Improvement in out-of-hours outcomes following the implementation of Hospital at Night

D.J. BECKETT1,* C.F. GORDON2, R. PATERSON1, S. CHALKLEY3, C. STEWART1, M.C. JONES1, M. YOUNG1 and D. BELL3

From the 1Royal Infirmary of Edinburgh, Little France, Edinburgh, EH16 4SA, 2Western General Hospital, Crewe Road South, Edinburgh, EH4 2XU and 3Imperial College Faculty of Medicine, Chelsea and Westminster Hospital, 369 Fulham Road, London, SW10 9NH, UK

Received 15 February 2009 and in revised form 16 April 2009

Summary

Background: Hospital at Night (H@N) is a Department of Health (England) driven programme being widely implemented across UK. It aims to redefine how medical cover is provided in hospitals during the out-of-hours period.

Aim: To investigate whether the implementation of H@N is associated with significant change in system or clinical outcomes.

Design: An observational study for 14 consecutive nights before, and 14 consecutive nights after the implementation of H@N. Data were collected from the Combined surgical and medical Assessment Unit (CAU), the 18 medical/surgical wards (The Ward Arc) and the four High Dependency Units (The Critical Care corridor) within the Royal Infirmary of Edinburgh.

Methods: Following an overnight episode of clinical concern, data were gathered on response time, seniority of reviewing staff, patient outcome and the use of Standardized Early Warning Score (SEWS).

Results: Two hundred and nine episodes of clinical concern were recorded before the implementation of H@N and 216 episodes afterwards. There was no significant change in response time in the CAU, Ward Arc or Critical Care corridor. However, significant inter-speciality differences in response time were eradicated, particularly in the Critical Care corridor. Following the implementation of H@N, patients were reviewed more frequently by senior medical staff in CAU (28% vs. 4%, \( P < 0.05 \)) and the Critical Care corridor (50% vs. 22%, \( P < 0.001 \)). Finally there was a reduction in adverse outcome (defined as unplanned transfer to critical care/cardiac arrest) in the Ward Arc and CAU from 17% to 6% of patients reviewed overnight (\( P < 0.01 \)). SEWS was more frequently and accurately recorded in CAU.

Conclusion: This is the first study that we are aware of directly comparing out-of-hours performance before and after the implementation of H@N. Significant improvements in both patient and system outcomes were observed, with no adverse effects noted.

Address correspondence to Dr D.J. Beckett, 8B West Mill Road, Edinburgh, EH13 0NX, UK.
email: dbeckett@doctors.org.uk

*Dr Daniel Beckett is the guarantor for this article.

© The Author 2009. Published by Oxford University Press on behalf of the Association of Physicians. All rights reserved. For Permissions, please email: journals.permissions@oxfordjournals.org
Introduction

The Hospital at Night (H@N) programme is a Department of Health (England) led project that was successfully piloted by the NHS Modernisation Agency in 2004. It is a competency driven, patient focused, change programme that utilizes a multidisciplinary approach to delivering healthcare overnight, whilst retaining the ability to access specialist input as necessary. It employs a whole systems approach emphasizing patient safety whilst protecting doctor training in the face of the reduction of junior doctor hours, brought about by the European Working Time Directive (EWTD).

The ethos of H@N is the provision of out-of-hours medical cover by a centralized multidisciplinary team, who have the full range of skills and competencies to meet the immediate needs of patients. The central tenets include multispeciality handovers, extended nursing roles (including prescribing), bleep filtering through central co-ordination and ensuring routine work is not carried over into the out-of-hours period.

It was successfully piloted in four sites across England in 2004 and the results made available to the wider NHS since 2005. This Department of Health report described that the implementation of H@N had improved staff perceptions of patient care overnight with no adverse clinical outcomes noted. Anecdotal positive outcomes were noted including:

(i) Patients being seen sooner
(ii) Patients not being ‘missed’
(iii) Patients being seen by the appropriate person.

By January 2006 a survey of Royal College of Physicians (RCP) tutors in 140 hospitals across England (representing 69% of those taking acute admissions) revealed that H@N had been adopted partially or fully by 50% of them. More recently the H@N 2008 UK implementation survey report found that H@N had been implemented by 90 out of 117 (77%) of acute trusts surveyed (compared with 48% in 2006). Although these surveys represent only a proportion of total UK NHS trusts (231), it is likely that the uptake of H@N is increasing. The majority (84%) of hospitals implementing H@N use a formalized handover system and most (63%) utilize a track-and-trigger tool linked to an Early Warning Score.

