Emergency department length of stay independently predicts excess inpatient length of stay

Don Liew, Danny Liew and Marcus P Kennedy

ABSTRACT

Objective: To examine the association between emergency department length of stay (EDLOS) and inpatient length of stay (IPLOS).

Design: Retrospective review of presentations and admissions data.

Setting: Three metropolitan hospitals in Melbourne, 1 July 2000 to 30 June 2001.

Main outcome measures: Mean IPLOS for four categories of EDLOS (⩽ 4 hours, 4–8 hours, 8–12 hours, >12 hours); excess IPLOS, defined as IPLOS exceeding state average length of stay; odds ratios for excess IPLOS adjusted for age, sex and time of presentation.

Results: 17 954 admissions were included. Mean IPLOS for the four categories of EDLOS were ⩽ 4 hours, 3.73 days; 4–8 hours, 5.65 days; 8–12 hours, 6.60 days; > 12 hours, 7.20 days ($P<0.001$). The corresponding excess IPLOS were 0.39, 1.30, 1.96 and 2.35 days ($P<0.001$). Compared with EDLOS 4–8 hours, odds ratios (95% CIs) for excess IPLOS associated with the other three categories of EDLOS were ⩽ 4 hour, 0.68 (0.63–0.74); 8–12 hours, 1.20 (1.10–1.30); and > 12 hours, 1.49 (1.36–1.63), after adjusting for elderly status, sex and time of ED presentation.

Conclusion: EDLOS correlates strongly with IPLOS, and predicts whether IPLOS exceeds the state benchmark for the relevant diagnosis-related group, independently of elderly status, sex and time of presentation to ED. Strategies to reduce EDLOS (including countering access block) may significantly reduce healthcare expenditure and patient morbidity.

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THERE HAS BEEN considerable publicity recently about access block and its effect on patient care. Access block appears endemic,[1] with institutions across Australia reporting various strategies to counter the problem and its effect.[2]

Richardson demonstrated an association between access block and prolonged inpatient length of stay (IPLOS) for patients admitted from the emergency department (ED), where IPLOS was used as a measure of outcome outside the ED.[3] Access block is a direct cause of prolonged ED length of stay (EDLOS), and is specified by an EDLOS exceeding 8 hours.[4] However, EDLOS is commonly prolonged by other factors, and may affect patient outcome even when less than 8 hours.

In this study, we investigated the association between EDLOS and IPLOS among patients admitted to inpatient units of a metropolitan Melbourne health service during 1 year.

METHODS

Inpatient admissions to the three campuses of Eastern Health, a major metropolitan health service in Victoria, from 1 July 2000 to 30 June 2001 were retrospectively reviewed. Eastern Health has 740 acute-care beds, provides all services except neurosurgery and cardiac surgery, and has a total annual ED census of more than 100 000 patients.

Data sources

Data were acquired from case linkage of two health service databases that populate the Victorian Emergency Minimum Dataset[5] and the Victorian Admitted Events Dataset.[6] The former contains de-identified demographic, administrative and clinical data on presentations at Victorian public hospitals with 24-hour EDs;[5] the latter has similar data on all admissions into Victorian public and private health institutions.[6] Dates of presentation and hospital record numbers were concatenated to produce unique identifiers that enabled records from the two datasets to be matched.

Data were selected for inpatients admitted via the ED. These included patients who were subsequently discharged from the ED without physically accessing inpatient beds (see definition of IPLOS below). We excluded patients who died in the ED, were admitted to short stay observation units or "hospital in the home" programs, or were transferred to other facilities.

From the two datasets, we extracted age, sex, time of presentation to the ED, time of initiation of treatment in the ED, time of transfer to the ward, time of discharge from hospital, diagnosis-related group at the time of discharge, and state average inpatient length of stay (SALOS) for that particular diagnosis-related group.

