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Phlebotomists on Emergency Department Performance: A Retrospective Comparative Study

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ABSTRACT

Introduction: Emergency departments (ED) in Australia have experienced an increase in patient presentations. To address this demand, we introduced phlebotomists at ED triage seeking to reduce ED waiting and disposition times. We report the impact of this intervention.

Method: Using a quantitative retrospective comparative study design guided by the STROBE checklist, we investigated the impact on ED performance before and after the introduction of phlebotomists (the intervention). Data from two periods—T1 (January–June 2021) and T2 (January–June 2023) were obtained and analysed for all ED presentations.

Results: A total of 90,020 patients were included (T1: 46,639; T2: 43,381). Post-intervention improvements included an increase in short stay unit–admissions from triage (3.1% vs. 5.9%, $p < 0.001$) and a decrease in the proportion of patients transferred to a cubicle from the waiting room (T1: 78.8%; T2: 76.4%). However, patients who left the ED before treatment was completed (known as 'Did not Wait') rose significantly (9.8% vs. 11.5%) as did waiting room times (80.02 vs. 112.91 min). Overall, ED length of stay (EDLOS) increased significantly (mean T1: 305.1 to T2: 319.4 min; $p < 0.001$). There were significant increases in blood tests (T1: 52.0% vs. T2: 59.9%) and ECGs (16.5% vs. 19.1%) performed.

Conclusion: The introduction of phlebotomists at triage failed to reduce waiting, treatment and disposition times and increased the number of investigations performed with an overall increase in EDLOS. We observed an increase in the number of patients directed from the waiting room to the short stay unit and fewer patients transferred from the waiting room to an ED cubicle.

1 | Introduction

Emergency departments (ED) in Australia have experienced an increase in demand. Reports indicate an increase in ED patient presentation rate from 321 per 1000 population to 339 per 1000 population between 2017–2018 and 2021–2022 [1]. This escalation in demand adversely impacts the available resources of nursing and medical staff. This in turn affects patients' satisfaction and leads to an increased number of patients leaving EDs without treatment [2].

In our facility, we use a multi-disciplinary triage model where nursing and medical teams work together and a senior ED physician reviews patients while they are in the waiting room

[3]. To mitigate the effect of the increasing demand and reduce the workload on our triage staff, we employed trained phlebotomists to work with our ED triage clinicians. Initially launched as a trial in June 2021, phlebotomists were employed to cover 1-day shift and one evening shift within a 24-h period, performing venipuncture and 12-lead electrocardiogram (ECG) tracing (as proscribed within their scope of practice).

Due to the escalating demand for COVID testing, the ED introduced the rapid SARS-CoV-2 (LIAT) assay [4] at triage in late 2022. Phlebotomists were then trained to collect nasopharyngeal samples and conduct LIAT testing, thus expanding their scope of practice. At this time, an additional overnight shift was added, and phlebotomists worked 24/7.

As a result of a series of clinical incidents in the waiting room, in February 2023, the scope of practice for phlebotomists was expanded to include the collection, processing and presenting of venous blood gases (VBGs) to the multi-disciplinary triage medical consultant [3] for urgent interpretation.

The aim of this study is to investigate whether the inclusion of phlebotomists in the ED triage setting impacted ED processes. The specific study objectives were to:

1. Evaluate the impact of the phlebotomist role on patient flow metrics such as wait times and disposition destination, including those that Did not Wait (DNW) after triage.
2. Evaluate the impact of the phlebotomist role on the number of blood and ECG tests.

This study was not powered sufficiently to evaluate the impact on patient safety.

2 | Method

2.1 | Study Method, Design and Data Sources

A quantitative method and retrospective comparative study design guided by the STROBE checklist was employed. The electronic patient records from the ED of a quaternary hospital located in Melbourne, Australia, with approximately 90,000 visits per annum were utilised. The ED treats patients of all ages with a separate adult and paediatric area that share a common triage point, and 26 short stay observation unit beds (SSU). Data extraction was restricted to the period between 1 January 2021 and 30 June 2021 considered as T1 and 1st January 2023 to 30th June 2023 considered as T2 for all patients who presented to ED. During the study periods, there were no changes in triage nursing and medical workforce or rostering apart from the introduction of phlebotomists in the second study period.

