Unexpected deaths and referrals to intensive care of patients on general wards. Are some cases potentially avoidable?

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ABSTRACT – *Objectives:* (i) To determine the incidence of unexpected deaths occurring on general wards, and whether any were potentially avoidable; (ii) to assess whether the quality of care on general wards prior to admission to intensive care affected subsequent outcome.

■ ***Design:* Six-month audit in teaching hospital. Review of medical, nursing and physiotherapy notes, bedside charts and laboratory data in ward patients either dying unexpectedly (ie not having a prior 'do not resuscitate' order) or requiring intensive care unit (ICU) admission. Panel assessment of quality of ward care prior to unexpected ward death or ICU admission.**

■ ***Subjects:* Adult general ward patients admitted to ICU or dying unexpectedly.**

■ ***Outcome measures:* ICU and hospital mortality.**

■ ***Results:* (i) In the six-month study period, 317 of the 477 hospital deaths occurred on the general wards, of which 20 (6%) followed failed attempts at resuscitation. Thirteen of these unexpected deaths were considered potentially avoidable: gradual deterioration was observed in physiological and/or biochemical variables, but appropriate action was not taken; (ii) in the same period, 86 hospital inpatients were admitted on 98 occasions to the ICU, 31 of whom received suboptimal care pre-ICU admission due either to non-recognition of (the severity of) the problem or to inappropriate treatment. Both ICU (52% vs 35%) and hospital (65% vs 42%) mortality was significantly higher in these patients compared to well managed patients ($p < 0.0001$).**

■ ***Conclusions:* Patients with obvious clinical indicators of acute deterioration can be overlooked or poorly managed on the ward. This may lead to potentially avoidable unexpected deaths or to a poorer eventual outcome following ICU admission. Early recognition and correction of abnormalities may result in outcome benefit, but this requires further investigation.**

Some patients without end-stage disease will continue to deteriorate after admission to a general ward. This may result in either a cardiopulmonary arrest, after which resuscitation will often fail, or to an unplanned admission to intensive care. In a study of 8,796 patients admitted to 26 British intensive care units (ICUs)[1], 43.5% of those admitted from the general wards died, a mortality rate significantly higher than in those admitted from either the operating theatre (20%) or the casualty department (29.6%). Case mix obviously differs, though a recent study which assessed cardiorespiratory management prior to ICU admission suggested that substandard care was a contributory factor[2]. Even with sudden events such as cardiac arrest, there is often a preceding period of deterioration during which the problem could potentially be detected and treated[3,4].

One proposed solution is a medical emergency team[5] whose aim is to prevent potentially avoidable deaths and/or delayed ICU admissions by early assessment and treatment of acutely ill general ward patients. To quantify the need for such a team, a six-month audit was performed to determine:

1 The incidence of unexpected deaths, and whether any were potentially avoidable.
2 The number of admissions to ICU from the general wards, and whether ward care deemed suboptimal affected the subsequent outcome in these patients.

Methods

The audit was conducted over a six-month period (June to December 1996) in the University College London Hospitals NHS Trust. The Trust has 702 acute beds, including 43 intensive care and high dependency beds (including coronary care, cardiothoracic, maternity and renal), 64 paediatric and neonatal beds, and 151 beds designated for general medicine and surgery. Twenty-four hour resident medical cover is provided by housemen or senior house officers, supervised by medical and anaesthetic registrars on each of the two main sites (Middlesex and University College), plus surgical, orthopaedic, cardiothoracic, obstetric/gynaecology and intensive care registrars. For other specialties (eg cardiology, nephrology, urology, HIV, oncology, haematology), non-resident registrars provide the support. Nursing cover on the general wards is at an approximate qualified staff to patient ratio of 1:6–1:7.

Patient case records, bedside physiological observation

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charts, nursing Kardex and physiotherapy care plans, computerised chemical pathology and haematology laboratory results were used to identify abnormal physiological and biochemical parameters indicating acute deterioration. Values falling outside an individual patient's usual range were predetermined for subsequent recording. Table 1 lists abnormal values for the physiological and biochemical parameters measured. Any additional relevant information in the nursing or medical notes or drug charts was also noted. The data were recorded by one of the three investigators (one intensive care physician, two experienced intensive care nurses) on a proforma within two days of ICU admission or ward death. HMcG recorded hospital outcome and duration of stay two months after the audit had finished.

