ORIGINAL ARTICLE

The ''OBS'' chart: an evidence based approach to re-design of the patient observation chart in a district general hospital setting

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Objective: The primary role of the patient bedside observation chart is to make clinicians aware of the deteriorating patient. Despite this, its performance has not been scrutinised. Many versions exist with different styles of data entry but the optimal format remains elusive. This paper hypothesised that chart design measurably influences function and that redesign and standardisation would improve the detection of physiological decline by clinical staff.
Design: Objective evaluation of existing charts (n = 5), evidence based redesign, and re-evaluation of new chart.
Setting: 250 bed district general hospital.
Results: Design of existing observation charts had a significant effect on the ability of clinical staff to detect patient deterioration, with detection rates of parameters indicating physiological decline ranging from 0% to 100%. Graphical plots portrayed information better than written values for all parameters being measured except tachypnoea. No single existing chart was best for all variables. A new chart was designed, implemented with training in its use, and re-evaluated. The new chart also incorporated an early warning scoring system. There were significant improvements in the average detection rates of parameters poorly identified on existing charts: detection rates of tachypnoea and hypoxia increased by 41% (p<0.05) and 45% (p<0.05) respectively. There were also significant improvements in detection rates of tachycardia and fever by 29% (p<0.05) and 16% (p<0.05) respectively.
Conclusion: Evidence based redesign of the patient bedside observation chart coupled with specific training in its use significantly improves the detection of patient physiological deterioration.

T he identification of the deteriorating patient is the key to preventing admission to high dependency facilities. This is of particular importance on outlying medical and surgical wards where physiological decline may be high-lighted late in the development of critical illness: 30% of intensive care unit admissions receive cardiopulmonary resuscitation before intensive care admission despite being on a hospital ward,[1] and up to 41% of admissions to intensive care units from wards can be avoided if earlier treatment occurs.[2] Of more concern is that abnormal physiological values are often charted without action in the hours preceding an in-hospital cardiopulmonary arrest[3–6] and up to 24 hours before ward patients are admitted to intensive care.[7]

One way of increasing the recognition of the high risk patient is to implement an early warning scoring system (EWS) or modified early warning scoring system (MEWS).[8–13] These are algorithms that collate charted physiological data into a single risk score and are designed to alert healthcare professionals to the deteriorating patient. Mortality increases as the number of physiological abnormalities increase being as high as 21.3% with three or more abnormalities and as low as 0.7% with no abnormalities (p<0.01).[13]

Respiratory rate, heart rate, and adequacy of oxygenation have been implicated as indicators of critically ill patients on the general ward.[7] Systolic blood pressure, temperature, and level of consciousness graded by AVPU (alert, responding to voice, responding to pain, unresponsive) are additionally predictive of adverse outcome in acute medical admissions.[14]

Bedside observation charts are the mainstay of detecting patient deterioration but the monitoring and charting of physiological variables is often poor. This is especially true of respiratory rate.[1] Observation charts vary between and within hospitals, yet to our knowledge the effectiveness of different types of observation charts in clinical practice has not been studied. The optimal chart format thus remains elusive. Moreover, there have been no defined standards against which observations are charted.

At our institution, a 250 bed district general hospital, five charts were in use and here we test the effectiveness of different types of observation charts in highlighting physio-logical decline.

We hypothesise that an evidence based approach to observation chart redesign improves the detection of physio-logical decline by end users.

METHODS

Examples of stable and unstable physiological data were selected from ward patients and accurately plotted by a single operator across the existing five charts. These were presented in a stereotyped fashion to 63 end users in two groups: group 1, n = 32 (pre-registration house officers, senior house officers, and specialist registrars); group 2, n = 31 (healthcare assistants and student nurses: this cohort generally chart observations at our institution and clarify physiological values that concern them with a registered nurse). The ability of the various charts to allow clinical staff with different levels of training to detect unstable physiology was measured.

End users were asked to identify physiological parameters they perceived as being abnormal on the charts based on physiological parameters considered to lie within the normal range as follows: heart rate 50–100 beats per minute; systolic blood pressure 100–160 mm Hg; respiratory rate 10–20 per minute; oxygen saturations >95% on air; temperature >37°C.