Ethics approval for the study was obtained from the Institutional Human Research Ethics committee reference: HREC/101323/Austin-2023. Patient consent was waived for this study, as the data were de-identified and observational in nature.

2.2 | Data Collection

A total of 90,020 patients presented to ED during the study periods of the years T1:2021 ($N=46{,}639$) and T2:2023 ($N=43{,}381$). Convenient sampling was used to include all participants who presented to the ED during this period. The sample was large enough to sustain a power of 90% or above to detect a moderate effect size ($f^2=0.15$) to find a significant difference of the EDLOS time at a 5% significance level [5, 6].

2.3 | Data Extraction

Variables extracted from the electronic patients' records were: gender (male, female, non-binary), age (in years), triage category, presenting triage complaint, tests performed in triage (yes, no), disposition destination from waiting room (minutes), disposition destination from ED cubicles for those admitted to ED cubicle (minutes), EDLOS time (minutes), diagnosis (yes, no) and length of stay in the department (minutes) were uploaded from our institutional data bank into a Microsoft Excel. Age was considered from 0 to 99 years to avoid outliers.

2.4 | Statistical Analysis

Incomplete or missing responses were omitted from the analysis under the assumption that data were missing at random [7, 8]. Age, time to first destination from waiting room, and EDLOS were the only continuous variables, and the rest of the variables were categorical. Along with descriptive statistics, *t*-test, chi-squared test, analysis of variance (ANOVA), multiple linear regression and multinomial logistic regression analyses were undertaken to evaluate the impact of phlebotomists and associated risk factors. Post hoc pairwise comparisons were conducted using Tukey HSD, Bonferroni and Games–Howell tests. Tukey and Bonferroni were used because of their general applicability for ANOVA, whereas Games–Howell was used to account for unequal variances. Statistical significance was indicated by a two-sided p value <0.05. All analyses were conducted in SPSS (v.29) and R 4.2.2.

The models for both 2021 ($F=2937.25$, $p<0.001$) and 2023 ($F=2735.37$, $p<0.001$) were statistically significant, with no multicollinearity (VIF) or serial correlation (DW = 1.78 and 1.92, respectively). Assumptions of linearity, normality, homoscedasticity and independence of residuals were satisfied because of the large sample size.

A multinomial logistic regression was conducted to examine predictors of triage categories ('urgent', 'semi-urgent' and 'non-urgent') relative to the 'emergency' category for both T1 and T2. Detailed results are presented in Tables S1–S7, which highlights significant predictors such as gender, blood tests, VBG, PCR_Liat, ECG, age, EDLOS and time to first destination.

3 | Results

Between January and June 2021 (T1), prior to the introduction of phlebotomist services in ED triage, a total of 46,639 patients presented. In contrast, during the same period in 2023 after the recruitment of phlebotomists to the department, 43,381 patients presented. Table 1 shows demographic details, triage categories, tests performed, and patient flow metrics including disposition destination from the waiting room, time spent in the waiting room and EDLOS. Comparing the two cohorts, age ranged from 0 to 99 years, with a mean age of 45.16 years (SD = 27.31 years) in T1 and 0–99 years (mean = 46.12 years, SD = 26.98 years) in T2.

The two groups displayed similarity in gender, but differences in triage categories with a higher proportion of urgent (T1: 18,916 [40.6%] and T2: 18,634 [43%]) and semi-urgent (T1: 16,570 [35.5%] and T2: 12,354 [28.5%]). With the employment of phlebotomists, more investigations were conducted at triage, though this is partly explained by the greater use of the COVID-19 rapid PCR test (LiatR) commencing in T1. However, regular blood tests increased significantly from 52% in T1 to 59.9% in T2 ($p < 0.001$), whereas VBGs significantly increased from 22.2% to 27.2% ($p < 0.001$). This increase was related to the introduction of VBGs into the scope of practice of the phlebotomists following safety concerns detailed below. In addition, the percentage of patients who had ECGs performed increased significantly from 16.5% to 19.1% ($p < 0.001$). The largest relative increase was observed in PCR/LIAT coronavirus testing, which rose significantly from 10.1% in T1 to 18.8% in T2 ($p < 0.001$), aligning with the greater availability of the test during the peak of the pandemic (Table 1).

