

Computers in Medicine

Use of microcomputers for self-assessment and continuing education in anaesthesia

CAROL SCHMULIAN, G N C KENNY, D CAMPBELL

Abstract

The suitability of computer-assisted self-assessment was evaluated as a means of quality assurance in anaesthesia. Altogether 202 anaesthetists participated in four trials of the method. Analyses of their performance in a self-assessment programme dealing with obstetric anaesthesia showed significant differences in the levels of knowledge of anaesthetists practising for different numbers of years. The acceptability of computer-assisted self-assessment ranged from 91% to 100% for the four trials. Similar programs have been shown to be of value in medical education and thus computer-assisted self-assessment appears to fulfil simultaneously the functions of self-assessment and continuing education. The criteria for a method of quality assurance are met.

Introduction

The Alment Report *Competence to Practise*¹ and the Royal Commission on the National Health Service² have suggested that regular peer review sessions are of value in maintaining standards in medical practice. While these sessions should be educational, it is important that the practising doctor has access to an objective measure of standards of knowledge and skill.³ There is support for the use of self-assessment and recommendations that the procedures be set up voluntarily by practising doctors rather than by imposition from outside the profession, as has occurred in other countries.¹⁻³

Medical audit implies the concept of an external systematic examination of performance. Peer review suggests a review of a doctor's performance by his colleagues where clinical decisions are debated with a view to improving subsequent care of the patient. Quality assurance entails the assessment of a doctor's performance and its comparison with an acceptable standard. Self-assessment constitutes a major aspect of quality assurance, but the method chosen for self-assessment must ensure the participants of anonymity and confidentiality if the results are to be collated and subjected to subsequent analyses. Many conventional forms of self-assessment exist, including multiple choice questions and case presentations in journals, programmed learning texts, and, recently, a method of assessment appeared using postal and telephone services.⁴ It is difficult or impossible

to obtain information about the performance of those using these methods and therefore they cannot readily be used for quality assurance.

Computer-assisted learning (CAL) has already been shown to be of value in medical education,^{5,6} and the advent of microprocessor-based computers has enabled inexpensive systems that can be easily programmed and are portable and independent of specialist computing services to be developed. Microcomputers are now used routinely in the University of Glasgow Department of Anaesthesia (Royal Infirmary) for undergraduate and postgraduate teaching. Similar microcomputer systems have been evaluated as an objective method of self-assessment while fulfilling the function of continuing postgraduate education. A preliminary report on the success of computer-assisted self-assessment (CASA) has already been published.⁷

Methods

The test programs simulated the diagnosis and management of clinical problems in anaesthesia and intensive care. A short case history was presented to the participant, who was then asked to score a series of questions using the numeric keys of the computer. All other keys had been blocked. An obstetric anaesthesia case was scored on a three-point scale and the other cases on a five-point scale that attempts to accommodate the qualitative judgments of clinical practice. Full explanation of each scoring system with illustrative examples was given at the beginning of each case. The response entered for each question was then compared with the response deemed correct by an authoritative panel of doctors practising in that subject. After answering each question, the anaesthetist was informed immediately whether or not his reply was correct and the reason. An example of a question from the obstetric program is, "If aspiration occurs what action do you take? Increase inspired oxygen to 100% and inflate lungs immediately?" The feedback to this question, if incorrectly answered is, "No. Injudicious positive-pressure ventilation with oxygen before suction is applied through the endotracheal tube may cause the gastric aspirate to pass further down the respiratory airways." Each score given by the participants was stored on magnetic disc for subsequent analysis. It is therefore possible to identify the apparently "preferred" answer compared with the "correct answer."

Four "field" trials of computer-assisted self-assessment have been completed to date. In September 1979 four Apple systems were taken to the annual general meeting of the Association of Anaesthetists where 56 anaesthetists completed two programs, one on the management of endotoxic shock and the other on obstetric anaesthesia.⁷ In March 1980 a similar assessment was undertaken at the Annual Scientific Meeting for Junior Anaesthetists when 30 participants performed two programs, one on the management of burns with pulmonary complications and again the obstetric program was used. During March 1981, the system was taken to four district general hospitals in the west of Scotland. In this part of the trial 53 anaesthetists completed two programs—the obstetric anaesthetic case and one on managing a posttonsillectomy haemorrhage in a child with sickle-cell trait.

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During the Faculty of Anaesthetists' Annual Assembly for Regional Educational Advisers and Faculty Tutors held in July 1981 a fourth trial was undertaken because of the specialist educational interests of those attending the meeting. Sixty-three anaesthetists completed the same programs that had been used in the district general hospitals. At the three formal meetings where computer-assisted self-assessment was available, the number of participants was limited by the free time and number of microcomputers available.

In total, 202 anaesthetists have taken part in the trial. Participants used computer-assisted self-assessment singly to ensure privacy and were assured of complete anonymity before starting. They were allocated to various groups on the basis of age, educational background, and experience. These data were written on to computer files so that statistical analyses could be performed on the results. After completing computer-assisted self-assessment each participant was automatically given his individual score for each program and requested to complete a questionnaire about the technique.

All programs for handling participants' responses, calculating scores, performing statistical analysis of results, and presenting graphical display of results were written in BASIC.

