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**Original Article**

# Investigating Immediate and Intermediate Patient Outcomes Following Transfer From the Acute Medicine Unit at the Western General Hospital, Edinburgh: A Prospective Cohort Study

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**Background:** An ageing population is placing increasing pressure on acute medical units (AMUs), necessitating frequent, and often inappropriate transfer of patients. We identified a gap in the literature, with similar studies relating to either cardiac or intensive care settings, with another, reporting frequency of movement and adverse outcomes in the elderly. The aim of this study was to ascertain whether patients admitted to the AMU and who are moved "out of hours" (22:00–06:59) experience adverse outcomes opposed to patients moved "within hours."
**Methods:** Data was extracted from TrakCare—a unified, web-based healthcare information system—which facilitates real-time bed management processes. This prospective cohort study was carried out at the Western General Hospital (WGH), Edinburgh. The final cohort (n = 219) was split into two groups (out of hours vs. within hours) for statistical analysis. Specific sub-group analysis was used to supplement findings, with eight sub-groups, each defined by a 3-hr time frame around the 24-hr clock.
**Results:** The final cohort after application of exclusion criteria was n = 219 (female: n = 114, median age = 76; male: n = 105, median age = 75). There was a significant difference in length of stay (LoS) between boarded and non-boarded patients who were: (1) moved out of hours (2) moved within hours ($p$ = 0.003). Remainder of patient outcome results (readmission at 7 and 30 days respectively; mortality during admission, and at 7 and 30 days) were not statistically significant.
**Conclusion:** We revealed a significant difference in LoS between patients moved within and out with hours; the "out of hours" patient group—was significantly less than that of the "within" hours group.

**Key words:** *acute medicine, medical boarding, adverse outcomes*

## Introduction

Together with the King's Fund, the Office for National Statistics[1] has published regional ageing population statistics, which reflect the national trend, with the exception of London, where there are 1.3 people under the age of 15 for every person over the age of 65, while for rest of the United Kingdom (U.K.), those over the age of 65 outnumber those under the age of 15. The increasing ageing population, together with pre-existing medical conditions has brought challenges and prospects to the field of acute medicine within the U.K.,[2] necessitating frequent, and often inappropriate transfer of patients.

Poor planning of patient transfer may result in

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delayed recovery and adverse health outcomes thus resulting in readmission to critical care areas.[3] Current evidence suggests that patients transferred from intensive care areas overnight or "out of hours" have a higher risk of mortality than those moved during the day.[4,5]

The acute medical unit (AMU) at the Western General Hospital (WGH) commonly transfers patients late in the day and overnight (i.e., "out of hours") as beds become available throughout the hospital. Some of these patients are "boarded" in wards that are not suited to their primary diagnosis or care requirements; for example, a patient diagnosed with pneumonia occupying a bed on a surgical ward due to lack of available beds in a general medicine or respiratory ward. At the WGH, boarded patients are selected on medical assessment, and prediction of short stay, meeting criteria in accordance with the "Clinical Quality Indicators for Acute Medical Units"[6] (Supplement 1).

In general, there are two main types of boarding whereby the clinical responsibility for the patient lies with either the parent ward or the host ward. The literature suggests both types of boarding are associated with adverse patient outcome; such as increased Length of Stay (LoS),[7] risk of adverse events,[8] and mortality.[9,10] To date, the majority of studies investigating the effect of transfer time on patient outcome have focused on critical care. In 2009, the Scottish Emergency Access Delivery Team commisioned a report to review the pressures experienceed and subsequent response by National Health Service (NHS) Scotland during winter 2008–2009. In this report, they stated the following: "*Boarding—Health Boards should aim to eliminate boarding of patients as a solution to bed capacity problems. Specifically, the boarding of patients from the Acute Medical Unit and/or Emergency Department should not occur (this includes 'treat and transfer' policies, with the exception of tertiary care referrals).*" The aim of this study therefore, was to ascertain whether patients moved "out of hours" from AMU have worse outcomes, with a view to inform and shape policy, together with improving acute medical patient pathways. It also aims to determine whether there are any discernable differences in patient outcomes between boarders and non-boarders, moved both within, and out with hours from the AMU at the WGH, using the same indicators, thus ascertaining whether the review process and management plan provides an accurate prediction of patient outcome.[11]

