Improving emergency department efficiency by patient streaming to outcomes-based teams

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Abstract

Objective: To describe the process and results of a process redesign based on task analysis and lean thinking approaches aimed at improving emergency department (ED) efficiency.

Methods: Before-and-after study comparing 12-month periods before and after the process redesign for total episodes of ambulance bypass, waiting times (overall and by triage category) and total ED time (overall and by triage category). Time data were analysed using non-parametric methods.

Results: The years were broadly comparable, with the exception that there was an 8.4% increase in total hours of care delivered (a marker of ED workload) in the year after the change. Episodes of ambulance bypass reduced by 55% (120 v 54). There were statistically significant waiting times reductions for triage categories 3 and 5 (median reductions 5 and 11 minutes respectively). There was an increase in total ED time for triage category 3 (median increase 7 min) and a decrease for categories 4 and 5 (median reduction 14 and 18 min, respectively).

Conclusion: ED process redesign based on task analysis and lean thinking approaches can result in improved ED efficiency.

Aust Health Rev 2007: 31(1): 16–21

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EMERGENCY DEPARTMENT (ED) OVERCROWDING is a growing problem in Australia and around the world.[1-3] Current understanding is that it is a complex interaction of hospital, ED, patient and ambulance factors. The results can be longer waiting times for patients, increased episodes of ambulance bypass, patients spending long periods "boarding" in the ED awaiting ward beds, and increased clinical risk.[4-8]

Access block (shortage of available hospital beds to accommodate emergency patients requiring admission) seems to be the major contributor to ED overcrowding,[1,9,10] and a lot of work has been going into hospital systems to better manage beds. That said, there might be processes within EDs that also contribute to overcrowding.

The aim of this project was to analyse ED patient flow processes using a task analysis and lean thinking approach,[11] and re-engineer these processes to improve flow through the ED for all groups of patients.

Methods

This project was undertaken in the ED of Western Hospital, a 300-bed, community teaching hospital in Melbourne, Australia. The ED treats adult patients only and has an annual census of about 32 000. It has two adjacent but separate treatment zones and 26 treatment spaces. It is staffed by a mixture of emergency physicians, registrars in training and other junior medical officers. Indicative admission rates by triage category for the study hospital are National Triage Scale (NTS) 1, 46%; NTS 2, 44%; NTS 3, 32%; NTS 4, 16% and NTS 5, 6%. The project had three main steps: patient flow and task analysis using lean thinking approaches,[11] process redesign, and implementation and evaluation.

Patient flow and task analysis

Having considered materials from the "See and treat" programs and the "4-hour" target in the United Kingdom[12] and streaming of discharged patients from Flinders Medical Centre in South Australia,[13] we decided to divide patients into two groups: those likely to be admitted and those likely to be discharged. It was our perception that the processes required by these groups were different and that the needs of the sicker (admitted) group could delay activities for the "discharge" group, thus negatively impacting patient flow. For each group, we qualitatively mapped the steps in their flow through the ED and identified barriers to more effective flow.

For the admitted group, major barriers were availability of space for initial assessment, waiting for investigations or their results, consultations with inpatient teams and waiting for a ward bed to be available. We also identified that there was a fairly fixed waiting period after requesting a ward bed, so that if the request could be made earlier, the total ED stay might be reduced.

For the discharged group, the major barriers were again availability of space for initial assessment and waiting for investigations or results. We also identified that there were delays in the actual discharge process (medical review, organising referrals, etc) because staff had competing priorities with sicker patients who were requiring admission. We also identified that the majority of the discharged group were managed in one of the treatment areas that did not have immediate access to a specialist emergency physician to guide care and encourage early decision making.

Process redesign

Following our analysis we decided on a process redesign with two key elements: streaming of patients from triage based on likelihood of admission or discharge, and re-allocation of medical and nursing staff into two teams — one handling patients likely to be admitted and the other those likely to go home. These teams are functional 15 hours per day (8am until 10pm) and each is led by an emergency physician and senior nurse.

The theory behind streaming is that the two patient groups require different tasks, in particular closeness of observation, intensity of investigation and treatment, consultations and organising of home supports or follow-up. By concentrating the patient groups, we hoped to better match their needs and the available resources in order to speed their flow through the department. We also wanted to reduce competing demands on staff. The theory behind the team-based approach was to ensure senior input into decision making at an early stage, again with the aim of improving patient flow.

We supported our processes change with some interim process-related targets that we could easily monitor. For admitted patients, we set a target of 75% of requests for beds being made within 4 hours of ED presentation. The month before our changes, this was at 54%. For discharged patients, the target was 90% treated and discharged from ED within 4 hours of presentation. The month before the changes, this was 83%.

Our new processes were implemented in May 2004.

