH and 1,680 had a GMU-BPMH. Patient demographics and clinical characteristics are presented in Table 1. Among the total sample (n=3,277), median (IQR) age was 83.2 (73.3-89.9) years and 53% were female. Medication use was high across the cohort with a median (IQR) of 8 (5-11) regular medications and 2 (0-3) pro re nata (PRN) medications. Polypharmacy, defined as use of five or more regular medications,[20] was present in 80% of the total sample. The average CCI score across the cohort was 4.0 (3.0-5.0), depicting a moderate to high level of comorbidity in the patient population,[21] which is in line with published literature on comparable patient populations reporting median CCI scores of 3.0 to 5.0.[14,22]

TABLE 1: PATIENT DEMOGRAPHICS AND CLINICAL CHARACTERISTICS.

	GMU-BPMH N=1680	ED-BPMH N=1597	TOTAL N=3277
PATIENT CHARACTERISTICS			
Age, median (IQR)	83.3 (72.7, 89.9)	83.2 (73.8, 89.8)	83.2 (73.3-89.9)
Male Sex (%)	758 (45.1)	773 (48.4)	1,531 (46.7)
Indigenous (%)	6 (0.4)	12 (0.8)	18 (0.5)
Non-English speaking (%)	148 (8.8)	95 (5.9)	243 (7.4)
CCI, median (IQR)	4.0 (3.0, 5.0)	4.0 (3.0, 5.0)	4.0 (3.0-5.0)

MEDICATION PROFILE	Home medications, regular, med (IQR)	8 (5, 11)	8 (5, 12)	8.0 (5-11)
	Home medications, PRN, med (IQR)	1 (0, 3)	2 (1, 3)	2 (0, 3)
	Home medications, Total, med (IQR)	10 (6, 14)	10 (7, 14)	10 (6, 14)
	Polypharmacy (%)	1,302 (77.5)	1,311 (82.1)	2,613 (79.7)
	Poor medication adherence (%)	207 (12.3)	133 (8.3)	340 (10.4)
MEDICATION ADMINISTRATION CONTEXT	Patient (%)	1182 (70.4)	1049 (65.7)	2,231 (68.1)
	Carer (%)	274 (16.3)	254 (15.9)	528 (16.1)
	RACF staff (%)	224 (13.3)	294 (18.4)	518 (15.8)
HOSPITAL AND DISCHARGE DETAILS	Box Hill Hospital (%)	598 (35.6)	360 (22.5)	958 (29.2)
	Maroondah Hospital (%)	614 (36.5)	466 (29.2)	1,080 (33.0)
	Angliss Hospital (%)	468 (27.9)	771 (48.3)	1,239 (37.8)
	Private Residence (%)	977 (58.2)	927 (58.0)	1,904 (58.1)
	Transfer to RACF - usual residence (%)	140 (8.3)	162 (10.1)	302 (9.2)
	Transfer to RACF -not usual residence (%)	74 (4.4)	50 (3.1)	124 (3.8)
	Statistical separation (%)	54 (3.2)	41 (2.6)	95 (2.9)
	Transition Care Bed-Based Program (%)	37 (2.2)	34 (2.1)	71 (2.2)

GMU: General Medicine Unit; ED: Emergency Department; BPMH: Best Possible Medication History; CCI: Charlson Comorbidity Index; RACF: Residential Aged Care Facility

When compared to the GMU-BPMH group, the ED-BPMH group had a higher proportion of male patients (48.4% vs. 45.1%) and more patients from RACFs (18.4% vs. 13.3%). In contrast, the GMU-BPMH group had a higher proportion of non-English speaking patients (8.8% vs 5.9%) and more patients with suspected medication non-adherence issues (12.3% vs. 8.3%). Notably, the disposition between groups and hospital campuses differed, with the highest proportion of ED-BPMH patients being recruited from Angliss Hospital. Overall, the two groups were balanced across key confounders such as age, number of home medications, and comorbidity, reinforcing comparability between cohorts (Table 1).

OUTCOME DATA

Inpatient length of stay

The median inpatient LOS (IQR) for the ED-BPMH group was 5.03 days (120.7 hours) (2.81, 8.98), compared to the GMU-BPMH group, which was 5.67 days (136.1 hours) (3.04, 10.03); resulting in a median difference of -0.64 days (-15.4 hours) (-1.08, -0.20). After adjustment for confounders (age, gender, number of home medications, CCI scores, ED campus/site), the estimated median difference for LOS was -0.71 days (-17.0 hours) lower in the ED-BPMH group (-1.10, -0.32; $p < 0.001$).