There is little evidence, however, regarding impact on H@N on patient outcome. The recently published NHS-IC document ‘The Case for Hospital at Night – The Search for Evidence’ looked at 22 NHS trusts in England who had self-reported successful implementation of H@N against a set of 15 identified validated national datasets. This study demonstrated that H@N, where implemented, was associated with

(i) A reduction in HSMR (Hospital Standardized Mortality Ratio) in 9/14 sites studied
(ii) A greater reduction in death within 48 h of admission compared with the all England position
(iii) A reduction in cardiac arrests in 10/11 sites.

The document concludes that ‘there is a trend towards improvement in patient outcomes when measured over 15 indicators in the NHS trusts studied’ and ‘when Hospital at Night is implemented there appears to be no detrimental effect to patient outcomes or efficiency’. There are significant flaws with this study, however. Foremost the data studied is not limited to the out-of-hours period and thus improvements cannot be attributed entirely to the implementation of H@N. Furthermore, the small number of hospitals studied (the majority of which were staffed above the national average) may not be representative of the total population.

The Royal Infirmary of Edinburgh is an 870-bedded tertiary referral teaching hospital. The Ward Arc consists of 18 level 0–1 medical and surgical wards plus the Combined Assessment Unit (CAU) (31% monitored beds). There are four level 2 High Dependency Units (the critical care corridor) plus the Intensive Care Unit (ICU). Until the implementation of H@N in 2006 it operated a mixture of on-site shift-based cover and traditional on-call cover (Table 1). Clinical audit prior to the implementation of H@N showed that overnight use of the local track-and-trigger tool Standardized Early Warning Score (SEWS) was variable, ranging from 50% in the Ward Arc to 92% in the CAU. Furthermore ‘time to doctor’ demonstrated large inter-specialty variation, particularly within critical care, where a patient would often not be seen for over an hour following an episode of clinical concern. Number of overnight cardiac arrests, transfers to critical care and patient outcome were also noted.

Following the implementation of H@N, we carried out a further overnight audit assessing hospital activity. The aim was also to objectively assess the assertions in the H@N pilot document that it had led to patients being ‘seen sooner’, ‘not being missed’ and ‘being seen by the most appropriate person’. The audit was carried out exclusively out-of-hours and the data were compared with that previously obtained out-of-hours, thus allowing a direct comparison of the effect of the implementation of H@N.
In September 2006, prior to the establishment of H@N, data were collected over 14 consecutive nights (2100-0900) for the Ward Arc, CAU and the four High Dependency Units. Audit forms were left in each ward of the hospital, on which nursing staff was asked to record details of any unscheduled overnight clinical episodes requiring medical review. This included patents triggering SEWS four or above, but did not include routine or expected events, such as the prescription of post-operative anti-emetics, analgesia or intravenous fluids.

Each ward was telephoned at the start of each nightshift to ensure the staffs were aware of the study, and forms were collected each morning before the nightshift ended. Data collected included:

(i) Utilization of SEWS overnight
(ii) ‘Time to doctor’ overnight following an episode of clinical concern
(iii) Seniority of staff attending an episode of clinical concern
(iv) Overnight transfers to critical care
(v) Overnight cardiac arrests.

In October 2007, following the implementation of H@N, the same data were collected for a further 14 consecutive nights. A similar system was used, but a clinical audit nurse was employed each night to facilitate data collection. Furthermore cross-reference was made with the centralized database kept by the H@N co-ordinator.

If, following a clinical episode, a patient had not been reviewed by medical staff by 0900 the following morning then they were recorded as ‘not reviewed’. These events were excluded from ‘time to review’ and ‘seniority of review’ analyses, but were included in analysis of patient outcome.

### Methods

In September 2006, prior to the establishment of H@N, data were collected over 14 consecutive nights (2100-0900) for the Ward Arc, CAU and the four High Dependency Units. Audit forms were left in each ward of the hospital, on which nursing staff was asked to record details of any unscheduled overnight clinical episodes requiring medical review. This included patents triggering SEWS four or above, but did not include routine or expected events, such as the prescription of post-operative anti-emetics, analgesia or intravenous fluids.