TABLE 1 | Bi-variate association (unweighted) of predictor variables across two time periods (T1:2021 and T2:2023).

Variables	T1:2021 (*N* = 46,639) *n* (%)/mean (SD)[a]	T2:2023 (*N* = 43,381) *n* (%)/mean (SD)[a]	*p* for chi-squared test/*t*-test (Cramer's *V*/Cohen's *d*)
Gender			
Female	23,570 (50.5)	21,854 (50.4)	**0.631** (0.002)
Male	23,069 (49.5)	21,527 (49.6)	
Triage category			
Emergency	7197 (15.4)	10,183 (23.5)	< 0.001 (0.129)
Urgent	18,916 (40.6)	18,634 (43.0)	
Semi-urgent	16,570 (35.5)	12,354 (28.5)	
Non-urgent	3956 (8.5)	2210 (5.1)	
Destination from triage			
Did not Wait	4577 (9.8)	4970 (11.5)	< 0.001 (0.080)
Home	3841 (8.2)	2724 (6.3)	
ED short stay unit	1455 (3.1)	2541 (5.9)	
ED cubicle	36,766 (78.8)	33,146 (76.4)	
Red blood test done			
No test done	22,374 (48.0)	17,389 (40.1)	< 0.001 (0.079)
Test done	24,265 (52.0)	25,992 (59.9)	
VBG done			
No test done	36,279 (77.8)	31,603 (72.8)	< 0.001 (0.057)
Test done	10,360 (22.2)	11,778 (27.2)	
PCR_Liat done			
No test done	41,936 (89.9)	35,217 (81.2)	< 0.001 (0.125)
Test done	4703 (10.1)	8164 (18.8)	
ECG done			
No ECG done	38,961 (83.5)	35,091 (80.9)	< 0.001 (0.035)
ECG done	7678 (16.5)	8290 (19.1)	
Age[a]	45.16 (27.31)	46.12 (26.98)	< 0.001 (0.035)
EDLOS[a]	305.10 (254.87)	319.44 (239.68)	< 0.001 (0.058)
Time to first destination	80.02 (87.11)	112.91 (117.17)	< 0.001 (0.321)

[a]Metric variables.

Regarding waiting and treatment times, EDLOS increased significantly (mean T1: 305.1 to T2: 319.4 min; $p < 0.001$). This increase was seen in all disposition types (Table 2). A one-way ANOVA was conducted to compare EDLOS across destination from triage for T1 and T2 (Table 3). During the intervention, longer waiting times in the waiting room, cubicles, and for those admitted to the short stay were associated with a significant increase in overall EDLOS (Table 2).

The EDLOS for participants who underwent regular blood tests, blood gas and PCR/LIAT tests were significantly associated with a longer EDLOS ($p < 0.05$), whereas ECGs were associated with a shorter stay ($p < 0.001$). Age demonstrated a small but consistent positive association ($p < 0.001$), but gender did not have a significant effect (T1:2021: $p = 0.191$ and T2:2023: $p = 0.626$). These findings were consistent across both years. For every 1-min increase in the time to the first destination from WR, the EDLOS increases by an average of 1.03 min in T1 and 0.96 min in T2, holding all other variables constant.

Regarding disposition from the waiting room, there was a statistically significant decrease in the percentage of patients who needed an ED cubicle from the waiting room (78.8% of patients in T1 to 76.4% in T2) and a 75% increase in the number of patients admitted to the SSU directly from the waiting room (T1: 1455 patients, T2: 2541 patients). However, there was a significant decrease ($p < 0.001$) in the number of patients discharged home (T1: 3841 [8.2%] and T2: 2724 [6.3%]) from the waiting room and a significant increase ($p < 0.001$) in the number of patients who

TABLE 2 | Comparison of EDLOS time (minutes) time across the predictors during two time periods T1 and T2 separately.