ED and total length of stay

The median ED LOS (IQR) for the ED-BPMH was 0.81 days (19.4 hours) (0.48, 0.99), compared to GMU-BPMH group, which was 0.48 days (11.5 hours) (0.31, 0.82); resulting in a median difference of +0.34 days (8.2 hours) (0.30, 0.37). This longer ED

LOS likely reflects selection bias, as ED pharmacists may have prioritised patients who had already spent more time in the ED.

The median total LOS (IQR) for the ED-BPMH was 5.91 (141.8 hours) (3.69, 9.94), compared to GMU-BPMH group, which was 6.15 days (147.6 hours) (3.87, 10.82); resulting in a median difference of -0.25 days (6.0 hours) (-0.67, -0.18).

After adjustment for the same confounders, the median differences in ED and total LOS between groups were +0.32 days (7.7 hours) (0.29, 0.35; $p < 0.001$) and -0.49 days (11.8 hours) (-0.88, -0.10; $p = 0.015$), respectively. For further details refer to Table 2.

The median time (IQR) from arrival in ED to BPMH in the ED-BPMH group was 15.4 hours (7.1-21.2), compared to the GMU-BPMH group, which was 45.7 hours (26.7-70.4).

TABLE 2: MAIN RESULTS: INPATIENT, ED AND TOTAL LENGTH OF STAY

	GMU-BPMH N=1680	ED-BPMH N=1597	LOS DIFFERENCE (95% CI)	LOS ADJUSTED DIFFERENCE (95% CI)*	P-VALUE
INPATIENT LOS, (DAYS), MEDIAN (IQR)	5.67 (3.04, 10.03)	5.03 (2.81, 8.98)	-0.64 (-1.08, -0.20)	-0.71 (-1.10, -0.32)	<0.001
ED LOS, (DAYS), MEDIAN (IQR)	0.48 (0.31, 0.82)	0.81 (0.48, 0.99)	0.34 (0.30, 0.37)	0.32 (0.29, 0.35)	<0.001
TOTAL LOS, (DAYS), MEDIAN (IQR)	6.15 (3.87, 10.82)	5.91 (3.69, 9.94)	-0.25 (-0.67, -0.18)	-0.49 (-0.88, -0.10)	0.015

GMU: General Medicine Unit; ED: Emergency Department; BPMH: Best Possible Medication History; LOS: Length of Stay

DISCUSSION

This study compared high-needs general medicine patients across three Victorian metropolitan EDs who were reviewed by a pharmacist in ED versus general medicine wards. The ED-based pharmacist review resulted in an expedited time to BPMH, approximately three times faster. The ED pharmacy service was associated with a significant reduction in both inpatient and total hospital LOS, by 12.5% and 7.9%, respectively. These observed reductions in LOS are in line with emerging published literature highlighting the importance of early pharmacist interventions in reducing LOS.[13] They are also particularly relevant for improving patient access to healthcare services, especially given the heightened operational demands on health services in recent years.

Pharmacy services targeted at high medication needs patients are a potentially effective strategy that, in synergy with broader organisation-level strategies, can be utilised to improve patient flow across the continuum of hospital care. This is in line with the 2024 evidence briefing from the Australian Commission on Safety and Quality in Health Care, which emphasises that early pharmacist interventions aimed at improving medication reconciliation and reducing medication errors at the 'transition of care' can indeed shorten a patient's hospital stay.[23] These interventions are likely effective because they ensure timely and accurate medication reconciliation, preventing downstream prescribing errors[17] and

subsequent adverse drug events, and promote early discharge planning to minimise delays at the point of discharge. By resolving medication discrepancies early, pharmacists can expedite medical review and facilitate ward admissions. In turn, this supports the broader advanced discharge planning, which is widely accepted as the gold standard for addressing healthcare access.[8,9] While impactful, ED pharmacist interventions complement other strategies such as early discharge planning, geriatric assessments, multidisciplinary care, and post-discharge programs.[10]

In this study, we observed a predominantly older adult population with a very high rate of polypharmacy. This patient population is particularly vulnerable at points of transition of care such as transition through the ED, where the likelihood of medication-related adverse events is significantly increased.[23,24] Polypharmacy further heightens the risk of such events and is associated with increased falls, fractures, prolongation of hospitalisation and overall mortality.[20] ED pharmacy services focused on older medical patients with polypharmacy can therefore address key factors driving medication errors in this setting—namely, the unavailability of accurate home medication histories and limited time and training among medical staff to manage patients with large numbers of medications. Additionally, ED pharmacy services may help prevent medication errors from progressing to the inpatient setting, likely having a significant downstream impact by reducing the workload in inpatient units.[17] This aligns with existing literature, which associates early pharmacist review in ED with improved patient access to care and shorter hospital stay.[25] Moreover, when pharmacists conduct BPMHs in the ED, they free up significant time for medical staff, allowing the team to focus on medical priorities in the fast-paced ED environment.