## Methods

The Scottish Government delivered an e-health strategy to be rolled out between 2011–2017 which included the national Patient Management System, TrakCare, which provides Health Boards with patient administration functionality, medical history, scheduling, order communications and results reporting.[12] This innovative system allows for effective communication from admission to discharge across the Lothian region. Therefore, for the purposes of data collection, the NHS Lothian TrakCare system was applied.

This investigation was a prospective cohort study investigating immediate and intermediate patient outcomes following transfer from the AMU at the WGH over a consecutive eleven-day period. An anonymised patient dataset was migrated to Statistical Package for Social Sciences (SPSS), version 24.0. Inclusion criteria, was all medical patient admissions to the Medical Assessment Unit Emergency (MAUE; otherwise categorised as "trolleys," time spent on "examination couches," which differs from actual ward based beds, and viewed as temporary arrangement in healthcare—area, between August 28, 2016 (00:00) and September 8, 2016 (23:59), which generated an original cohort of 550 patients. Ethical approval was not required as the data was anonymised prior to migrating from TrakCare to SPSS version 24.0 which was applied to all specific statistical tests. The significance level was set at 0.05.

A retrospective follow-up of all 550 patients was conducted between November 27, 2016 and November 30, 2016 in TrakCare, and the following features of admission noted for each patient.

(1) Date and time of transfer from either;
   A. MAUE (trolleys) directly to clinical specialty (non-boarding patient)
   B. Medical Assessment Unit (MAU) base to an appropriate clinical specialty (non-boarding patient) or inappropriate clinical area (boarding patient). We defined an appropriate clinical area as access to specialist practitioners meeting the needs of diagnosis and providing timely and effective care.

(2) Destination of transfers from either MAUE or MAU "beds" (i.e., clinical area transferred). This was to allow for identification of "non-boarders" and "boarders." The criteria and definition applied was type-1 board-

ing:[13] and defined as "patient who occupies a borrowed bed is described as boarding, including patients in beds who are:
A. Managed by an individual consultant or consultant team out with the main allocated inpatient area for that consultant, or patient specialty
B. Transferred to any non-inpatient bedded area (for example day units)"

(3) Date and time of discharge from hospital to allow for calculation of total length of admission: defined as the total number of hours (rounded down) from presenting in MAUE to discharge.
(4) Seven and 30-day readmission rates post-discharge: defined as new presentation to AMU and subsequent admission to a ward. Exclusion criteria included those re-admitted for elective surgeries or routine checks/pre-admissions.
(5) Mortality rates including
A. Cardiac arrest during admission and subsequent death
B. Seven and 30-day mortality post-discharge

## Exclusion Criteria

The following exclusion criteria were applied from the original cohort of 550:

(1) Patients discharged home directly from MAUE or MAU beds.
(2) Patients who were discharged after October 28, 2016 and patients who were still inpatients from their original admission; the reason being, this would not have allowed adequate time for evaluation of 30-day readmission and mortality rates post-discharge amongst these patients when conducting the follow-up.
(3) Patients with no unique identifier (cumulative health index [CHI] number) admitted to MAUE during data collection, including U.K. non-residents.

The remaining cohort after application of exclusion criteria was n = 219, which was further split into eight sub-groups depending on time they were transferred from either MAUE, directly to ward, or from MAU to ward. Each group was defined by a 3-hr time frame around the 24-hr clock, thus eight sub-groups in total (Table 1). Refer to Fig. 1. for flowchart of patient pathways, and Table 2 for sub-group tabular data.

