



## Does the introduction of HDU reduce surgical mortality?

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**The aim of this study was to assess the change in workload in a general surgery department over 2 consecutive 1-year periods and document the impact of a high dependency unit (HDU) on hospital mortality. Data were collected on all admissions, the number and type of operations performed for a 1-year period before and after a purpose-built HDU was opened. During the study period, the total number of admissions increased by 15%, with a disproportionately large increase (27%) in the number of emergency admissions. This was reflected by increases in the emergency out-of-hours operating by 12%. During the study period, the overall in-patient mortality rose from 2.16% to 3.2%.**

**Introduction of HDU facilities alone does not lead to a reduction in hospital mortality. Alterations in emergency workload and changes in case-mix are important in determining outcome. League tables of hospital mortality are likely to be difficult to interpret without adequate information about facilities and case-mix.**

*Key words:* High dependency unit (HDU) – Audit – Mortality – Emergency operating lists – NCEPOD

The National Confidential Enquiry into Perioperative Deaths (NCEPOD) has made a series of recommendations aimed at identifying and rectifying causes of preventable postoperative deaths. Key among these are the provision of theatre lists dedicated to the care of emergency patients, adequate supervision of trainees and, in the 1992/93 report, 'any hospital admitting emergency patients, and hospitals admitting complex elective patients must have adequate facilities for

intensive and high dependency (HDU) care at all times'.<sup>1</sup> Despite this, under 50% of hospitals surveyed in the 1995/96 NCEPOD report had high-dependency facilities.<sup>2</sup> It is envisaged that adequate provision of high-dependency care may lead to a reduction in avoidable peri-operative morbidity and mortality<sup>3</sup> in patients who require more observation than can realistically be provided on the ward, but do not require full intensive care (ICU). Despite these recommendations,

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there is little data demonstrating the relative importance of emergency theatres and HDU facilities.

The opening of a high dependency unit in a surgical unit at a time when daytime emergency theatre capacity was withdrawn, allowed an opportunity to assess whether HDU alone can impact upon the surgical mortality rate.

The aims of this study were to: (i) review hospital mortality in general surgical patients over 2 consecutive 1-year periods; (ii) assess whether the introduction of HDU alone influenced hospital mortality; and (iii) identify workload and case-mix for the 2 periods.

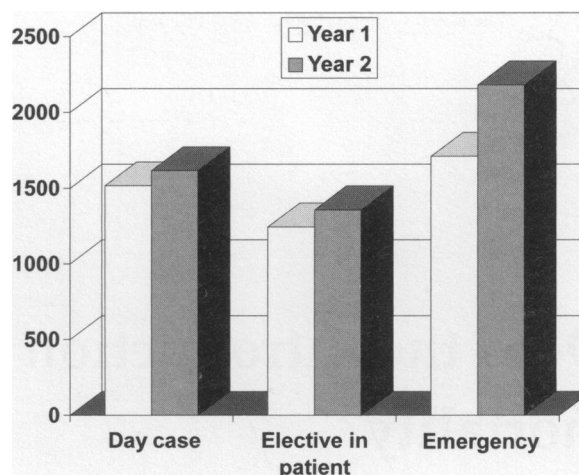
## Patients and Methods

The general surgery department at Pinderfields General Hospital consisted of 4 general surgeons until May 1996 when a second general surgeon with a vascular interest joined the team and one existing surgeon dropped all but elective breast surgery and became part-time (4 surgeons on acute rota, 4.5 wte). During the study period, centralisation of gynaecology and ENT services led to re-allocation of 6 theatre sessions from emergency to elective work.

A four-bedded HDU opened on 1 September 1996 in line with the 1992/93 NCEPOD recommendations and aimed at targeting the high early postoperative mortality that several authors have noted (30% of all deaths in the 1996/97 NCEPOD data occurred within 48 h of surgery). Admission was appropriate for patients requiring invasive monitoring (excluding pulmonary arterial lines), with a predicted length of stay of less than 48 h and for those patients with single organ failure. The use of inotropes (adrenaline and noradrenaline) and the requirement for continuous positive airways pressure (CPAP) mask ventilation or intubation precluded admission and necessitated ICU care.

Data were collected from the hospital computer system on all surgical patients admitted to Pinderfields General Hospital for a one year period (1 September 1995 to 31 August 1996) before the HDU opened and similarly for the same time period (1 September 1996 to 31 August 1997) after the HDU opened. The numbers of patients admitted as day-cases, elective and emergency cases was recorded. The number of patients admitted to the ICU and the HDU during the same time period was also recorded.

Theatre activity during the same time period was also retrieved by interrogating the theatre computer system. Operations were coded as elective or emergency and knowledge of whether they were performed in-hours or out-of-hours was also available.