Table 1 Detection rates (%) of abnormal physiological parameters by doctors (normal type) and healthcare assistants and student nurses (bold) from existing charts

Parameters measured	Chart 1		Chart 2		Chart 3		Chart 4		Chart 5	
Fever	100 plotted	**100**	100 written	**29**	100 plotted	**65**	100 plotted	**65**	100 plotted	**84**
Hypotension	84 plotted	**87**	100 plotted	**71**	72 plotted	**84**	84 plotted	**84**	84 plotted	**84**
Tachycardia	100 plotted with BP	**71**	100 written	**13**	100 written	**50**	100 written	**50**	84 plotted with BP	**32**
Tachypnoea	72 plotted	**29**	100 written	**58**	84 written	**50**	66 written	**32**	84 plotted	**16**
Hypoxia	100 plotted	**100**	84 written	**13**	59 written	**16**	84 written	**32**	50 written	**0**

Results were recorded by the interviewer. Subjective chart preferences were also recorded. These data were used to design a new observation chart that also incorporated an early warning scoring system. This was standardised throughout all medical wards with clinical staff trained in its use. The new chart was re-evaluated three weeks after introduction to wards.

Statistical analysis for binomial distributions was used to assess if relative frequencies of detection of abnormal physiology were significantly different before and after chart re-design.

RESULTS

Table 1 shows the objective chart performance. Not all physiological decline was equally well detected across the five charts and there were broad ranges.

On average, tachypnoea was missed by 19% (range 0%–34%) of junior doctors (PRHO, SHO, SpR—cohort 1) and 63% (range 42%–84%) of healthcare assistants and student nurses (cohort 2); hypoxia by 25% (range 0%–50%) of cohort 1 and 68% (range 0%–100%) of cohort 2; tachycardia by 3% (range 0%–16%) of cohort 1 and 57% (range 29%–87%) of cohort 2; hypotension by 15% (range 0%–28%) of cohort 1 and 18% (range 13%–29%) of cohort 2; fever was missed by 0% of cohort 1 and 31% (range 0%–71%) of cohort 2.

Combining all parameters in all charts, overall detection rates of physiological decline for cohorts 1 and 2 were 88% (range 50% to 100%) and 53% (range 0% to 100%) respectively.