## Data Analysis

The "out of hours" group was classified as patients moved between 22:00–06:59 (sub-groups 1–3: n = 57) whilst the "within" hours group was classified as patients moved between 07:00–21:59 (sub-groups 4–8: n = 162). Preliminary analysis determined any significant differences in patient outcomes (using the indicators described) when comparing the two main groups (all patients moved "out of hours" vs. all patients moved "within" hours) as well as comparing boarders and non-boarders. Specific sub-group analysis was used to supplement findings. SPSS version 24.0 was applied to all specific statistical tests.

### LoS

(1) Data distribution was assessed for both main groups ("out of hours" and "within hours") using histogram analysis. The Mann-Whitney test was then applied to determine whether there was a significant difference in LoS between the two main groups.
(2) The Kruskal-Wallis test was then applied to determine whether there was a significant difference in the LoS (hours rounded down) between boarded and non-boarded patients: moved "out of hours" and moved "within hours."

### Seven and 30-Day Readmission

(1) Seven-day: chi-square test was applied, however did not meet required assumptions (one expected count was < 5.0), thus Fisher's exact test was used.
(2) Thirty-day: chi-square test was used as the assumptions were met.

**Table 1.** Patient sub-group data

| Group | n | Time range of patient transfer from MAUE or MAU |
|---|---|---|
| 1 | 29 | 22:00–00:59 |
| 2 | 21 | 01:00–03:59 |
| 3 | 7 | 04:00–06:59 |
| 4 | 5 | 07:00–09:59 |
| 5 | 27 | 10:00–12:59 |
| 6 | 37 | 13:00–15:59 |
| 7 | 57 | 16:00–18:59 |
| 8 | 36 | 19:00–21:59 |

MAU: Medical Assessment Unit; MAUE: Medical Assessment Unit Emergency.

**Cardiac Arrest During Admission, Seven- and 30-Day Mortality**

Fisher's exact test was applied for all.

## Results

The final cohort, after application of exclusion criteria, was n = 219 (female: n = 114, median age = 76; male: n = 105, median age = 75).

### LoS

Distribution of LoS was skewed right for both groups ("out of hours" and "within hours") thus the Mann-Whitney test was applied to determine any significant difference in LoS between the two groups. Data distribution for LoS (hours rounded down) for the two groups: "out of hours" (all patients in sub-groups 1–3; n = 57) and "within hours" (all patients in sub-groups 4–8; n = 162). Both groups were positively skewed thus the Mann-Whitney test was applied. The *p* value for the test was 0.002 thus rejecting the null hypothesis and concluding that, there is a difference in distribution of LoS (hours rounded down) between the "out of hours" and "within hours" group. The median (and interquartile range) LoS for the "out of hours" group (n = 57) was 99 (56,234); for the "within hours" group (n = 162) it was 192 (95,454) hrs. The Kruskal-Wallis test was then applied to determine whether there was a significant difference in the LoS between boarded and non-boarded patients (1) moved "out of hours" and (2) moved "within hours." The *p* value for the test was 0.003 concluding that there is a significant difference in distribution of LoS between the four patient categories. The median LoS for boarders "out of hours" was 88 (156); non-boarders "out of hours" 125 (251); boarders "within hours" 156 (269); non-boarders "within hours" 220 (359).