	T1:2021		T2:2023	
Variables	**Mean (SD)**	***p* for *t*-test/ANOVA (Cohen's d/η^2)**	**Mean (SD)**	***p* for *t*-test/ANOVA (Cohen's d/η^2)[a]**
Gender				
Female	311.48 (254.52)	<0.001 (0.051)	325.16 (237.88)	<0.001 (0.048)
Male	298.57 (255.07)		313.63 (241.37)	
Red blood test done				
No test done	178.35 (143.59)	<0.001 (1.088)	182.16 (148.13)	<0.001 (1.082)
Test done	421.96 (278.17)		411.28 (245.28)	
VBG done				
No test done	255.16 (214.62)	<0.001 (0.948)	263.55 (204.66)	<0.001 (0.929)
Test done	479.97 (303.05)		469.41 (261.42)	
PCR_Liat done				
No test done	291.05 (241.94)	<0.001 (0.554)	301.19 (231.33)	<0.001 (0.410)
Test done	430.30 (323.74)		398.19 (258.45)	
ECG done				
No ECG done	295.69 (254.09)	<0.001 (0.225)	305.92 (238.31)	<0.001 (0.297)
ECG done	352.81 (253.52)		376.66 (237.05)	
Triage category				
Emergency	359.64 (267.11)	<0.001 (0.062)	371.01 (241.35)	<0.001 (0.067)
Urgent	353.11 (268.63)		352.82 (242.89)	
Semi-urgent	263.38 (229.39)		259.37 (218.02)	
Non-urgent	151.00 (152.20)		136.18 (144.21)	
Destination from triage				
Did not Wait	117.10 (108.37)	<0.001 (0.111)	148.73 (138.66)	<0.001 (0.103)
Home	161.84 (112.14)		225.87 (140.66)	
ED short stay unit	174.95 (108.53)		209.83 (133.25)	
ED cubicle	328.62 (264.68)		361.13 (248.14)	

[a]*p* values were obtained using *t*-tests for two-category variables (gender, red blood test done, VBG done, PCR_Liat done, ECG done) and ANOVA for multi-category variables (triage category and destination from triage). Effect sizes are reported as Cohen's *d* for *t*-tests and η^2 for ANOVA.

TABLE 3 | Results of the fitted multiple regression models for EDLOS time by considering selected covariates for T1 and T2.

	T1:2021					T2:2023				
Predictors	**Regression coefficient (95% CI)**	**Standard error**	**Standardisation coefficient**	***t***	***p***	**Regression coefficient (95% CI)**	**Standard error**	**Standardisation coefficient**	***t***	***p***
Constant	99.334 (91.05, 107.62)	4.226		23.504	< 0.001	92.014 (84.53, 99.5)	3.820		24.089	< 0.001
Gender	−1.109 (−5.5, 3.29)	2.242	−0.002	−0.494	**0.621**	3.268 (−0.69, 7.23)	2.019	0.007	1.618	**0.106**
Red blood test done	134.518 (128.75, 140.29)	2.944	0.249	45.690	< 0.001	99.589 (94.17, 105.01)	2.766	0.192	36.003	< 0.001
VBG done	92.164 (86.42, 97.91)	2.930	0.155	31.457	< 0.001	103.253 (98.27, 108.23)	2.542	0.194	40.621	< 0.001
PCR_Liat done	103.735 (96.56, 110.91)	3.663	0.123	28.323	< 0.001	36.451 (31.5, 41.4)	2.526	0.06	14.428	< 0.001
ECG done	−16.324 (−22.34, −10.31)	3.070	−0.023	−5.317	< 0.001	−6.318 (−11.65, −0.99)	2.720	−0.01	−2.323	0.02
Time to first destination	1.028 (1, 1.05)	0.013	0.338	78.231	< 0.001	0.957 (0.94, 0.97)	0.009	0.452	107.497	< 0.001
Age	1.147 (1.05, 1.24)	0.049	0.12	23.560	< 0.001	1.129 (1.04, 1.22)	0.044	0.127	25.474	< 0.001
DW = 1.78, multiple R^2 = 0.343, F-statistic = 2746.72 and p value < 0.001						DW = 1.92, multiple R^2 = 0.455, F-statistic = 3951.20 and p value < 0.001				

left the department before receiving treatment (DNW) (T1: 4577 [9.8%] and T2: 4970 [11.5%]), associated with a longer wait time (117 min in T1 and 148 min in T2) (Table 2).

4 | Discussion

The initiation of clinical investigations requires significant time and resources from trained staff. In a previous study, we found that 62% of non-urgent patients presenting to our ED underwent blood testing at triage [9]. This represents a substantial workload, diverting the triage clinicians from their primary task of assessing and triaging new patients [10–12].