1 *Deaths*

Basic demographic data were collected on all adult patients dying in hospital. Death was categorised as an unexpected ward death if a 'do not resuscitate' order was not recorded in the notes and the patient could not be successfully resuscitated. Patients who had not been expected to die were identified, and further data collected (as described above) for the inpatient period up to seven days prior to death. Cause of death was obtained from the death certificate, or from post-mortem when this was requested by the primary team.

2 *Intensive care unit admissions*

All adult patients admitted to the ICU from the general wards were assessed as above, including the reasons for admission. Their management in hospital was examined for up to a week prior to ICU admission. Intensive care and hospital mortality were recorded.

Table 1. Abnormal physiological and biochemical values.

Physiological variables	Biochemical variables
BP systolic <100 mmHg or >200 mmHg	Creatinine >150 μmol/l
Heart rate <60 beats/min or >120 beats/min	Sodium <130 mmol/l or >150 mmol/l
Temperature <35.5°C or >38.5°C	Potassium <3.0 mmol/l or >6.0 mmol/l
Urinary output <200 ml/12 hours	White cell count >20 × 10^9/l or <2 × 10^9/l
Respiratory rate <10 breaths/min or >25 breaths/min	Haemoglobin <90 g/l
Inspired O_2 concentration >60%	Platelet count <50 × 10^9/l
O_2 saturation <90%	International Normalised Ratio >2.5
Glasgow coma score ≤12	PaO_2 <10 kPa $PaCO_2$ >6 kPa Arterial standard base excess > ±4 mmol/l

BP = blood pressure

Key Points

General ward patients with obvious physiological or biochemical indicators of acute deterioration can be overlooked or poorly managed

This may lead to potentially avoidable ward deaths or a poorer eventual outcome following ICU admission

Medical and nursing staff should be trained to recognise and deal appropriately with clinical deterioration

A medical emergency team comprising staff experienced in managing acutely unwell patients may be a useful innovation to support ward-based doctors and nurses; the benefits of such an approach await confirmation

Review of unexpected deaths and intensive care unit admissions

Three months after completion of the audit the authors met to review each case of unexpected death or ICU admission to assess whether or not management prior to the event had been suboptimal (see below for definition). For the ICU admissions, patients were coded by number, with their medical history and admission diagnosis hidden to prevent ready identification. The investigators were thus unaware of hospital outcome. Only clear-cut cases of poor management were deemed suboptimal: for example, worsening hypoxaemia with tachypnoea but no obvious increase in therapeutic intervention. It was decided to give the benefit of the doubt in borderline cases or where a unanimous decision could not be achieved (in practice, the latter did not occur).

Suboptimal care was defined as either:

- non-recognition of an abnormality *clearly* apparent from physiological recordings or laboratory data, but which had either not been identified in the case records or not acted upon with any obvious therapeutic intervention (ie no entry on the drug chart)
- *clearly* inappropriate or inadequate treatment, although the case records showed that the abnormality had been identified by nursing or medical staff.

Care was not deemed suboptimal if medical and nursing ward management was considered satisfactory, even though abnormalities may have persisted for more than 12 hours.

Age, APACHE II scores and length of ICU stay for both suboptimally and optimally managed groups were compared using the Mann-Whitney U-test. Mortality was compared between groups using the χ^2 test. Data are expressed as median and interquartile ranges.

Results

There were 6,756 elective and 8,879 emergency admissions to the Trust during the six-month study period. Of the

elective adult admissions, 3,584 were surgical and 2,384 medical; 2,836 of the emergency adult admissions were surgical and 4,863 medical.

Ward deaths

There were 477 deaths in the six-month study period, with 41 in the casualty department, 119 in the ICU, and 317 on the general wards. Of the 317 ward deaths, 20 (6%) followed failed attempts at resuscitation. The median age of these patients was 67 years (range 48–89 years). Nine of the deaths (45%) occurred over the weekend (5 pm Friday to 9 am Monday), a period which constitutes 38% of the week. Four patients received inappropriate cardiopulmonary resuscitation, as clear evidence of end-stage disease was documented in their notes. Three suffered sudden cardiac events while 13 showed prior evidence of clinical deterioration. Table 2 shows the recorded cause of death in these 16 patients, only two of whom underwent post-mortem. Abnormal physiological or biochemical markers associated with these deaths included:

- uncorrected hypotension (9 patients), four of whom had a systolic blood pressure below 80 mmHg for at least 24 hours
- hypokalaemia uncorrected prior to arrest (3)
- hypoxaemia (2)
- hypoglycaemia (3).