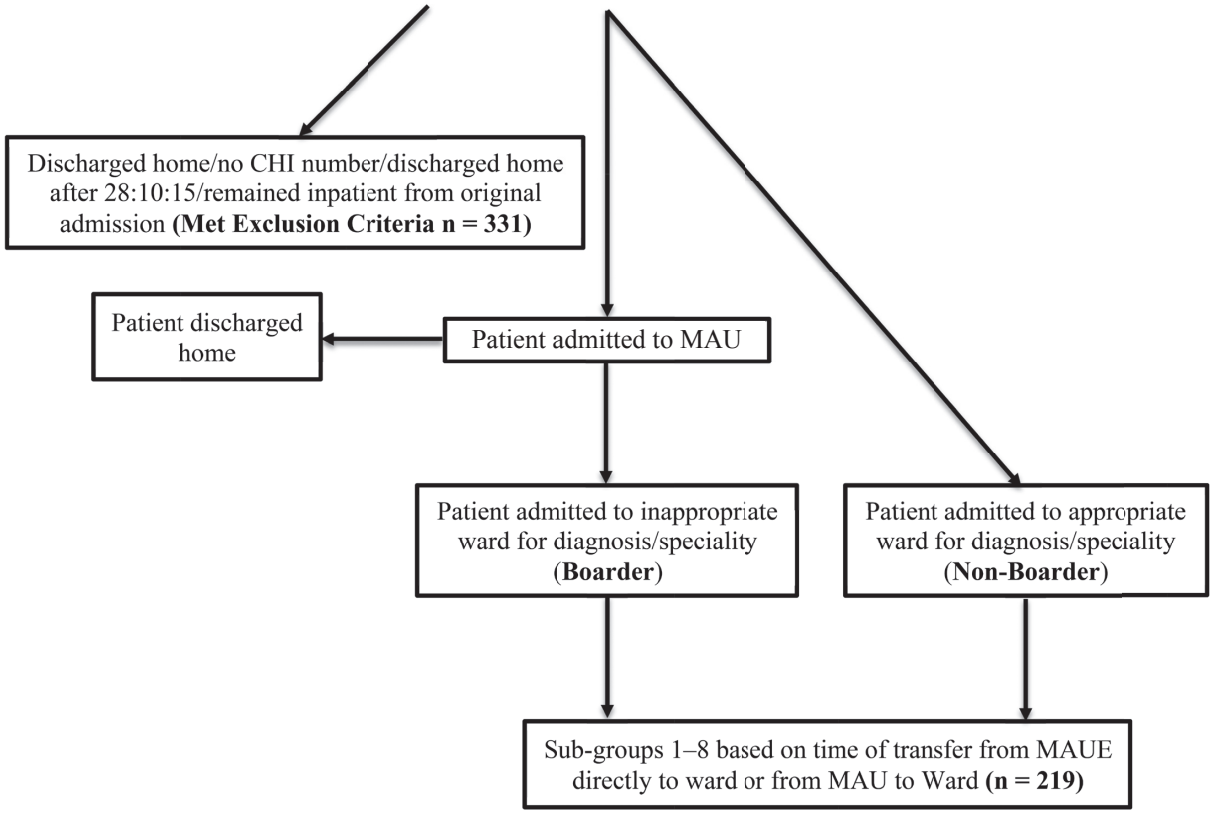


**Fig. 1.** Patient pathways from Medical Assessment Unit Emergency (MAUE) (trolleys) at Western General Hospital (WGH). The original cohort (n = 550) included all patients admitted to MAUE over an 11-day period (00:00, August 28, 2016–23:59, September 8, 2016). Follow up was conducted between November 27, 2016 and November 30, 2016 (n = 219) following application of exclusion criteria (n = 331). Final cohort divided into eight sub-groups based time of transfer.

CHI: Community Health Index; MAU: Medical Assessment Unit.