Each ward was telephoned at the start of each nightshift to ensure the staffs were aware of the study, and forms were collected each morning before the nightshift ended. Data collected included:

(i) Utilization of SEWS overnight
(ii) ‘Time to doctor’ overnight following an episode of clinical concern
(iii) Seniority of staff attending an episode of clinical concern
(iv) Overnight transfers to critical care
(v) Overnight cardiac arrests.

In October 2007, following the implementation of H@N, the same data were collected for a further 14 consecutive nights. A similar system was used, but a clinical audit nurse was employed each night to facilitate data collection. Furthermore cross-reference was made with the centralized database kept by the H@N co-ordinator.

If, following a clinical episode, a patient had not been reviewed by medical staff by 0900 the following morning then they were recorded as ‘not reviewed’. These events were excluded from ‘time to review’ and ‘seniority of review’ analyses, but were included in analysis of patient outcome.

### Results

Four hundred and twenty-five clinical episodes were recorded in four hundred and seven patients. Each night was considered a separate entity so one patient could appear several times. The numbers
of incidents per clinical area before and after the implementation of H@N is demonstrated in Table 2.

**Time to review**

Median, quartile and outlying values of time to review in the CAU, Ward Arc and Critical Care corridor are displayed in box and whisker plot format (mean values also depicted) in Figure 1a and b. Figure 1b is provided for clarity purposes.

**Pre-H@N**

Patients in the CAU were reviewed significantly quicker than patients in critical care \( (P < 0.05, \text{ Mann–Whitney U-test, MWUT}) \) but not the Ward Arc. Patients on the Ward Arc with SEWS >4 were seen quicker than those with SEWS <4 \( (P < 0.05, \text{ MWUT}) \). There was no significant difference in time to review patients in the Ward Arc combined with Critical Care.

**Post-H@N**

Patients in the CAU were seen significantly quicker than patients in both Critical Care \( (P < 0.01) \) and the Ward Arc \( (P < 0.01) \), though the latter was not true if limited to patients with SEWS >4. There remained no difference between time to review patients on the Ward Arc and those in Critical Care.

**Pre-H@N vs. Post-H@N**

Following the implementation of H@N, there was no significant change in overall time to review patients in CAU, the Ward Arc or the Critical Care corridor.

**Inter-speciality time to review**

Prior to the implementation of H@N, there were significant differences in time to review between wards on the Ward Arc \( (P < 0.05, \text{ Kruskal–Wallis Test, KWT}) \). This was no longer true once H@N had been implemented \( (P > 0.05, \text{ KWT}) \). Note wards are grouped in accordance with provision of medical cover before the implementation of H@N (e.g. one Foundation Year 1 Doctor covered both cardiology and respiratory). The same groupings are kept for the post-H@N analysis to ensure valid comparison (Figure 2).

Significant differences were also seen in response times across the critical care corridor before the implementation of H@N \( (P < 0.001, \text{ Kruskal–Wallis Test}) \). Once more this was no longer seen when the audit was repeated \( (P > 0.05) \). Time to review in the Critical Care corridor is depicted in box and whisker format in Figure 3.

Patients triggering SEWS ≥4 require review within 20 min. Performance against this target is shown in Table 3.

There was no significant change in performance against the 20-min target following the implementation of H@N.

---

**Figure 1.** Response times pre- and post-H@N and (b) Response times pre- and post-H@N.

**Figure 2.** Inter-speciality response times (Ward Arc).
Seniority of staff

Following the implementation of H@N, patients were more likely to be reviewed by senior medical staff (registrar or equivalent) in the CAU (4% vs. 28%, \( P < 0.05 \), Fishers Exact Test, FET) and the Critical Care corridor (22% vs. 50%, \( P = 0.001 \), \( \chi^2 \) test). There was no significant change in seniority of staff reviewing patients on the Ward Arc. On 10 (7%) occasions following the introduction of H@N, patients were reviewed by Senior Nurse Practitioners only (Figure 4).

In the pre-H@N study, 5/198 (2.5%) of incidents were not reviewed before the end of the night shift. This fell to 3/216 (1.4%) following the implementation of H@N (NS).

Clinical outcome

Patient outcome, defined as stabilization on the ward, transfer to critical care, expected death or cardiac arrest, was recorded at the end of each night period for every patient that had been reviewed overnight (Table 4).

