ORIGINAL ARTICLE

Knowledge of aspects of acute care in trainee doctors

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Deficiencies in trainees' knowledge, skills, and attitudes have the potential to influence the initial assessment, treatment, and outcome of acutely ill ward patients. Knowledge of basic aspects of acute care were assessed among a group of 185 trainee doctors at six hospitals. Many were unaware of the signs of total airway obstruction, confusing them with those of partial obstruction (pre-registration house officers (PRHOs) 11%, senior house officers (SHOs) 14%) or apnoea (PRHOs 47%, SHOs 26%). Knowledge about the use of non-rebreathing oxygen masks was poor; 23% of trainees could not describe the purpose of the reservoir bag or gave answers that were unclear or incorrect. Seven trainees thought that it was involved in humidification, or carbon dioxide collection or removal. Seventeen per cent of trainees could not quote the maximum deliverable inspired oxygen concentration provided by these masks or gave values below the normal range. Thirty one per cent of trainees thought that the lower end of the normal range for pulse oximetry (S_pO_2) was below 95%; nine (5%) believed it to be below 90%. There was also poor knowledge of the factors influencing the function of a pulse oximeter. Similar deficits in knowledge and understanding existed in relation to the normal capillary refill time, minimum hourly urine output, the use of the AVPU scale and the role of blood glucose testing in unconscious adults. Only 22% of PRHOs and 21% of SHOs identified the correct percentage hospital survival for patients who suffer an in-hospital cardiac arrest. Knowledge of aspects of consent was unsatisfactory. It is recommended that all medical schools urgently incorporate training about common aspects of "generic" acute care in their curricula.

In the UK, most of the initial assessment and treatment of acutely ill ward patients is provided by trainee doctors. However, deficiencies in trainees' knowledge, skills, and attitudes have been identified[1–6] and these have the potential to influence patient outcome and to contribute to the high level of clinical error reported in the NHS.[7] In particular, the failure to detect clinical deterioration, to provide timely intervention, and to institute simple supportive care may lead to cardiac arrest, intensive care unit admission, or death.[8–13] Frequently, there is poor management of the patient's airway, breathing, circulation, oxygen therapy, fluid balance, and monitoring.[10] Although the cause of such substandard care is inevitably multifactorial, basic education in acute care and the preparation of staff for clinical practice may be important determinants.[14] This study attempts to determine the level of knowledge about basic aspects of acute care amongst newly qualified pre-registration house officers (PRHOs) and senior house officers (SHOs).

SUBJECTS AND METHODS

In August 2001, a questionnaire concerning aspects of basic, acute care was distributed to all PRHOs and SHOs attending hospital orientation programmes in six different UK hospitals. The questionnaires were distributed by resuscitation training officers and were completed immediately in a serious manner in an examination-style setting. They contained the following questions regarding 12 acute care topics:

1. List the signs of total airway obstruction.
2. Describe how to use a non-rebreathing (reservoir) oxygen mask (participants were shown a diagram of the mask).
3. Describe the role of the bag attached to a non-rebreathing oxygen mask.
4. What is the maximum deliverable oxygen concentration (%) using a non-rebreathing (reservoir) oxygen mask?
5. What is the normal range (in %) for the oxygen saturation of haemoglobin in arterial blood?
6. Which (of eight factors) affect the functioning of a pulse oximeter positioned on an index finger?
7. What is the normal capillary refill time in seconds?
8. What is the normal minimum hourly urine output (in ml/kg/hour) expected in an adult?
9. What does P on the AVPU scale mean?
10. List the tests or investigations that should be done urgently in any unconscious adult patient.
11. What percentage of patients suffering an in-hospital cardiac arrest survive to leave hospital?
12. Who can give legal consent to an operation on an unconscious adult male patient?

The responses given by each participant were compared to a set of pre-determined correct answers that are available in standard textbooks, taught on life support courses, or would be familiar to specialist doctors working in acute care.

RESULTS

Altogether 108 PRHOs from six different hospitals and 77 SHOs (three hospitals) completed the questionnaire. The response rate was 100%.

Airway obstruction

One PRHO failed to answer the question and only two described the correct combination of signs of total airway obstruction: absent breath sounds, paradoxical breathing and, ultimately, cyanosis. Only 68/108 (63%) of PRHOs correctly identified that breath sounds would be absent, while 12/108 (11%) believed that stridor would occur. Almost half of the PRHOs (51/108; 47%) believed that apnoea was a sign of airway obstruction.