Increasing demand in Australian EDs is an ongoing and significant barrier for patient access to healthcare and overcrowding cannot be explained solely by population growth alone[26] and there are likely complex root causes. Crowding reflects imbalance across input, throughput and output[27], with medication-related misadventures a recurring contributor to throughput and output pressures. The Australasian College for Emergency Medicine recognises the impact of inpatient access block on ED, leading to overcrowding.[28] Whilst we observed a significant downstream impact of early ED-based BPMH on reducing inpatient LOS, the ED LOS was longer for the intervention cohort. Our primary explanation for this observation is that ED pharmacists, when starting their shifts, strategically choose to see patients who have been in ED longer. This may have introduced selection bias, reducing the likelihood of newly arrived patients being captured in the ED-BPMH arm of our study. Furthermore, pharmacist reviews in ED are often challenging and time-consuming, especially when patients are unable to provide a reliable history and carers are absent. In these circumstances, establishing an accurate medication history may require contacting GPs, community pharmacists, or next of kin, which can extend the time patients remain in ED. Further research is warranted to explore additional factors beyond selection bias that may have contributed to this observation.

There is extensive literature demonstrating the positive impact of ED pharmacy services on patient safety and quality of care across both ED and inpatient settings.[29] Numerous health economic studies have also highlighted the cost-effectiveness of these services.[13,30] Beyond financial value, ED pharmacy services enhance workforce efficiencies by alleviating pressure on medical and nursing staff, streamlining medication management and reducing prescribing errors[17]. However, few studies have rigorously evaluated the role of ED pharmacy services in enhancing hospital efficiency and facilitating patient flow into inpatient settings. This study builds upon prior research, highlighting the health-economic benefits of extended-hours ED pharmacy services, particularly its impact on reducing LOS. Notably, the only variable between the compared groups was the timing of the pharmacy review—conducted either in the ED or upon ward admission—indicating that the observed improvements required no additional resources. These findings have important policy implications, highlighting extended-hours ED pharmacy services as a cost-effective and workforce-efficient strategy to enhance hospital efficiency and improve access to care, while promoting medication safety, quality, and timelier patient care.

LIMITATIONS

Limitations of this study include a retrospective design which precludes inference of causation, and inclusion of only 'high-needs' medical patients, who may have a higher rate of medication errors in the absence of an ED pharmacist and as such our results may not be necessarily generalisable to all patient populations.

Unmeasured confounders such as illness severity, socioeconomic factors, and clinician workload may also have influenced the outcomes. Additionally, the study did not capture post-discharge data, such as readmission rates or medication-related adverse events, limiting assessment of longer-term outcomes. It was also noted that the ED-BPMH group included a larger proportion of male patients compared to the GMU-BPMH group, though its impact on study outcomes is unclear. The ED-BPMH group also included more patients who presented directly from a RACF, and it is possible that these patients may have a higher likelihood of earlier discharge back to their usual residence, as they do not face barriers such as identifying suitable new placements. In contrast, the GMU-BPMH cohort contained more patients who were reported to have medication adherence issues, which may correlate with extended length of hospital stay.

CONCLUSION

This study provides evidence supporting the potential of extended-hours pharmacy services in ED to reduce LOS, reinforcing prior evidence that early medication reconciliation and pharmacist-led interventions can enhance patient flow and healthcare system efficiency. Although the ED cohort experienced a longer ED stay, the observed benefits of earlier BPMH completion were substantial, particularly for high-needs patients with polypharmacy. Overall, this study contributes to the growing body of evidence supporting the health-economic benefits of pharmacist-led interventions in ED, showcasing their potential to improve hospital efficiency and patient access to care.

Future research could include prospective or multicentre studies and formal cost-benefit evaluations to further establish the effectiveness and sustainability of ED pharmacy services across diverse healthcare settings, particularly among surgical and mental health patient groups. Collectively, these findings support broader implementation of extended-hours ED pharmacy services as a cost-efficient strategy to improve patient flow, enhance hospital efficiency, and strengthen system-wide access to timely, safe care.

CONFLICT OF INTEREST:

The authorship team declares no conflict of interest.

ETHICS APPROVAL:

This study received ethical approval from the Eastern Health Human Research Ethics Committee (HREC) (LR21-032-79058).

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