**Table 2.** Sub-group analysis

| Sub-group | n | seven-day readmission | 30-day readmission | Cardiac arrests | seven-day mortality | 30-day mortality |
|---|---|---|---|---|---|---|
| 1. 22:00–00:59 | 29 | | | | | |
| Boarders | 24 | 2 (8.3%) | 1 (4.2%) | 0 | 1 (4.2%) | 0 |
| Non-boarders | 5 | 0 | 0 | 0 | 0 | 0 |
| 2. 01:00–03:59 | 21 | | | | | |
| Boarders | 7 | 0 | 1 (14.3%) | 0 | 0 | 0 |
| Non-boarders | 14 | 0 | 2 (14.3%) | 1 (7.1%) | 0 | 0 |
| 3. 04:00–06:59 | 7 | | | | | |
| Boarders | 5 | 0 | 0 | 0 | 0 | 0 |
| Non-boarders | 2 | 0 | 0 | 1 (50.0%) | 0 | 0 |
| 4. 07:00–09:59 | 5 | | | | | |
| Boarders | 1 | 0 | 0 | 0 | 0 | 0 |
| Non-boarders | 4 | 1 (25.0%) | 0 | 0 | 0 | 1 (25.0%) |
| 5. 10:00–12:59 | 27 | | | | | |
| Boarders | 3 | 1 (33.3%) | 1 (33.3%) | 0 | 0 | 1 (33.3%) |
| Non-boarders | 24 | 0 | 1 (4.2%) | 4 (17.4%) | 0 | 0 |
| 6. 13:00–15:59 | 37 | | | | | |
| Boarders | 0 | 0 | 0 | 0 | 0 | 0 |
| Non-boarders | 37 | 2 (5.4%) | 3 (8.1%) | 4 (10.8%) | 1 (2.7%) | 1 (2.7%) |
| 7. 16:00–18:59 | 57 | | | | | |
| Boarders | 16 | 0 | 3 (18.8%) | 0 | 0 | 0 |
| Non-boarders | 41 | 3 (7.3%) | 3 (7.3%) | 4 (9.8%) | 0 | 0 |
| 8. 19:00–21:59 | 36 | | | | | |
| Boarders | 12 | 0 | 2 (16.7%) | 0 | 0 | 0 |
| Non-boarders | 24 | 1 (4.2%) | 5 (20.8%) | 3 (12.5%) | 0 | 0 |

## Seven-Day Readmission

Fisher's exact test was used to compare seven-day readmission rates amongst the two groups. There was no significant difference in seven-day readmission rates between patients moved "out of hours" (n = 57) and patients moved "within hours" (n = 162; $p = 1.000$). Specific sub-group analysis revealed that the two patients with a seven-day readmission from the "out of hours" group were both boarders from sub-group 1 (moved between 22:00 and 00:59), and deducing 8.3% seven-day readmission rate amongst the boarders of sub-group 1; the highest, of all sub-group comparisons for all patient categories.

## Thirty-Day Readmission

The chi-square test with continuity correction was applied. Results indicated that 30-day readmission rates were higher for patients transferred "within hours" (n = 18; 11.1%) in comparison to those moved "out of hours" (n = 4; 7%). However, the $p$ value was 0.530 and therefore not statistically significant, concluding that, there was no evidence to suggest that 30-day readmission rates differ between patients moved within, and out with hours. For specific sub-group analysis, 30-day readmission was highest amongst boarders in sub-group 5 (10:00–12:59) at 33%. The highest rate amongst "out of hours" patients was 14% for both boarders and non-boarders in sub-group 2 (01:00–03:59) respectively.

## Cardiac Arrest

Cardiac arrest rates were higher for patients moved "within" hours (n = 15; 9.3%) when compared with rates in patients moved "out of hours" (n = 2;

3.5%). However, this was not statistically significant, with Fisher's exact test returning a *p* value of 0.250. Specific sub-group analysis revealed that the highest rate of cardiac arrests occurred in non-boarders of sub-group 3 (04:00–06:59) at 50% (however the number (1:2 patients) was too low to extract meaningful data). The second highest rate occurred in non-boarders of sub-group 5 (10:00–12:59) at 17.4% (4 of 24 patients). Interestingly, no cardiac arrests occurred in any boarders across all eight sub-groups.

### Seven-Day Mortality

Seven-day mortality rates were higher for patients "out of hours" (n = 1; 1.8%) when compared with patients moved "within hours" (n = 1; 0.6%). However, Fisher's exact test returned a *p* value of 0.454 thus indicating this result was again, insignificant. Sub-group analysis revealed that one of the seven-day mortality cases was a "boarder" from sub-group 1 (22:00–00:59) whilst the other case was a non-boarder from sub-group 6 (13:00–15:59).