Abbreviations: CRT, capillary refill time; PRHO, pre-registration house officer; SHO, senior house officer; S_pO_2, pulse oximetry

Table 1 Numbers (%) of trainees correctly identifying phases of correct use of non-rebreathing oxygen masks

	PRHO (n=108)	SHO (n=77)
Attach tubing to oxygen source	79 (73)	57 (74)
Ensure oxygen is flowing	73 (68)	57 (74)
Identification of correct flow rate (>10 litres/min)	12 (11)	29 (38)
Ensure reservoir bag is filled	47 (43)	27 (35)
Reservoir does not fully collapse during inspiration	5 (5)	5 (6)
Apply mask to patient's face	93 (86)	73 (95)

Table 2 Numbers (%) of trainees correctly identifying factors that would interfere with the correct functioning of a pulse oximeter

	PRHO (n=108)	SHO (n=77)
Convulsions	65 (60)	47 (61)
Nail varnish	54 (50)	54 (70)
Carbon monoxide	57 (53)	56 (73)
Methaemoglobin	45 (42)	43 (56)
Shivering	56 (52)	46 (60)
Shock	81 (75)	65 (84)
Hypothermia	74 (69)	64 (83)

One SHO did not answer this question and only five (6%) identified the correct signs of complete airway obstruction. A smaller proportion of SHOs (41/77; 53%) than PRHOs thought that breath sounds would be absent while a greater percentage (14%; 11/77) believed that stridor would be present. Almost one quarter of the SHOs (20/77; 26%) believed that apnoea was a sign of airway obstruction.

Use of non-rebreathing oxygen masks

Table 1 describes the number of trainees correctly identifying each stage of the mask's use. No trainee identified all phases of the correct use of the mask. Five trainees (three PRHOs, two SHOs) thought the device was a self inflating manual resuscitator (bag-valve-mask device).

Five trainees, all PRHOs, did not attempt to describe the purpose of the oxygen reservoir bag attached to the mask, from which oxygen is drawn. A further 30 (11 PRHOs, 19 SHOs) gave answers that were incorrect. Six trainees (two PRHOs, four SHOs) thought that the reservoir bag was involved in the collection or removal of expired carbon dioxide. One PRHO thought that the bag ensured adequate humidification of inspired oxygen.

Altogether 89/108 (82%) of PRHOs and 65/77 (84%) of SHOs identified maximum deliverable inspired oxygen concentration values in the correct range (60%–100%), but the median concentration quoted by those giving incorrect values (n = 21) was 28% (mean=31%). Three trainees gave answers that were lower than the oxygen concentration of inspired room air (10%, 16%, and 20%). Ten trainees gave no value.

Pulse oximetry (S_pO_2)

Only 55/108 (51%) of PRHOs and 53/77 (69%) of SHOs identified values for the oxygen saturation of haemoglobin in arterial blood within the correct normal range (95%–100%). Fifty seven (31%) trainees thought that the lower end of the normal range was below 95%; nine (5%) believed it to be below 90%. Forty trainees gave no range or values that bore no relation to any recognisable range.

Table 2 shows the responses of trainees to the question regarding factors that may interfere with the correct functioning of a pulse oximeter. Thirty three trainees (22 PRHOs and 11 SHOs) wrongly believed that carbon dioxide would affect the functioning of the device.

Capillary refill time (CRT)

Normal capillary refill time is conventionally taught to be <2 seconds,[15 16] although research suggests that it is <2 seconds in children and adult males, and <3 seconds in adult females.[17] Altogether 64/108 (59%) of PRHOs and 47/77 (61%) of SHOs identified a CRT <2 seconds, but 68/185 (37%) of trainees gave a value that was higher. Six trainees gave no value, but 22 trainees thought that the CRT would be normal if it were <4 seconds (n=5), <5 seconds (n=15), <6 seconds (n=1), and <10 seconds (n=1).