Evaluation

The primary outcome measures were:
- Episodes of ambulance bypass. It is important to note that criteria for bypass did not change between study years, being based on total numbers in ED and perceived risk of accepting additional ambulances as judged by senior ED clinicians
- Waiting time, overall and by triage category
- Proportion of patients who left ED without treatment
- Staff satisfaction survey

Periods for comparison were May 1 to April 30 in 2003–04 and 2004–05, respectively. We defined a clinically significant reduction in waiting time as 5 minutes for triage categories 2 and 3 and 10 minutes for categories 4 and 5. We also collected total hours of patient care delivered for each period (the aggregate of admission to discharge times for all patients) as an indication of ED workload in the study periods.

1 Comparison of parameters pre and post process change (medians, interquartile ranges)*

Parameter	2003	2004	Difference (2004–2003)	Significance
Total patient number	31 570	31 515	− 55	–
Triage category, no. (%)				
1	460 (1.46%)	413 (1.31%)	− 0.15%	$P < 0.005$[†]
2	3 139 (9.9%)	3 038 (9.6%)	− 0.3%	–
3	10 721 (34.0%)	9 944 (31.6%)	− 2.4%	–
4	13 173 (41.7%)	13 540 (43.0%)	+ 1.3%	–
5	3 888 (12.3%)	4 391 (13.9%)	+ 1.6%	–
Ambulance cases, no. (%)	11 847 (37.5%)	11 699 (37.1%)	− 0.4%	ns
Ward admissions, no. (%)	7 458 (23.6%)	7 270 (23.1%)	− 0.5%	ns
Left without being seen, no. (%)	1 172 (3.71%)	1 175 (3.73%)	+ 0.02%	ns
Total patient care time (total days)	5 552	6 019	+ 467 (8.4% increase)	$P < 0.001$

* Patients who were brought to the Emergency Department for certification of death only have been excluded from triage distribution. † Refers to triage distribution across National Triage Scale categories 1–5 between study years. ns = not significant.

Statistical analysis

Waiting times and total times were very highly skewed distributions, so standard parametric methods were not applicable. We used medians and interquartile range (IQR) statistics to describe and estimate differences between groups, and median regression analysis to estimate confidence intervals for differences in median times between years. We used Stata Statistical Software, Release 9 (2005, StataCorp LP, College Station, Tex, USA) to perform all analyses.

first month and was sustained at an average of 92% over the first year of the project. Bed requests within 4 hours of presentation also improved quickly — to 77% within the first month. Over the first year of the project, bed requests within target time averaged 73%.

Episodes of ambulance bypass decreased from 120 in the year before the change, to 54 in the year after it. (55% reduction; 95% CI, 38%–68%; $P < 0.001$).
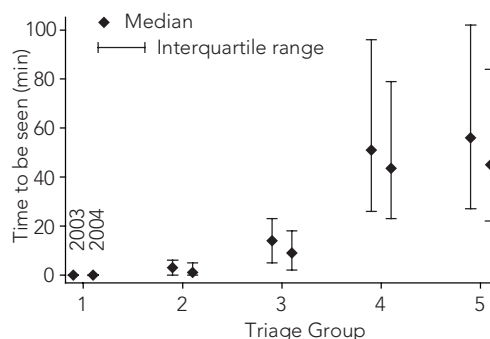
Results

The ED characteristics for the two study periods are summarised in Box 1. The years are broadly comparable across most parameters, with the exceptions being a slight reduction in the proportion of triage category 3 patients and slight increases in triage category 4 and 5 groups between years. There was an 8.4% increase in the hours of care delivered between the study periods, indicating a significant increase in ED workload despite there being no increase in patient presentations.

Interim targets improved markedly within the first month of the project. The proportion of discharged patients increased to 97% within the

2 Comparison of waiting times between study years by National Triage Scale triage group

3 Change in median waiting time and total Emergency Department time between study years, by National Triage Scale triage category, with 95% confidence interval for change

Triage group	Difference in medians	95% CI for difference	Significance
Waiting time			
Overall	−3	−5.0 to −1.0	0.003
1	0	−0.2 to 0.2	1.000
2	−2	−3.9 to −0.1	0.039
3	−5	−6.9 to −3.1	< 0.005
4	−7	−9.0 to −5.0	< 0.005
5	−11	−14.0 to −8.0	< 0.005
Total Emergency Department time			
Overall	−12	−15.9 to −8.1	< 0.005
1	9	−21.4 to 39.4	0.562
2	13	−0.9 to 26.9	0.067
3	7	1.1 to 12.9	0.020
4	−14	−17.9 to −10.1	< 0.005
5	−18	−23.9 to −12.1	< 0.005