Intensive care unit admissions

Eighty-six ward patients were admitted unexpectedly to the ICU over the six-month study period on a total of 98 occasions (11 were readmitted, one being readmitted twice). Primary reasons for admission (which could be multiple) were cardiovascular (49), respiratory (47), renal (4), metabolic (3) and neurological (3). There were 43 (50%) hospital deaths, of which 34 (40%) occurred in the ICU and 9 post-ICU discharge. Survivors were not significantly younger (52 years (37, 67) versus 63 years (37, 68)) but were less sick on admission (APACHE II score 15 (10, 21) versus 20 (18, 24), p <0.001), though they had a similar ICU stay (3 (2,5) days versus 4 (1,7) days, not significant).

Thirty-one patients were deemed to have received suboptimal care pre-ICU admission, due either to non-recognition of the problem (or its severity) or to inappropriate treatment. Mortality was significantly higher in these patients (20/31, 65%) than in the well-managed group (23/55, 42%) (p <0.0001). The abnormal physiological and biochemical values in these patients leading to their subsequent ICU admission are shown in Table 3. In six cases, the abnormalities had been present for more than three days. Additional abnormalities noted in these patients, but felt to be adequately managed, were pyrexia (12), low body temperature (1), Glasgow Coma Score below 12 (1), abnormal white blood count (11), low platelet count (5) and a raised International Normalised Ratio (2). Arterial blood gases were taken in 21 of these 31 patients while they were still on the general ward on a total of 31 occasions: at four hours (18 samples), 4–12 hours (9), 12–24 hours (2) and 1–2 days (2) prior to ICU admission.

The investigators considered that earlier admission to ICU would have been appropriate for some patients, judging by the degree of physiological abnormality and/or the therapy being administered on the ward. Referral delayed by 12 hours or more occurred on 15 occasions in 14 patients, and by longer than 24 hours in nine patients. In three cases, the patient had been previously reviewed by an ICU registrar. However, despite this perceived delay in transfer to a more appropriate environment, management was often adjudged adequate. Hospital mortality in these

Table 2. Causes of unexpected deaths as stated on death certificates (n = 14) or from post-mortem (n = 2).*

Cause of death	No. of deaths
Cardiac events (eg myocardial infarction, arrhythmias)	6
Pulmonary embolus	2
Haemorrhage	2
Pneumonia/sepsis	3
Hypoglycaemia	1
Diabetic ketoacidosis	1
Post-operative left ventricular failure	1

* excluding four patients with end-stage disease who received inappropriate cardiopulmonary resuscitation

Table 3. Physiological and biochemical problems leading to intensive care unit admission in the 31 patients deemed to have received suboptimal ward care.

Abnormality	Non-recognition of problem (or its severity) (n = 12)	Inappropriate treatment (n = 19)
Cardiovascular:		
hypotension	4	4
severe hypertension	0	1
tachycardia	2	5
bradycardia	1	0
Respiratory:		
hypoxaemia	4	10
tachypnoea	6	6
hypercapnoea	0	3
Metabolic:		
oliguria	2	2
rising urea & creatinine	2	1
hyponatraemia	3	0
hyperkalaemia	1	0
hypokalaemia	0	1
metabolic acidosis	4	2
metabolic alkalosis	0	1
anaemia	0	1

delayed referrals and in patients requiring readmission to ICU was 50%.

Discussion

Unexpected ward deaths and unplanned admissions to intensive care are two valid markers for assessing the quality of care received by acutely ill patients on general wards. For unexpected ward deaths in whom resuscitation was unsuccessfully attempted, there was clear evidence of physiological or biochemical deterioration in 13 patients over the six-month study period, suggesting about two potentially avoidable ward deaths each month. This may be an underestimate as neither successfully resuscitated patients who died later (eg in intensive care) nor any patient deemed 'not for resuscitation' were included. Most of these 'DNR' decisions were made within a few days of death, except for 'care of the elderly' patients in whom the decision was generally taken within the first few days of hospital admission.

Outcome from cardiorespiratory arrest on general wards is poor, with hospital survival rates quoted at 8-9%[3,4]. However, many of these patients display obvious indicators of clinical deterioration in the hours or even days preceding arrest which are either overlooked or inadequately managed. In Franklin and Mathew's[3] study of 150 cardiac arrests on medical wards, a nurse or physician had documented clinical deterioration within six hours of the arrest in 99 cases. These authors recommended preventive strategies, including training in cardiopulmonary stabilisation and how to respond to neurological and respiratory deterioration. This view was similar to that of Schein *et al*[4] who found that 84% of 64 consecutive in-hospital cardiopulmonary arrests had documented observations of clinical deterioration or new complaints within eight hours of the arrest: in particular, changes in respiratory, metabolic or mental function.

