Cohort study to estimate the effect of the introduction of the NHS Institute for innovation and improvement paediatric early warning system on the workload of nursing, junior and senior medical staff

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INTRODUCTION

National recommendations have brought about an increase in the number of hospitals using some form of Paediatric Early Warning System (PEWS). Since 2005, the numbers of hospitals in Great Britain using PEWS has increased from 22% to 85% (1). Concerns have been raised about the scoring tools used in these systems as in order to achieve high sensitivity they have low specificity (2,3). The consequence is a low positive predictive value which could lead to over triggering of a rapid response team (RRT) or other escalation to abnormal scores. This will have implications on the workload for nurses, junior and senior doctors if the PEWS tool is used correctly.

The NHS Institute for Innovation and Improvement (NHSIII) has a series of four charts based on the work of the brighton system, freely available to download and use (4). These charts are classed according to age range and observations outside the normal range are calculated to give a score. The overall score is colour coded and this triggers a response depending on the severity of the score. A higher score triggers a higher level of staff seniority to respond and assess the child.

An NHSII PEWS score of 2 or more, which triggers review, has a sensitivity of 91.5% (95% CI 85.4 to 97.5), specificity of 39.8% (95% CI 38.8 to 40.8), positive predictive value of 1.4% (95% CI 1.1 to 1.7) and negative predictive value of 99.8% (95% CI 99.7 to 99.9) for predicting PHDU admission, PICU admission or death. The area under the receiver operating characteristic (ROC) curve for the NHSIII PEWS score was 0.83 (95% CI 0.77 to 0.88) (5).

The NHSIII PEWS was the second most frequently used PEWS in Great Britain (1). The purpose of this analysis was to determine the workload implications for staff to assess a child following a trigger of the PEWS tool if it was fully implemented as designed.

METHOD

Data collection

Data were collected prospectively on observations and outcomes to validate another PEWS score. The method of data collection is described elsewhere (6). In summary paediatric (age 0–16 years) admissions to any of the paediatric wards at the University Hospital of Wales over a 12 month period, 1 December 2005 and 30 November 2006, were eligible for inclusion into the study. Patients admitted directly to the paediatric intensive care unit (PICU) and the paediatric high dependency units (PHDU) were excluded. Observations were recorded directly onto a new paediatric observation chart on which staffs were trained prior to its introduction.

Data analysis

The number of person days of observation was calculated from the first and last date/time of observation during an admission. If the time of the first or last observation was not recorded then the time of the next or previous observation was used. The period of observation for children who had only a single observation during an admission was assumed to 12 hours. The frequency of response triggered by the NHSIII PEWS score were calculated per 100 person days of observation, which is the equivalent of observing one child for a 100 days or 100 children for one day. The relative risk of different NHSIII PEWS scores that would have triggered a response were compared “in hours” (9am to 5pm) and out of hours.

Data were analysed using Stata 11.2 (7). All patient identifiers were removed from the data set prior to analysis. The original study [6] was approved by the Trust Research and Development Committee and ethical approval was granted by the South East Wales Local Research Ethics Committee.

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The total period of observation was 1188 person days. A review by the nurse in charge, NHSIII PEWS score of 2 or more, was triggered on 2290 occasions (193 times per 100 person days of observation). A review by a junior doctor, NHSIII PEWS score of 3 or more, was triggered on 296 occasions (25 times per 100 person days). A discussion with or review by the Consultant, NHSIII PEWS score of greater than or equal to 4 or 5, was triggered on 66 and 29 occasions respectively (5.6 or 2.4 per 100 person days of observation). The workload for nurses and junior doctors responding to a NHSIII PEWS trigger were both relatively constant between 9am to 5pm compared to 5pm to 9am (TABLE 1).

### TABLE 1

<table>
<thead>
<tr>
<th>Observation time</th>
<th>NHSIII PEWS score</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>09.00 Hours-17.00</td>
<td>0 or 1</td>
<td>2258</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>711</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>6</td>
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<td></td>
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<td>4</td>
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<tr>
<td></td>
<td>Total</td>
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<tr>
<td>17.01 Hours-08.59</td>
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</tr>
<tr>
<td></td>
<td>2</td>
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<td>5 or 6</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>5954</td>
</tr>
</tbody>
</table>

Relative risk (95% CI) response triggered

Reference: Relative risk (0.85-1.00) 0.97 (0.73-2.7) 2.59 (1.04-6.91) 3.14 (1.04-10.62)

*The time of 63 observations were not recorded

Scores that would have triggered a response from a consultant were more likely to occur outside of normal working hours, with calls for advice (p=0.04) and the requirement for a consultant to attend (p=0.04) being significantly more likely to happen out of hours. Consultants were most likely to see the child at response to a trigger by a NHSIII score in the early hours of the morning (Figure 1).