EDLOS is defined as the time from ED presentation to transfer to a ward;[4] IPLOS is the time from ED presentation to discharge from hospital.[6]

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Emergency Department, Angliss Hospital, Upper Ferntree Gully, VIC.
Don Liew, MB BS, FACEM, Emergency Physician.
Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, VIC.
Danny Liew, MB BS(Hons), FRACP, Lecturer; and NHMRC Postgraduate Medical Scholar, Central and Eastern Clinical School, Alfred Hospital, Melbourne.
Emergency Department, Royal Melbourne Hospital, Parkville, VIC.
Marcus P Kennedy, MB BS, FACEM, Director of Emergency Services.
Reprints will not be available from the authors. Correspondence: Dr Don Liew, Emergency Department, Angliss Hospital, Albert St, Upper Ferntree Gully, VIC 3156. don.liew@angliss.org.au

1: Means (95% CIs) of inpatient length of stay and excess* inpatient length of stay

	Emergency department length of stay			
	⩽4 hours	4–8 hours	8–12 hours	>12 hours
IPLOS (days)†	3.73 (3.53–3.93)	5.65 (5.48–5.82)	6.60 (6.31–6.89)	7.20 (6.91–7.49)
IPLOS – SALOS* (days)†	0.39 (0.21–0.57)	1.30 (1.15–1.45)	1.96 (1.71–2.21)	2.35 (2.08–2.62)

* Excess inpatient length of stay is defined as inpatient length of stay exceeding the state average length of stay for the diagnosis-related group (IPLOS – SALOS). IPLOS = Inpatient length of stay. SALOS = State average inpatient length of stay (for specific diagnosis-related group). † $P < 0.001$ for difference, on analyses of variance (ANOVA).

SALOS values for each diagnosis-related group were obtained from Victorian Department of Human Services data.[7]

Data analysis

The primary outcome was the difference between IPLOS and SALOS (IPLOS – SALOS). This adjusts for admission diagnosis and is a measure of *excess* IPLOS (relative to the state average). Across four categories of EDLOS (⩽ 4 hours, 4–8 hours, 8–12 hours and > 12 hours), differences in means were compared by analyses of variance.

IPLOS – SALOS was then dichotomised (positive versus zero and below) and logistic regression analysis undertaken to assess univariate and multivariate associations with EDLOS, age (65 years or above versus less than 65 years), sex, campus and time of ED presentation (08:00–18:00 hours versus 18:00–08:00 hours). Binary logistic regression analysis was chosen because the outcome parameter is a clinically meaningful dichotomy, and because it avoids the pitfalls of applying linear regression to skewed data.

All analyses were undertaken using SPSS.[8]

RESULTS

Of the 34 932 admissions to Eastern Health from 1 July 2000 to 30 June 2001, 18 619 (53%) were via the ED. Of these, 665 (4%) were excluded from analysis because of insufficient data or admission to a facility other than an inpatient unit, leaving 17 954 admissions (96%). Of these, 48.1% were men, whose mean (SD) age was 50.7 (27.0) years. The mean (SD) age of women was 56.0 (27.4) years.

The overall mean EDLOS was 7.96 hours and the overall mean IPLOS was 5.63 days.

The distribution of cases across the four categories of EDLOS was ⩽ 4 hours, 23.5%; 4–8 hours, 42.4%; 8–12 hours, 17.6%; and > 12 hours, 16.6%. The means of IPLOS and IPLOS – SALOS for each category of EDLOS are shown in Box 1.

The results of logistic regression analysis linking EDLOS and other major factors to excess IPLOS are presented in Box 2. A "dose-dependent" association with EDLOS was found, even after adjusting for elderly status, sex and time of presentation to ED. Each of these other major factors was also significantly and independently associated with excess IPLOS.

DISCUSSION

This study is the first to show that prolonged EDLOS is associated with *excess* IPLOS (defined as exceeding the state benchmark for the relevant diagnosis-related group), even after adjusting for major confounding factors. That is, common explanations for this association were accounted for, such as being elderly (more complex illness, or awaiting discharge to an aged care facility) and time of ED presentation (delays in access to diagnostic and treatment facilities outside of normal working hours).

Compared with patients who stay in the ED for 4–8 hours, those who remain for 8–12 hours are about 20% more likely to stay in hospital longer than the state average for the relevant admission problem. This rises to 50% if EDLOS is greater than 12 hours. Conversely, there is about 30% less likelihood of IPLOS exceeding SALOS if EDLOS is four hours or less.