Analysis of combined parameters showed that one chart (chart 1) at 84% had the highest average detection
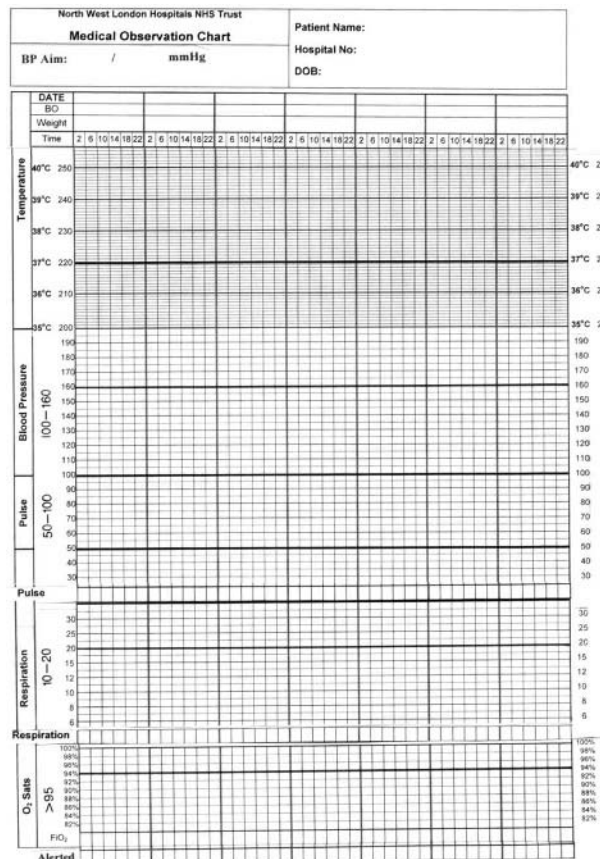
Figure 1 Key features of new chart. Temperature—plotted on a large scale; blood pressure and heart rate plots overlain on the same axis with a separate box underneath for pulse rate to be recorded as a number—to allow for the fact that inaccurate joining of points may obscure the reading within the blood pressure plot; respiratory rate was better detected as a written parameter but duplicated on the new chart as a written number and plotted value to account for subjective preferences of clinical staff and to highlight changes in this parameter as being the most important early manifestation of critical illness; oxygen saturation plotted. Parameter values were written on both sides of the chart. A standard for detecting physiological decline—early warning score (EWS)—was incorporated on the back of the chart. Warning lines corresponding to a EWS score of 1 or 2 (first alert score for parameter) were incorporated within the chart.
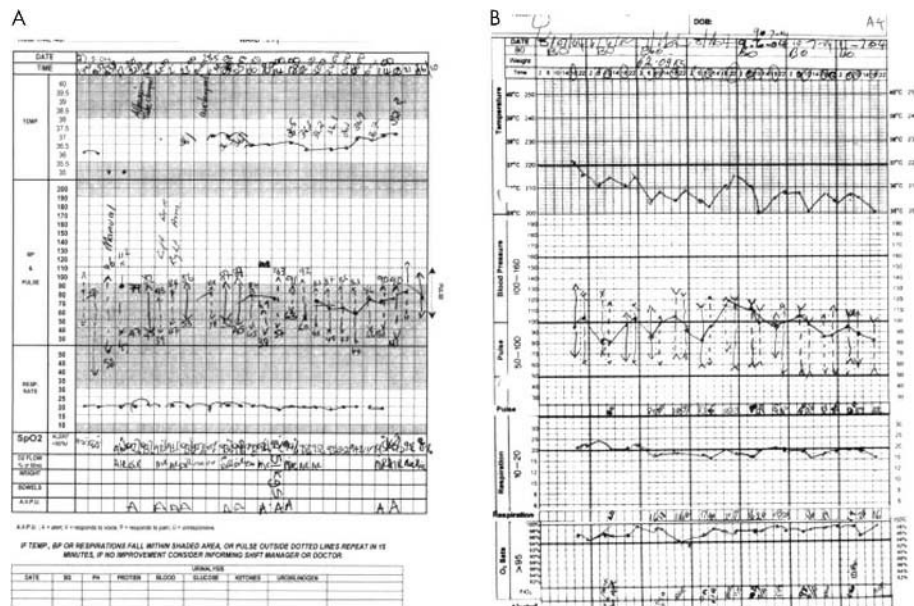
Figure 2 Examples of charts taken from the same medical ward before (A) and after (B) intervention.

rates. This was 15% higher than chart 4, 16% higher than chart 3, 18% higher than chart 2, and 23% higher than chart 5.

As well as having the highest average detection rates of physiological decline, chart 1 was also preferred by most clinical staff: (70% of cohort 1 and 47% of cohort 2). Of the individual chart parameters, all categories were preferred on chart 1 except respiratory rate, which was preferred duplicated as a written value and charted plot.

Overall, plotted parameters were better detected than written values (80% compared with 58%). Of the individual parameters, this held for fever (89% compared with 65%); tachycardia (72% compared with 69%) and hypoxia (100% compared with 42%). Tachypnoea was better detected when written (65% compared with 50%). Blood pressure readings were plotted on all charts.

A new chart was designed based on objective and subjective assessment (fig 1).

This was introduced to all wards with training in its use performed over a three week period. Reassessment showed that accuracy of plotting was considerably improved compared with existing charts (fig 2). Table 2 shows the objective performance of the new chart. There were improvements in detection rates of all parameters of physiological decline. This was significant in four of five parameters being measured: percentage improvements after chart redesign were, fever 16% (p<0.05); hypotension 8% (p>0.05); tachycardia 29% (p<0.05); tachypnoea 41% (p<0.05); hypoxia 45% (p<0.05).

DISCUSSION

Modern medicine and the introduction of shorter working hours set by the New Deal and European Working Directive enforce time restraints on hospital practice. This means that clinicians may lose continuity of patient care. Nevertheless, clinicians need to be aware of patient deterioration. The bedside observation chart plays a critical part in identifying physiological decline of the ward patient.