**Figure 1** The total workload in the general surgery department increased by 15% in year 2 compared to year 1. Day-case activity went up by 7%, elective admissions by 9% and emergency admissions by 28%

Case-mix is a very difficult variable to assess. We identified numbers of specific 'indicator' operations during each of the two periods. These operations included major vascular procedures, gastrectomies and colectomies. The aim of this exercise was to identify any large differences in the type of surgery performed during the two time periods.

### *Outcome (in-patient hospital mortality)*

This was defined as a death from any cause, which occurred within the hospital at any time during that admission or following surgery, regardless of the time period (i.e. not 30 day or 90 day mortality).

## Results

### *Surgical workload*

The total number of admissions increased from 4471 to 5154, an increase of 15%. The number of day-case, elective and emergency admissions all increased over the study period (Fig. 1). This was reflected by increases in the planned in-hours number of operations (8% increase), and both the number of emergency (20% increase) and emergency out-of-hours operations performed (12% increase; Fig. 2).

During the study period, the number of 'indicator' major elective procedures remained relatively constant

Table 1 Patient data

	ICU		HDU		Total	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Admitted	77	69	–	300	4471	5154
Median LOS (days)	4.5	5.6	–	1.5	1	2
In-hospital mortality	29%	58%	–	19%	2.16%	3.2%

Overall mortality among patients admitted to general surgery increased but the majority of these deaths were in emergency admissions (year 1, 86 out of 97 deaths were in patients admitted as emergencies – 89%; year 2, 143 out of 166 deaths – 86%).

(232 procedures versus 231 procedures). However, in year 1, 79 of 232 procedures were performed out-of-hours (34%) compared with 119 out of 231 in year 2 (52%) – an increase of 51%.

*Patient demography*

The median age of patients in year 1 was 52 years (interquartile range 33–68 years) and, in year 2, was 54 years (interquartile range 34–69 years). In year 1, 946 patients were 70 years of age or older (21%) compared to 1209 patients (25%) in year 2. In addition to a slightly older population, there was a modest shift in sex distribution in year 2 (50% male in year 1, 52% male in year 2). None of these differences reached statistical significance.

*Intensive care unit mortality*

The number of admissions to the ICU remained similar between the two study periods [77 patients

(1.7%) versus 69 patients (1.3%)], but the median length of stay increased from 4.5 days to 5.6 days. The hospital mortality for year 1 patients who had been on the ICU was 29% (22 of 77) compared with 58% in the year after HDU opened (40 of 69; Table 1).

*High dependency unit*

During the first year, 417 patients were admitted to the HDU; of these, 300 patients were under the care of the four general surgeons. Thirty-five patients were ‘stepped-down’ from ICU. Over half the patients were booked elective cases, with the remainder being non-booked urgent and emergency cases. The median length of stay on the HDU was 36 h (interquartile range 16–60 h). The majority of patients (87%) returned to the ward, 10% of patients were ‘stepped-up’ to ICU and 3% of patients died on HDU.

*High dependency unit mortality*

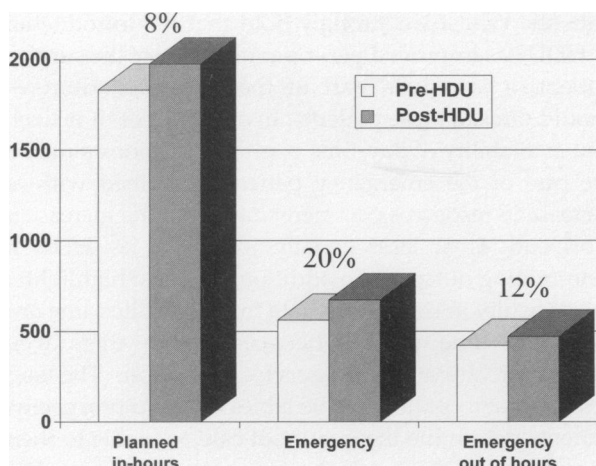
The in-hospital mortality for general surgery patients who spent time on the HDU was 19% (56 of 300), and the 30-day mortality was 13% (39/300).

*Overall hospital mortality*

During the study period, the overall in-hospital mortality went up from 2.16% to 3.2% with the in-hospital mortality for emergency admissions increasing from 5% to 6.5% (Table 1).

**Discussion**

The government white paper, *A First Class Service. Quality in the NHS*, has placed great emphasis on the role of audit, identification of inadequate clinical service and on publishing comparative data between hospitals and units.<sup>4</sup> Recent high profile cases have accelerated the timetable of change. NCEPOD has played an important part in arguing the case for service reconfiguration in surgical units and emergency day-time operating