A significantly higher mortality occurred in those patients referred to intensive care for whom ward management prior to ICU admission was considered suboptimal. Such findings are neither new nor restricted to either our hospital or UK practice. The Harvard Medical Practice Study[6] reviewed over 30,000 hospital records from 54 New York State hospitals. Adverse events occurred in 3.7% of hospitalisations, over a quarter of which were deemed negligent; this percentage increased in the elderly and in categories of more severe injuries. A companion paper[7] reported that 58% of these adverse events were associated with management errors, nearly half of which were attributed to negligence. Adverse events associated with an operation were less likely to be caused by negligence than non-surgical adverse events (17% vs 37%). The percentage of negligence-related adverse events was highest for non-invasive therapeutic mishaps ('errors of omission') (77%), diagnostic mishaps (75%), and events in the casualty department (70%). In the Quality in Australian Health Care Study[8] of 14,000 admissions to 28 hospitals, adverse events occurred in 16.6% of ward patients, of whom 4.9% died. The investigators considered 51% of these events to have been preventable. The recently published study[2] of 100 emergency admissions to ICUs in Portsmouth and Southampton used external assessors to rate the quality of pre-ICU care. Twenty patients were well managed, 54 received suboptimal care, and the assessors disagreed on the quality of management in 26. Hospital mortality in these groups was 7 (35%), 30 (56%) and 8 (31%) ($p = 0.07$), respectively, with ICU admission considered to be delayed in 37 (69%) of the suboptimally managed patients.

The methodology we used to collect data and assess quality of care has a number of limitations:

- Data were not collected contemporaneously, so we were dependent upon the quality of note-keeping to detect whether an abnormality had been recognised and what plan of treatment instituted. However, the absence of a therapeutic intervention recorded in the drug or bedside charts corroborated our view of a lack of recognition of a problem. If a problem had been recognised, but was neither recorded in the notes nor any treatment obviously given, this still constituted suboptimal care due to a lack of appreciation of the severity of the problem.
- It was our intention to examine only the response to recorded physiological or biochemical abnormalities and not other aspects of diagnosis or management.
- Although the review process was not performed by external reviewers, only *clear-cut* cases of suboptimal management were so designated. From the filtered information presented at review, we were unaware of outcome.

Early recognition and correction of abnormalities may result in outcome benefit, both in terms of morbidity and mortality. A financial benefit is also likely if either the requirement for, or length of stay in, intensive care can be reduced. Education is an obvious starting point, with both junior and senior medical and nursing staff trained to recognise and deal appropriately with clinical deterioration. This is particularly pertinent in view of the changes in nursing and medical training that have occurred in recent years, with less exposure to acutely ill patients. Proposed initiatives include a medical emergency team[5], comprising staff experienced at managing acutely unwell patients, who can be summoned for help by ward-based nursing or medical staff in response to the development of abnormal physiological measurements. The benefits of such an approach have yet to be demonstrated, and the values used to determine abnormal physiology require validation.

References

1 Rowan KM. Outcome comparisons of intensive care units in Great Britain and Ireland using the APACHE II method. PhD Thesis 1992, University of Oxford.

2 McQuillan P, Pilkington S, Allan A, Taylor B, *et al.* Confidential inquiry into quality of care before admission to intensive care. *Br Med J* 1998;**316**:1853—8.

3 Franklin C, Mathew J. Developing strategies to prevent in-hospital cardiac arrest: analysing responses of physicians and nurses in the hours before the event. *Crit Care Med* 1994;**22**:244–7.
4 Schein RM, Hazday N, Pena M, Ruben BH, Sprung CL. Clinical antecedents to in-hospital cardiopulmonary arrest. *Chest* 1990; **98**:1388–92.
5 Lee A, Bishop GF, Hillman KM, Daffurn K. The Medical Emergency Team. *Anaesth Intensive Care* 1995;**23**:183–6.
6 Brennan TA, Leape LL, Laird NM, Hebert L, *et al.* Incidence of adverse events and negligence in hospitalized patients. Results of the Harvard Medical Practice Study I. *N Engl J Med* 1991;**324**:370–6.
7 Leape LL, Brennan TA, Laird N, Lewthers AG, *et al.* The nature of adverse events in hospitalized patients. Results of the Harvard Medical Practice Study II. *N Engl J Med* 1991;**324**:377–84.
8 Wilson RM, Runciman WB, Gibberd RW, Harrison BT, *et al.* The Quality in Australian Health Care Study. *Med J Aust* 1995; **163**:458–71.

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