Here we identify problems associated with poor chart design—a problem that is further compounded by non-standardised recording practices.

Problems identified with existing charts were (fig 2A): temperature points are not always joined together as a graphical plot and writing in over the point obscures the value; charting of blood pressure and pulse together on the same overlain axes is easily correlated but difficult to read unless all the pulse values are joined together accurately—writing in over the point also obscures the reading; individual points are often joined together as a curved rather than straight line; the percentage oxygen is not always recorded when measuring oxygen saturations; respiratory rate, the only parameter typically measured without an electronic machine is too frequently recorded as "20" suggesting approximation.

Change in respiratory rate and adequacy of oxygenation are early and important indicators of the deteriorating ward patient[1 7 8 15] but these parameters were among the worst detected by clinical staff: on average tachypnoea was missed by 19% of doctors and 63% of nurses; hypoxia was missed by 25% of doctors and 68% of nurses.

Table 2 Performance of new chart

	Parameters of chart									
	Fever		Hypotension		Tachycardia		Tachypnoea		Hypoxia	
	A	B plotted	A	B plotted	A	B plotted with BP and written	A	B plotted and written	A	B plotted
Average detection rate (%)—cohorts 1+2	84.0	100	82.5	90.5	69.5	98.5	58.0	98.5	53.5	98.5

A, five existing charts; B, new chart.

Strengths and limitations of study

- This study has scrutinised chart performance. The strength of the study lies with using an evidence based and multidisciplinary approach to observation chart re-design. To our knowledge this is the first such study in the United Kingdom. The methodology is therefore new and untested.
- The advantages of the new chart and implementation included increased detection of patient physiological decline, incorporated criteria for alerting clinical staff to decline, and standardisation across wards and potentially hospital trusts.
- We tried to avoid selection bias by testing all junior doctors and student nurses and healthcare assistants within our institution. The same participants within each cohort were tested before and after chart redesign.
- The sample size was small nevertheless statistical significance was shown.
- Although this is a single centre study it defines a significant problem with observation chart design that is unlikely to be unique to this centre alone.

On average the percentage detection rate of abnormalities was 35% higher for doctors compared with nurses. The reason for this is unknown and may represent local practices but raises the issue of the need for consolidation of skills and re-training in plotting observations and identifying abnormalities.

Overall, plotted parameters were better detected than written values (80% compared with 58%) but in the case of respiratory rate, written values had higher rates of detection compared with graphical plots (65% compared with 50%).

Poor chart design can therefore seriously undermine the detection of patient deterioration and in this study we show the benefits that accrue from objectively quantifying chart performance.

Best features for making clinical staff aware of physiological decline based on objective and subjective testing were used to re-design a new observation chart that was standardised on all medical wards. Accurate detection of physiological deterioration is reliant on a chart that is well plotted and indeed in this study training of clinical staff in plotting observations based on defined standards resulted in significant improvements in the quality of the observation chart plot (compare fig 2A and 2B) and in detection rates of most parameters. Parameters poorly identified on existing charts namely tachypnoea and hypoxia were significantly better detected on the new chart: there was a 41% and 45% increase in the detection rate of tachypnoea and hypoxia respectively by clinical staff. There were also significant percentage improvements in the detection rates of fever and tachycardia after intervention by 16% and 29% respectively.

Here for the first time we show that design of the bedside observation chart affects transfer of clinical data to staff. As a study confined to one hospital the problems identified with chart design were significant but unlikely to be unique to this centre.

With new working practices and the requirement of increased staff rotation, there may be a role for standardisation of observation charts nationally to increase ease of use and decrease the chance of clinical error. To this end the incorporation of physiological based early warning scores designed to alert nursing and medical staff to patients requiring closer supervision further decreases the chance of clinical error.

Anecdotal evidence suggests that chart re-design is all too often arbitrarily done by an individual or group of individuals perceived as having some experience in chart design. We show that an evidence based and multidisciplinary approach to observation chart redesign together with retraining in its use significantly improves detection rates of patient physiological decline.

We anticipate that this type of study could be extended to a national based project with the eventual aim of standardising an observation chart throughout the United Kingdom.

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