There was a statistically significant reduction in waiting time, overall and in the subgroups triage categories 2 to 5. Results are shown graphically in Box 2, and change in times is shown in Box 3. Differences only reached clinical significance for triage category 3 (median for 2003, 14 minutes compared with median for 2004, 9 minutes) and triage category 5 (median for 2003, 56 minutes compared with median for 2004, 45 minutes).
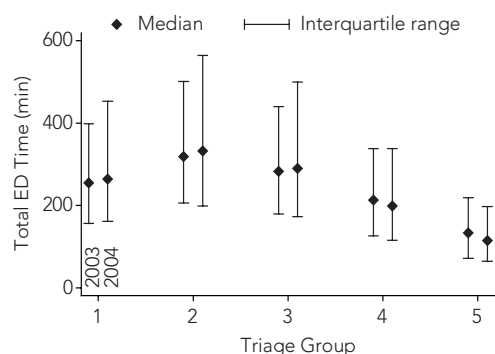
With respect to total ED time, there was a statistically significant difference between the years for triage categories 3 to 5. Data are shown in Box 4, and change in times in Box 3. There was an increase in total ED time for category 3 patients (median for 2003, 283 minutes compared with median for 2004, 290 minutes). For triage categories 4 and 5, there was a reduction in total treatment time (triage 4: median for 2003, 213 minutes compared with median for 2004, 199 minutes; triage 5: median for 2003, 133 minutes compared with median for 2004, 115 minutes).

There was not a significant difference in the number of patients who left the ED without being seen. 90% of staff reported that they believed the ED ran better after the change. A by-product of the initiative has been a 55% increase in the number of hours of direct supervision of junior medical staff by consultants.

Discussion

ED overcrowding is a complex issue and, as such, the solutions are not likely to be simple. In Australia, access to inpatient beds is probably the most significant factor.[1,9,10] That said, management of ED flow might increase efficiency (as evidenced by reduction in time on bypass and reduced waiting times) despite so-called bed block. Our study has shown that despite an 8.4% increase in aggregate hours of care delivered to patients, there was a highly significant reduction in episodes of bypass and modest reductions in waiting times across triage groups. Pleasingly, the tops of the IQRs for waiting time show reductions of the order of 20 minutes, suggesting that extreme outlying times have been reined in. These findings support our thesis that using task analysis and lean thinking approaches to re-design processes for care can improve ED efficiency.

4 Comparison of total Emergency Department (ED) time between study years, by National Triage Scale triage category

The total ED time data are more complex, showing increases in median times and IQR ranges for triage categories 1,2 and 3 and reductions in total ED time in triage categories 4 and 5. Given that hours of care delivered increased by 8.4% without an increase in patient attendances or ward admissions, this probably means that access to ward beds actually worsened between the study years. This makes it likely that our efficiency gains were in moving discharged patients through the ED faster, thus freeing up cubicle space, rather than any improvements in ward bed access. This supports our thesis that process change within the ED can improve efficiency in spite of increasing ward access problems.

Although other hospital units were informed of our process changes, they had no direct input into them. This change was managed completely within the ED, developed and led by clinicians. We believe that its rapid uptake and success are due to strong clinical leadership, a collaborative design and implementation process involving all professional groups and grades of staff, and an open, iterative process that addressed problems as they arose. Perhaps the most important factor was a very high level of staff dissatisfaction with the state of the ED before the changes, making any change for the better highly attractive.

This study highlights some of the tension between statistical significance and clinical significance when analysing such a large data set. Small changes in times may be statistically significant but not of clinical relevance for the patient or the health service. It also raises the tension between clinical significance for an individual patient and clinical significance at the system level. A 10-minute reduction in waiting time may be highly valued by a patient but, for low triage category patients, may be of little interest to the system. A 10-minute reduction in total treatment time may seem not much to an individual patient, but if that is achieved for 40 patients per day, that is 400 minutes (more than 6 hours) of additional cubicle availability at the department level. We achieved a median reduction in total time of 12 minutes for an average of 86 patients per day, equating to more than 17 hours of additional cubicle availa-

bility per day. Our efficiency gains are likely to have come from reducing total ED times for triage 4 and 5 patients that together make up 50% of the patient load.

The improved performance we have demonstrated is heartening, but with fixed space and staff resources it is of course not open ended. It has moved the point where ED performance falls off in the face of workload pressures, however, if ward access block is very high, this or any ED process is unlikely to be able to function efficiently. This highlights the fact that while some aspects of ED efficiency can be improved internally, the inter-dependence regarding ward access remains a critical success factor.

Our study has some limitations that must be considered when interpreting the results. The study was conducted at a single centre, with a unique ED geography, patient profile and staff mix. Results may not be generalisable to other centres. That said, the processes used by us could be applied to other settings to design a patient flow model that suits their environment. Data was collected for the year immediately following the process change and as such there may be an element of the Hawthorne effect. Data was collected from a database that is regularly monitored for data accuracy, however misclassifications may still have occurred.

Conclusion

This ED process redesign has resulted in improved ED efficiency as evidenced by reductions in episodes of bypass and reduced/stable waiting times despite an 8.4% increase in workload. This suggests that improved ED processes can improve performance even in the face of increasing bed access block.

Competing interests

The authors declare that they have no competing interests.

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