### Thirty-Day Mortality

Thirty-day mortality rate was higher for patients moved "within hours" (n = 3; 1.9%) when compared with patients moved "out with" hours (0%). Fisher's exact test returned a *p* value of 0.569, which was not statistically significant. Sub-group analysis revealed that of the 30-day mortality cases (n = 1), patient was a "non-boarder" from sub-group 4 (07:00–09:59); another (n = 1); a "boarder" from sub-group 5 (10:00–12:59) with the remaining (n = 1) a "non-boarder" from sub-group 6 (13:00–15:59).

## Discussion

This study aimed to explore the clinical outcome of medical patients moved in and out of hours using specific indicators; some of which are accounted for in the Institute for Healthcare Improvement Global Trigger Tool.[14] However, due to limitation of project time, did not allow for its application. It also aimed to investigate any discernable differences in outcomes between non-boarded and boarded patients who were moved "within hours" and "out of hours." We also identified a gap in the existing literature; similar studies relating to cardiac and intensive care settings.[15] However, Ranasinghe et al.[16] reported frequency of movement and adverse outcomes in the elderly.

The results suggest the median LoS, for the "out of hours" patient group, was significantly less than that of the "within" hours group. This may be attributed to the higher number of "boarders" in the "out of hours" group (36/57 patients = 63.2%) when compared to the "within hours" group (32/162 patients = 19.8%), and this may be attributed to boarders being selected on medical assessment and prediction of shorter stay. This differs from the findings of Singer et al.,[17] however they did not adjust for time of patient movement. Our results also suggested patient selection was consistent with local policy, in that "boarders" were found to have a significantly shorter median LoS than the "non-boarders" in both groups. However, what was unexpected, was that the "boarders" and "non-boarders" from the "within" hours had a significantly higher median LoS than the corresponding patient category of the "out of hours" group. Thus, it is possible, that this is a chance finding due to the relatively small dataset, but there may also be some other explanation, for example, patients who are moved during the day are possibly more unstable than those moved out with daylight hours which is perceived to be safer.[18] In addition, patients moved out of hours are likely to be appropriately reviewed the next morning with those boarded in daylight hours unlikely to be assessed until the next day with the potential for test and investigation results being overlooked. Yet, O'Horo et al. found that real-time feedback via an electronic handover system can actually improve the accuracy and completeness of clinical handovers, which include access to digital test results.[19]

Unfortunately, the lack of statistical power meant that there were no significant findings for the remainder of patient indicators: readmission (seven- and 30-day); cardiac arrest (during admission) and mortality (seven- and 30-day). Following application of the exclusion criteria, the original cohort of 550 patients was reduced to 219, with subsequent analysis in respective groups. Rates of readmission and mortality were relatively low (some scoring nil) in several of the sub-group analysis, thus it was impossible to draw conclusions of statistical significance. Nevertheless, this model requires a clear structure and process evaluation, to explain discrepancies between expected (hypothesis that patients moved "out of hours" would result in longer LoS and higher readmission and mortality rates) against observed outcomes.[20,21] The Medical Research Council[22] published guidance on developing and evaluating complex interventions, and this also might serve as a useful tool in a larger scale

study to provide insights and aid implementation of improved clinical practice. In addition, we cannot be certain that the "outcomes" were as a result of the causal effect (being moved "out of hours") as there are many confounding factors when recording patient readmission/mortality (demographics; pre-existing medical condition/diagnosis/malignancy; socio-economic status etc.). Therefore, exclusion criteria at this stage might have revealed different results. In addition, individual assessment of patient records—to ascertain whether Consultant review was undertaken within 4 hrs of admission,[23] might have induced a causal effect on outcome data. The Royal College of Physicians of Edinburgh (RCPE) hosted a Consensus Conference in 2013 entitled; "Acute Medicine: improving quality of care through effective patient flow" and highlighted two key points relating to acute medical admissions: (1) patients must be treated in the right place, and in the shortest time possible which requires the right numbers of staff and mix of skills across health and social care, and (2) all systems must have good patient flow to eliminate boarding. Nevertheless, the unacceptable practice of medical boarding still exists, and not solely related to the winter months. A survey of local medical and nursing staff revealed that the majority did not consider the process of boarding patients as providing quality care in the correct environment, or standard they would expect in the treatment of their own relatives.[24]