**Figure 2** Total general surgical operative activity increased in year 2 compared to year 1. There was an 8% increase in the number of planned in-hours operations but the largest increases in operative workload were in emergency (20%) and emergency out-of-hours operating (12%)

theatre sessions are now the rule, not the exception. The 1992/93 report placed emphasis on the provision of adequate high dependency facilities for the care of emergency and postoperative surgical patients.<sup>1</sup> It is likely that HDU facilities can complement emergency theatre sessions but conceptually cannot replace them. The benefit of emergency theatre sessions has been extensively documented and, in particular, can reduce the amount of 'out-of-hours' work done. For example Loft *et al.*<sup>5</sup> demonstrated a decrease from 40% to 12% of operations performed after 10 pm following the introduction of an afternoon theatre session. Inherent in the provision of emergency lists is an acceptance that up to 10% of lists will not be used and that up to 30% of each list will be empty.<sup>6</sup> In addition to the role of theatre sessions, there is increasing emphasis on the pre-operative preparation and postoperative care of elderly, ill surgical patients. The mortality after general surgery in the elderly was 27% and after emergency laparotomy was 48% in a recent study by Cook *et al.*<sup>7</sup> It is also clear that mortality rates alone are poor indicators of the quality of surgical care, but are increasingly being used as such.<sup>8</sup>

In the current study, a new HDU treated 417 patients in its first year through 4 beds. This is a high figure when compared to the unit on which it was modelled (350 patients through 4 beds at the end of year 4)<sup>9</sup> and when compared to figures from an established unit in Chester (520–590 patients per annum through 6 beds).<sup>10</sup> The introduction of our HDU increased the proportion of general surgery patients offered critical care nursing from 1.7% in year 1 to 7.1% in year 2. Despite this, the mortality among general surgery patients increased during the study period, while the number of major procedures (indicator operations) was relatively constant. There was, however, an identifiable increase in the percentage of major procedures being performed out-of-hours following re-organisation of hospital specialities leading to the loss of 6 day-time emergency operating sessions. The implications of the above changes may, in part, be responsible for an increase in overall mortality from 2.16% to 3.2%, with the changes in mortality in the emergency cases accounting for the majority of this increase.

There was a marked increase in the workload over the course of the study, with the total number of admissions increasing by 15%. Increased numbers of emergency admissions made up a disproportionately large part of this change. This was reflected by large 20% and 12% increases in the number of emergency and emergency out-of-hours cases being performed. The exact reasons why there has been such an acute

change in workload is difficult to identify, but changes of this sort have radical implications for resource management. The increase in acute workload means perhaps alterations within resource allocation and structure of the working week, leading to a greater emphasis on acute workload.

During the first year, 300 patients were admitted to HDU under the care of the general surgeons representing 6% of the total in-patient surgical workload, a figure similar to others (6.8–7.3%).<sup>10–12</sup> When the HDU was opened, the envisaged length of stay (LOS) was 24 h; the actual LOS was longer at 36 h. This is, however, much shorter than the median 60 h reported in the study by Thompson *et al.*,<sup>13</sup> which looked at 37 independent high dependency units identified by the Royal College of Anaesthetists 1992/1993 National ICU audit. The mortality within the HDU was 3% which is in keeping with other series,<sup>10</sup> but the in-patient mortality with this group of patients is higher at 19%, and 30-day mortality was 13%. This is in agreement with 30-day mortality of 11% reported by Jones *et al.*<sup>11</sup> The increase in mortality among ICU patients was notable and can be explained by the fact that almost 40% of patients admitted to ICU in the absence of a HDU have a low predicted and actual mortality and, therefore, artificially reduce the numbers.<sup>14</sup> By ensuring such patients are admitted to HDU, the mortality among the remaining patients admitted to ICU in year 2 would predictably increase, a finding in keeping with the literature.<sup>15,16</sup>

We believe that the data presented here re-inforce the importance of day-time emergency operating lists for the optimum care of emergency general surgery patients. Whilst we strongly hold that the introduction of HDU has improved peri-operative care of the surgical patient, it is only a part of the armamentarium we should offer to these patients. In our practice, it is likely that availability of day-time operating sessions aimed at the care of the emergency patient, combined with an increase in resources commensurate with the increase in workload, is at least equally important as HDU in determining outcome. In addition, we have highlighted the difficulty in comparing data from even the same unit over two time periods between which there were significant alterations in service provision. The suggestion that mortality league tables can help prospective patients determine the quality of care available to them demands that the surgical community document their concerns about the veracity of such comparisons.

The constant requirement to squeeze greater and greater efficiency out of hospital resources has reduced the 'slack' in the system such as the inherent inefficiencies in emergency 'CEPOD' theatre lists. Such

massive increases in workload as are documented are not compatible with the principles of 'a quality NHS' in the absence of the full range of surgical facilities to deal with them. In the interests of maintaining high levels of patient care, we would encourage other surgical colleagues to look critically at the resources available to them and to document workload and mortality since such data can be a very powerful tool in these times of clinical governance.<sup>17,18</sup>

In conclusion, the addition of a HDU to our surgical unit at a time when emergency operating capacity was reduced did not lead to a reduction in mortality. Indeed, the mortality rose during the study. High dependency care is an important element in the provision of a high quality surgical service, but it is a facility which complements other resources, not replaces them.

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