In CAU and the Ward Arc, the incidence of adverse outcome (defined as cardiac arrest or unplanned transfer to critical care) overnight significantly reduced from 17% to 6% of patients reviewed (\( P < 0.01 \), FET). The incidence of cardiac arrest also reduced significantly from 4% to 0% (\( P < 0.05 \), FET).

In the Critical Care corridor, patient outcome was recorded as stabilized on the High Dependency Unit, transfer to the Intensive Care Unit, expected death or cardiac arrest (Table 5).

There were no significant differences in adverse outcomes in the Critical Care corridor following the implementation of H@N.

Discussion

There is evidence that acute care in the out-of-hours hospital can be sub-optimal. Seward et al.\(^7\) analysed 200 consecutive deaths after emergency medical

Table 3  Performance against the 20-min target

<table>
<thead>
<tr>
<th></th>
<th>Pre-H@N</th>
<th>Post-H@N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time (median/quartiles)</td>
<td>Seen within 20 min (%)</td>
</tr>
<tr>
<td>CAU</td>
<td>5 min (0–50)</td>
<td>11/15 (73)</td>
</tr>
<tr>
<td>Ward Arc</td>
<td>5 min (2–10)</td>
<td>28/33 (85)</td>
</tr>
</tbody>
</table>

CCU = Coronary Care Unit, RHDU = Renal High Dependency Unit, GHDU = General High Dependency Unit, THDU = Transplant High Dependency Unit.

Figure 3. Inter-speciality response times (Critical Care).

Figure 4. Level of training of most senior staff member attending a clinical episode.
admission. In 12.5% of these, shortfalls of care were identified that may have contributed to patient mortality. Major problems included delays in seeing doctors, arranging investigations and commencing treatment. The majority of these happened at night. Prior to the enactment of H@N, The Royal College of Physicians of London Night Time Acute Cover Working Group report in 2003 highlighted doctors overnight would be expected to cover, on average, 67 patients each (with some covering up to 200).8 Other work has demonstrated an increase in mortality within 48 h of admission for those patients admitted at night.9

H@N was introduced to the Royal Infirmary of Edinburgh in 2006. Our initial study was designed to feedback to the H@N working group to enable accurate matching of capacity and demand. The follow-up study assessed whether H@N was delivering the same level of care despite the change in staff base and location.

Overall time to review patients in the CAU, the Ward Arc or the Critical Care corridor did not change following the implementation of H@N. Notwithstanding this, significant changes were noted when considering individual specialities. Prior to the implementation of H@N, significant inter-speciality variation in time to review was noted both on the Ward Arc and within the Critical Care corridor. These had been eradicated in the follow-up study. This resulted largely from an improvement in time to review in areas that were formerly covered from a different ward within the hospital (for example the median time to review in Transplant HDU, originally covered by middle grade staff on another floor, fell from 40 to 12 min). Thus a single, centrally co-ordinated team homogenized review times across the Ward Arc and Critical Care corridor, perhaps as to be expected.

Unlike models of H@N employed in other hospitals, the CAU was not covered by the H@N team but maintained its own clinical team in situ. This may explain why, following the implementation of H@N, response times in CAU were quicker than both the Ward Arc and the Critical Care corridor. Additionally, medical staff in CAU were no longer required to cover patients in the geographically distinct Critical Care corridor, which was now covered by the H@N team.

The Standardized Early Warning Score (SEWS) on admission has been shown to correlate with mortality and length of stay.10 Work carried out simultaneously with the current study demonstrated that SEWS is recorded and calculated correctly more often in the Combined Assessment Area (68%) compared with the Ward Arc (21%).11 A patient triggering a SEWS of 4 or above necessitates medical review within 20 min. Following the introduction of H@N a similar proportion of patients triggering SEWS 4 on the Ward Arc were seen within 20 min. Prior to the implantation of H@N, patients on the ward triggering SEWS >4 were reviewed significantly quicker than those with SEWS <4. Unfortunately this was no longer the case after H@N was implemented, almost certainly due to the fact that SEWS was only communicated in 36% of cases to the H@N co-ordinator, preventing appropriate triaging.