Other risk factors identified in our study for IPLOS exceeding the state average included age 65 years or greater, female sex and presentation to the ED outside normal working hours. Like EDLOS, these factors were associated with excess IPLOS independently of one other (and EDLOS). However,

2: Logistic regression results for excess* inpatient length of stay

Variable	Univariate odds ratio (95% CI)	Multivariate odds ratio (95% CI)†
Emergency department length of stay		
4–8 hours	1.0	1.0
⩽ 4 hours	0.58 (0.54–0.63)	0.68 (0.63–0.74)
8–12 hours	1.27 (1.17–1.38)	1.20 (1.10–1.30)
> 12 hours	1.62 (1.48–1.76)	1.49 (1.36–1.63)
Age		
< 65 years	1.0	1.0
⩾ 65 years	2.13 (2.00–2.26)	1.85 (1.72–1.96)
Sex		
Female	1.0	1.0
Male	0.83 (0.78–0.88)	0.90 (0.84–0.95)
Time of presentation to the ED		
08:00–18:00	1.0	1.0
18:00–08:00	1.16 (1.09–1.23)	1.16 (1.09–1.23)

* Excess inpatient length of stay is defined as inpatient length of staying exceeding the state average length of stay for the diagnosis-related group. † After adjusting for each of the other variables in the table, as well as campus.

unlike EDLOS, they are non-modifiable.

Funding of public hospitals for inpatient care is based on a formula that considers SALOS for the relevant diagnosis-related group, not actual IPLOS. However, it is the latter that drives hospital expenditure. Therefore, the extent to which IPLOS exceeds SALOS provides an indication of costs met by the hospital and not reimbursed by the state. Our results suggest significant potential for resource savings associated with decreasing EDLOS.

Importantly, strategies to reduce EDLOS may also counter greater morbidity associated with prolonged IPLOS.[9-12] This would be especially important for elderly patients, who appear to be independently at risk (about 1.85 times the risk of those under 65 years) of excess IPLOS, and in whom comorbidity is common.

Early intervention measures in the ED may be useful. Services that are traditionally initiated during the ward phase of an admission, such as referral to subspecialty and allied health groups, could be implemented while the patient remains in the ED awaiting a bed. Consideration of patient care as a system of intervention (a continuum), rather than discrete encounters, may lead to identification of effective collaborative strategies.

Limitations of the study

A limitation of the study is that systematic correlation exists between EDLOS and IPLOS, as EDLOS is a subset of IPLOS. However, our definitions were used for two reasons.

First, the period of inpatient stay invariably commences while the patient is in the ED, at the point when therapeutic intervention occurs. Taking the starting point of IPLOS as time of transfer to the ward would grossly underestimate the IPLOS, especially when access block occurs.

Secondly, SALOS is defined the same way. Therefore, the difference between IPLOS and SALOS, the main outcome measure, remains valid.

Another limitation is that we used data from non-tertiary metropolitan hospitals (although one campus approaches a tertiary profile), and it is unclear whether the results would be fully applicable to major tertiary and regional institutions. However, key results are specific to diagnosis-related groups (referenced to SALOS for the relevant diagnosis-related group) and hence would be at least applicable to the broad range of diagnosis-related groups considered. Furthermore, the very large size of the study provided high precision in estimates.

Finally, severity or complexity of illness are significant potential confounders not accounted for in the study. A patient with severe, undifferentiated or complex social problems may require more lengthy "work up" in the ED and require longer IPLOS.[3] However, data that accurately indicated severity or complexity of problems were not available. Australasian Triage Scale categories assigned to patients were not used, because these reflect illness *urgency*, which is not synonymous with severity or complexity.[13] Moreover, many sick patients have short EDLOS, as EDs tend to "fast-track" their disposition to the appropriate destinations, such as the intensive care unit, coronary care unit or operating theatre.

CONCLUSION

EDLOS is associated with excess IPLOS for the specific diagnosis-related group, independently of elderly status, sex and time of presentation to the ED.

Strategies to reduce EDLOS may save both ED costs and costs associated with inpatient care. Such strategies should target elderly patients. Importantly, they may also prevent patient morbidity and mortality related to prolonged IPLOS.

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COMPETING INTERESTS

None identified.

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