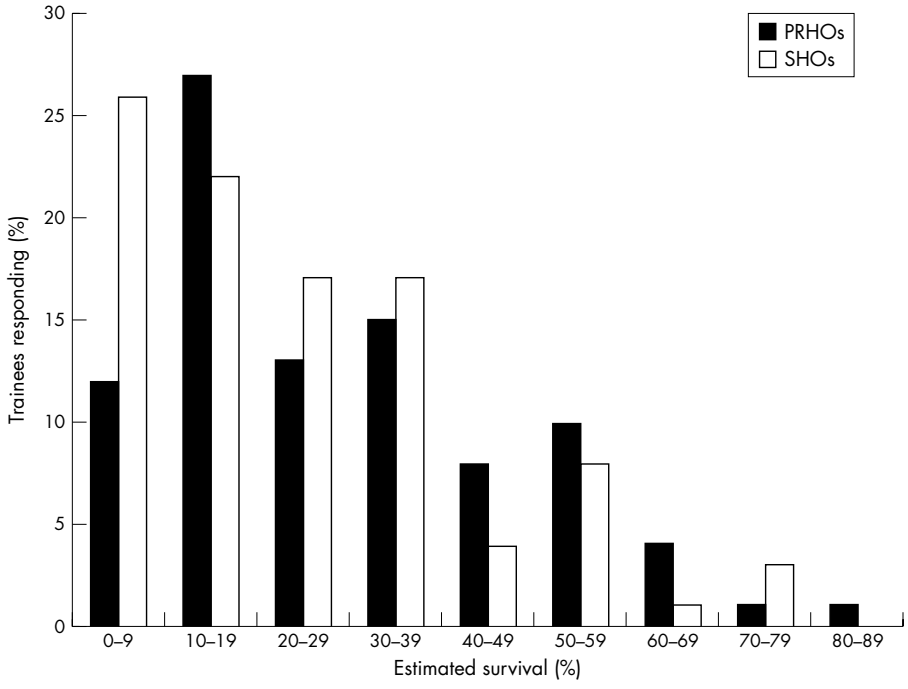

Figure 1 Distribution of trainees' responses about hospital survival (%) from in-hospital cardiac arrest.

Table 3 Trainees beliefs about who can give consent for surgery on behalf of an unconscious adult male patient; values are number (%)

	PRHO (n=108)	SHO (n=77)
Patient's wife	15 (14)	20 (26)
Patient's mother	14 (13)	15 (19)
Patient's father	15 (14)	15 (19)
Patient's 20 year old son	8 (7)	12 (16)
Patient's 15 year old daughter	0	0
Patient's brother	5 (5)	5 (6)
Patient's sister	5 (5)	5 (6)
None of the above	89 (82)	50 (65)

Normal minimum hourly urine output

One hundred and nineteen (64%) trainees (60% of PRHOs; 70% of SHOs) identified the correct minimum hourly urine output (0.5 ml/kg/hour); a further 19 (10%) suggested a value of 1 ml/kg/hour. Ten trainees did not give a value, but incorrect answers (n=37) ranged from 2–150 ml/kg/hour. Where an incorrect value was given, 43% (16/37) gave values in the range 2–20 ml/kg/min.

Management of the unconscious adult

Seventy of 108 (65%) PRHOs and 47/77 (61%) SHOs correctly identified that patients scoring "P" on the AVPU scale respond to painful stimuli only. Fifty five (30%) trainees did not answer the question. Incorrect answers (n=13) included "does not respond to pain", "pupils respond", "pulses present", "pale", "partial response", and "purple". Eighty three of 108 (78%) PRHOs and 49/77 (64%) SHOs identified the need to measure blood glucose in unconscious patients.

Survival to discharge of patients after an in-hospital cardiac arrest

The responses given to this question by PRHOs and SHOs are shown in fig 1. The ranges given by trainees were similar (1%–89% for PRHOs and 1%–75% for SHOs). Only 24/108 (22%) of PRHOs and 16/77 (21%) SHOs gave answers in the correct range (that is, 15%–25%). Twenty six trainees (14%) estimated survival to be higher than 50%.

Legal aspects of consent in adults

Trainees were asked to identify which of seven close relatives could give consent for an operation on behalf of an unconscious adult male. The responses are listed in table 3. Eighty nine of 108 PRHOs (82%) and 50/77 SHOs (65%) correctly identified that none of the relatives listed could give consent on behalf of the patient.

DISCUSSION

Our study demonstrates that trainee doctors, many of them having just completed medical school training, have significant gaps in their knowledge and understanding of the signs of acute illness and the basic, but potentially life saving, care required to support life. There were also inaccuracies in their knowledge of the success of in-hospital cardiac arrest and their understanding of issues surrounding consent. Surprisingly, the performance of PRHOs and SHOs was similar, suggesting that experience gained during the pre-registration year does not necessarily correct such deficiencies. Occasionally, we found that the PRHO was more likely to be correct than the SHO. This is worrying in that many PRHOs learn directly from SHOs, with the consequent potential for perpetuation of inaccuracies and misunderstandings.

Specifically, many trainees were unaware of the signs of total airway obstruction and confused them with those of partial obstruction or apnoea. Personal observation by the authors suggests that some trainees do not understand that airway patency and breathing are independent, and consequently believe that patients who are breathing do not have airway obstruction.