Along with the implementation of H@N came resident overnight medical registrar cover. This resulted in a significant improvement in numbers of patients being reviewed by a registrar in the CAU and the Critical Care corridor as junior staff felt able to ask for registrar assistance with sick patients, as they were more accessible. This improvement was largely limited to medical patients, as there was previously already a surgical registrar on site, and thus the number of surgical patients reviewed at

### Table 4: Patient outcome in the CAU and the Ward Arc

<table>
<thead>
<tr>
<th></th>
<th>Pre-H@N (%)</th>
<th>Post-H@N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAU (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stabilized</td>
<td>19 (83)</td>
<td>18 (78)</td>
</tr>
<tr>
<td>Transfer to Critical Care</td>
<td>2 (9)</td>
<td>4 (17)</td>
</tr>
<tr>
<td>Expected death</td>
<td>0</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>2 (9)</td>
<td>0</td>
</tr>
</tbody>
</table>

|                      |             |              |
| CAU (%)              | 79 (81)     | 132 (94)     |
| Ward Arc (%)         | 13 (13)     | 6 (4)        |
|                      | 2 (2)       | 2 (1)        |
|                      | 3 (3)       | 0            |

### Table 5: Patient outcome in the Critical Care corridor

<table>
<thead>
<tr>
<th></th>
<th>Pre-H@N (%)</th>
<th>Post-H@N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilized</td>
<td>74 (95)</td>
<td>39 (89)</td>
</tr>
<tr>
<td>Transfer to ICU</td>
<td>1 (1)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Expected death</td>
<td>3 (4)</td>
<td>4 (9)</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

|                      |             |              |
|                      | 95 (1)      | 9 (2)        |
|                      | 4 (4)       | 9 (9)        |
|                      | 0           | 0            |
registrar level remained unchanged. Both before and after the implementation of H@N, patients with SEWS >4 were more likely to be seen by a registrar or above.

In addition to bringing overnight medical registrar cover, the implementation of H@N also saw the introduction of independent Senior Nurse Practitioners. Integral to the H@N team, with extended capabilities including drug administration under a Patient Group Directive (PGD), they dealt with 7% of the clinical incidents on the Ward Arc without recourse to doctor involvement.

The advent of H@N saw a reduction in adverse outcome on the Ward Arc, as numbers of overnight transfers to critical care and cardiac arrests fell. This is important, as outcome following overnight cardiac arrest is known to be worse compared with during normal working hours.12 We believe that this improvement is due largely to the presence of an on site medical registrar overnight, acting as a senior clinical decision maker in patient management and also in decision making on appropriateness for escalation of care or cardiopulmonary resuscitation. The majority of cardiac arrests in our pre-H@N study had only been reviewed by junior medical staff who felt it inappropriate to document a ‘not for resuscitation’ status without senior review the following morning.

Potential sources of bias within this study were identified and attempts made to minimize them wherever possible. It is possible that a small number of clinical episodes prior to the implementation of H@N were not captured by the audit tool. Nevertheless close liaison with nursing staff and medical staff plus collection of data forms every night by designated staff allowed for a complete a collection of data as possible. Following the implementation of H@N, audit nurses were used to collect data and cross-reference with the H@N database ensured patients were not missed. Finally, medical and nursing staffs were fully aware of the audit being carried out both before and after the establishment of H@N. This introduces a potential Hawthorne effect, although any influence should have been equal for both halves of the study, as staff knew they were being audited on both occasions.

In conclusion this is the first study that we are aware of, to directly compare hospital performance, out-of-hours, before and after the implementation of H@N. The findings largely confirm those suggested by the initial Department of Health pilot. Although the overall time to review was no quicker, inequality in review times between different specialities was removed, and improvement in time to review was seen in areas previously covered by staff based in other areas of the hospital. Patients are being seen by the most appropriate person, with a greater number of sick patients (patients in CAU, Critical Care or SEWS >4) being reviewed at registrar level, as the reluctance to call seniors had been removed. Finally there was a reduction in adverse patient outcomes, defined as cardiac arrest or unplanned transfer to Critical Care. One area that has been highlighted as poorly performing is the inconsistent use of SEWS as a triage tool on the Ward Arc. This is now the subject of ongoing work, paralleled utilizing the SBAR12 (Situation-Background-Assessment-Recommendation) tool in order to further improve safety and quality of healthcare in the acute hospital overnight.

Acknowledgement
We are grateful to Alison Bonney and Joanne Odgers from the Department of Nursing at the Royal Infirmary of Edinburgh who provided £3000 to fund two research nurses.

Conflict of interest: None declared.

References
4. Hospital at Night Baseline report. 2006. [www.healthcareworkforce.nhs.uk/option,com_docman/task.doc_download/gid.890/Itemid.82.html]