The introduction of a phlebotomist role offers an innovative approach to 'front-loading' care, particularly during periods of high demand. At our institution, this initiative was implemented primarily to enhance the timeliness of investigations for patients in the waiting room and alleviate the burden on triage staff. However, the broader benefits of this role for patient flow and EDLOS have remained largely underexplored. Although some prior studies report minimal benefits [13, 14], others have suggested no significant advantages [15].

Our study found that the introduction of phlebotomists was associated with an increase in the total number of investigations performed. Excluding the COVID-19 PCR/LIAT testing [4, 16] introduced during the second study period, blood tests significantly increased from 52% in T1 to 59.9% in T2 ($p < 0.001$).

Importantly, our study failed to show an improvement in EDLOS and was associated with a larger number of patients who did not wait for treatment to be completed, despite front loading investigations.

The reason for this increase may be related to the difference in triage categories across the two time periods, given that gender and age were similar. In T2, there were 10% more emergency and urgent patients compared with T1. Additionally, fewer patients were discharged home from the waiting room (8.2% vs. 6.3%), suggesting increased acuity. The performance of tests at triage (apart from ECGs) may also have been a contributing factor. It is also possible that although staffing was unchanged, inpatient bed availability was different across the two time periods.

Our findings on EDLOS align with those of Tintinalli et al. [15], who also reported no significant reduction in EDLOS. However, their study was a small pilot conducted over only 5 days with a limited sample size. Unlike some studies, we did not observe a reduction in DNW rates [14].

The intervention period was associated with more SSU admissions and a proportionally lower use of ED cubicles, which we believe is attributed to the investigations initiated and interpreted at triage, which enabled senior clinical decision-makers to determine alternative management strategies from the waiting room [3]. However, wait times for all dispositions increased.

Although our study did not specifically evaluate patient safety it is worthwhile making some additional observations. Staff strongly believed that the phlebotomist role enhanced patient safety, a perception supported by prior reports [14, 17, 18]. One notable example was the reduction in blood sample mislabelling incidents, with 26 'wrong blood in tube' events recorded during the study period, 24 involving nursing staff and only two involving phlebotomists.

Following the introduction of VBG testing by the phlebotomists, 18 patients with critical results were identified in the waiting room before being seen by a doctor. As a direct result of this process, actions were initiated; the two most common were escalating the request for an ED cubicle to the next available space or conducting further formal blood tests. Importantly, none of these critical cases would have been identified using the existing ED Medical Emergency Team (MET) criteria [19]. This underscores the ongoing clinical risks associated with prolonged wait times in the ED waiting room.

4.1 | Limitations

There are several limitations to our study. First, this was an observational study and due to that, it cannot establish cause-and-effect relationships, making it difficult to rule out bias and confounding. There are many other factors that could have contributed to increased investigations and EDLOS, such as differences in patient caseload, complexity and availability of a disposition destination; however, there were no major changes to workflow or staffing during the two study periods, and presentation numbers were consistent. Examining bed inpatient availability would have assisted in understanding the impact on EDLOS, but it was outside the scope of this study. Second, it was difficult to determine time to diagnosis or time to disposition decision from the available data. It would have been interesting to see if having more investigations done earlier could have influenced those variables. Phlebotomists were associated with more tests. We did not ascertain the appropriateness of these tests. Finally, this study showed that there was an increase in patients who DNW. It is unclear what the eventual outcomes are with this subgroup; however, we hope to shed more light on this in a future study.

5 | Conclusion

The introduction of phlebotomists failed to achieve the primary study objective, notably a reduction in EDLOS. We observed an increase in waiting times and a significant increase in the DNW rate. Additionally, we observed an increase in blood tests, which in turn was associated with an increase in EDLOS; ECGs were associated with a reduction, suggesting that targeted investigations were more likely to have an impact on length of stay. There has been a positive impact based on patient referral trends, with more referred to SSU and less ED cubicle utilisation, suggesting that more clinical decision-making occurred while patients were in the waiting.

We welcome further multicentre studies in this area given strong staff support [18]. We suggest that inpatient bed utilisation and other factors such as patient safety and experience be measured to truly determine the appropriate role of phlebotomists at triage.

Author Contributions

All authors have equally contributed.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.