None of the participating trainees fully described the steps involved in the delivery of oxygen using a non-rebreathing oxygen mask. Some believed that the oxygen reservoir has a role in carbon dioxide removal or collection, or humidification. Although over 80% of trainees correctly identified that such masks deliver high concentration oxygen (60%–100%), the remainder gave much lower values. Three trainees gave values that were below 21%, thereby suggesting a significant gap in their understanding of the normal physical characteristics of room air.

Papers published during the early to mid-1990s clearly demonstrated that many hospital staff did not understand the function of a pulse oximeter or the normal physiology that underpins its use.[18–20] Our findings demonstrate that these deficits continue to exist, despite the increasing frequency with which oximeters are now used on general hospital wards. Particularly worrying is the finding that 22% of trainees could not give values for the normal range for S_pO_2 or presented data that was completely incorrect, while another 5% believed the lower end of the normal range to be below 90%. This suggests that some trainees might fail to respond to levels of desaturation that could have serious, adverse clinical effects on patients. Significant numbers of PRHOs and SHOs were also unaware of the factors that would interfere with the correct functioning of a pulse oximeter, and therefore the significance of displayed S_pO_2 values. This is clinically important, as a failure to obtain a pulse waveform or an S_pO_2 value, for instance in a shocked or hypothermic patient, could be interpreted as oximeter malfunction.

Sixty per cent of trainees correctly identified the normal capillary refill time and 64% of trainees were able to identify the correct minimum hourly urine output. However, in each case, the answers given by the remainder give considerable cause for concern regarding the ability of trainees to recognise, and respond to, circulatory dysfunction and its end organ effects. The understanding of the AVPU system, and the recognition that unconscious adults should have an urgent blood glucose measurement, was also poor.

In the UK, approximately 20% of patients suffering an in-hospital cardiac arrest survive to leave hospital.[21] Our data indicate a considerable over-estimation of success rate by many trainees at both PRHO and SHO levels, with values as high as 80% suggested. In an environment in which decisions regarding the appropriateness of resuscitation arise frequently, trainees should have some understanding of the likely outcome from cardiopulmonary resuscitation. Similar deficiencies in the knowledge of consent for operation were also identified.

Many of the areas of clinical practice chosen for study by us relate specifically to abnormalities that herald clinical deterioration and precipitate calls for help from nursing staff—that is, falling S_pO_2, oliguria, lowered conscious level. Published evidence already suggests that such abnormalities often go unnoticed, are misinterpreted or ignored, and that, eventually, these result in a catastrophic patient outcome.[8–13] The results of our study suggest that knowledge gaps may have an important part to play in these errors and that medical school training may not prepare medical students for their forthcoming responsibilities and clinical experiences. Such deficiencies have already been identified with respect to common practical skills, such as inserting a nasogastric tube, bladder catheterisation, and performing electrocardiography,[22–26] and basic clinical skills training has been shown to be inadequate during both the hospital induction period and the PRHO year.[22 23] Frequently, the practical ability of medical graduates often exceeds the expectations of their future employees.[14 27]

In an era when medical students' experience of medical emergencies and surgical procedures is falling,[23 28] it is perhaps

even more important that there is adequate undergraduate basic skills training. The initial phase of most illnesses follows common paths of organ dysfunction, usually involving abnormalities of airway patency, breathing, circulation and consciousness, and often the precise diagnosis is unimportant until physiological stability can be guaranteed. Despite this, few textbooks, other than those accompanying postgraduate life support courses,[15 16 29 30] include references to items such as AVPU, measuring CRT, oximetry, etc. In common with cardiopulmonary resuscitation training,[31] these areas are given little time, if any, in medical school curricula.

The findings of our study are equally applicable to nursing practice, where similar gaps in knowledge and understanding appear to exist. Consequently, our trust now runs a one day multiprofessional course (ALERT: **A**cute **L**ife-threatening **E**vents—**R**ecognition and **T**reatment) to give newly qualified doctors and nurses greater confidence and ability in the recognition and management of adult patients who have impending or established critical illness.[32] ALERT is now being implemented in hospital trusts around the UK and may have a part to play in undergraduate medical, nursing, and paramedical training.

In conclusion, our findings, and those of others,[1–6 14 18–20 22–28] suggest that medical graduates are poorly prepared to identify and treat critically ill patients. Gaps in knowledge may be due to inadequate, or even no, undergraduate training in the "generic" signs, symptoms, and management principles of acute illness. These deficits have the potential to contribute to error and to influence patient outcome. We recommend that all medical schools incorporate such training in their curricula urgently.

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