A small survey of staff perceptions on the care received by "boarded" patients, (Hume, unpublished data, July 2013), suggested that, the majority (39/42) perceived the care of "boarded" patients to be of lesser standard. Free text boxes allowed for comments which suggested lack of specialist medical advice specific to their diagnosis: "*patients always have questions but boarding doctors are not around to ask*," and "*patients often feel ignored when the parent ward round is occurring*." Staff also perceived inconsistency in clinical assessment and management plan; "*things could be missed during handovers*," and "*many experience discontinuous care*." The sad reality of medical "boarders" was expressed by a nurse participant, in stating that; "*during their 13 years of nursing in (specialty), 4 patients died; all of whom were 'boarders' from AMAU*." Perhaps Commissioners could replicate proactivity of NHS Greater Glasgow and Clyde, who have reduced boarding by 70% since 2007 through focused discharge planning.[11]

### Limitations of Study/Future Research

The time allocated for this study, together with the small sample size, did not allow for generalizability of findings. However, application of our results (as a pilot and feasibility study) might yield more robust results in a larger scale, and/or multi-centre collaboration, using specific indicators of patient outcome as defined by the Institute for Healthcare Improvement. Furthermore, we did not adjust for baseline patient morbidity/characteristics in the subgroups, therefore final patient outcomes may have been due to differences in morbidity rather than transfer time. Whilst the purpose of this study was to ascertain whether patients who are moved "out of hours" have worse outcomes, statistics alone do not adequately reflect psychological impact or patient perception of care received (including movement within, and out with acute medicine). Therefore, a mixed methods or qualitative study might add value in this context.

### Conclusions

We conclude that the median LoS, for the "out of hours" patient group, was significantly less than that of the "within hours" group, which supported clinical expectation, as boarders are selected on medical assessment and prediction of shorter stay. The existing literature lacks discussion of the effect of in-patient transfer time on both the clinical and psychological outcome in medical patients. Whilst the Quality Indicator Tool for Acute Medicine (2011) and Healthcare Improvement Global Trigger Tool[14] have been referenced, neither were applied to the data, therefore the results have not addressed satisfaction with care received. Nevertheless, the existing literature lacks discussion of the effect of in-patient transfer time on both the clinical and psychological outcome in medical patients.

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## Conflicts of Interest Statement

This project formed part of 4th year Medical School project, therefore received no external funding. The authors declare that they have no conflict of interest.

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**Supplement 1. Clinical Quality Indicators for Acute Medical Units**

(1) All patients admitted to the Acute Medical Unit (AMU) should have an early warning score measured upon arrival on the AMU.

(2) All patients should be seen by a competent clinical decision maker within 4 hrs* of arrival on the AMU who will perform a full assessment and instigate an appropriate management plan.

(3) All patients should be reviewed by the admitting consultant physician or an appropriate speciality consultant physician within 14 hrs of arrival on the AMU**.

(4) All acute medical units should collect the following data:

A. Hospital mortality rates for all patients admitted via the AMU.

B. Proportion of admitted patients who are discharged directly from the AMU.

C. Proportion of patients discharged from the AMU who are readmitted to hospital within 7 days of discharge.

*In most cases, clinical assessment and initiation of a management plan should be undertaken in much less time, and prioritised in accordance with clinical need; data collection should enable median and maximum times to be calculated for benchmarking.

**Consultant review for patients arriving on the AMU between 08:00–18.00 should usually be undertaken within 8 hrs of the patient's arrival on the AMU with provision for earlier review according to clinical need; data collection should enable median and maximum times to be calculated for benchmarking.