Results

Thirteen of those who took part had previously used the self-assessment programmes and were excluded from the analyses. All other participants from the four separate trials have been included in the present report, distinguished only by their allocation to appropriate groups according to years in practice and post held. Only analysis of the obstetric program has been presented, and the results are shown in table I. The reason for this choice is that the principles

TABLE I—Analyses of performance in obstetric program

Participating group	% Score	No	SEM	p value
Practising 0-4 y (trainees)*	70.4	33	± 1.51	< 0.05
v practising 10-14 y	66.4	41	± 1.11	
v practising 20-24 y	65.2	22	± 1.25	< 0.02
v practising 25-29 y	65.2	12	± 1.23	< 0.05
v practising 30-34 y	61.6	14	± 2.94	< 0.01
v practising 35-39 y	61.4	7	± 5.96	< 0.05
Practising 15-19 y	68.3	21	± 1.15	< 0.02
v practising 30-34 y	61.6	14	± 2.94	
Trainees*	70.4	33	± 1.51	< 0.05
v consultants only	65.7	127	± 0.83	
v practising 20-24 y†	65.2	22	± 1.25	< 0.05
v practising 30-34 y†	61.6	14	± 2.94	< 0.01
v practising 35-39 y†	61.4	7	± 5.96	< 0.05

*Senior house officer and registrars.

†Includes consultants and associate specialists.

202 anaesthetists of all grades participated, of whom 13 who had previously performed the self-assessment were excluded.

of obstetric anaesthesia are central to good anaesthetic practice in the widest sense and, in addition, there is a great deal of concern regarding the possible contribution of anaesthesia to morbidity and mortality. Moreover, all participants were asked if obstetric anaesthesia was one of their special interests. There were 13 in this group, but no statistical difference in scores was found between specialists and non-specialists in this respect. The most striking comparisons were between anaesthetists who had practised for different periods.

The individual anaesthetist may wish to compare himself with the group whose years of experience match his own. When the mean value of each group was graphed against years practising anaesthesia an inverse relationship was found ($R = -0.95$, figure).

A principal aim of the study was to measure the acceptability of the method for self-assessment in anaesthesia. The results of the questionnaire are shown in table II. The participants at the two scientific meetings had selected themselves to undertake the assessment. The acceptability of the method was 93% at the senior meeting and 100% at the junior meeting. The faculty tutors and advisers were also self-selected, and their acceptability was 91%. Those who took part in the district general hospitals were, however, not self-selected, but the acceptability for this group was 96%.

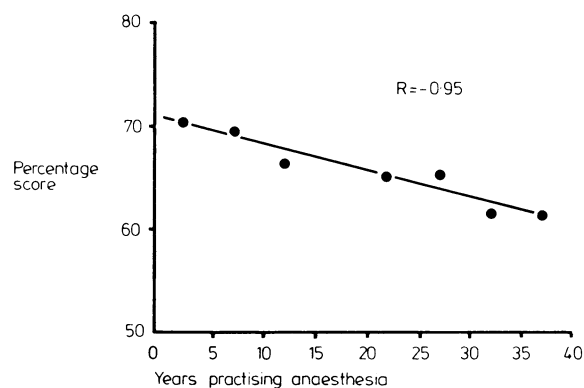
At the senior meeting one of the four video display units was defective, and the legibility of the text was not considered satisfactory by 31%. This would tend to verify that the responses to the questionnaire were a true indication of the opinions of the participants. When the defective video display unit was replaced at the junior meeting the legibility of the text was considered satisfactory by 100%.

TABLE II—Responses to subjective questionnaires: percentage of positive replies

Question	Senior meeting 49 consultants	Junior meeting	REAs and faculty tutors	District general hospitals
Do you find the presentation helpful/ unhelpful?	93	100	91	96
Is the scoring system for the obstetrics case acceptable/unacceptable? (3-point scale)	88	86	84	89
Is the scoring system for the second case acceptable/unacceptable? (5-point scale)	84	54	62	36
Is the feedback adequate/inadequate?	74	86	74	67
Is the legibility of the text on the video display unit satisfactory/unsatisfactory?	69	100	—*	—*

*Question not included in questionnaire.

REA = Regional educational adviser.



Mean percentage score in obstetric anaesthesia case/years practising anaesthesia.

Discussion

Shaw proposed that medical audit should be voluntary, objective, repeatable, and undertaken by clinical peers.⁸ It should also:

- assess adequately the level of knowledge of the participants;
- have some educational value;
- be acceptable to those who use it;
- allow easy retrieval of information on performance to permit analysis of results; and
- be easily used throughout the country at relatively low cost.

The purpose of this study was to assess the use of microcomputers for quality assurance to determine whether these criteria could be met by a relatively inexpensive computer system. It is easily moved and simple to operate, unlike large centralised computers. The programs have been designed to permit easy alteration and updating as new knowledge emerges.

There was an inverse correlation between years of experience in anaesthesia and scores obtained for the obstetric program. This might have been expected since the younger anaesthetists are studying for the fellowship examination or are engaged in research which particularly requires them to remain up to date with current advances. These pressures might have largely been removed from many older anaesthetists unless they are actively engaged in academic work or research. This is not to say that a high score in self-assessment programmes can be directly equated with clinical competence or vice versa, since anaesthesia is a practical specialty. The level of professional competence, however, must be related to some extent to theoretical knowledge. The obstetric program was selected since the concepts of obstetric anaesthesia are central to good anaesthetic practice.

Computers have been shown by several workers to have educational value that fulfils the second requirement stated

above. Ease of operation of the system would allow doctors to undertake self-assessment on an open access basis.

Computer-assisted self-assessment was well received both by those who were self-selected and by those who were not (table II). Most users enjoyed the programs and comments were volunteered such as "very enjoyable and helpful," "a salutary experience," and "not intimidating," although a few considered it to be "of uncertain benefit" and "of limited value." The programs were designed to simulate real clinical problems which the participants had to consider and evaluate before replying so that they became actively engaged in the self-assessment/teaching process. The scores for each question from each user could be rapidly retrieved and analysed, unlike printed programmed texts.

The method now requires a more extensive trial to determine how effectively it can be used throughout the country. The programs, however, have been sent by post to several other centres where they were used without direct guidance from us and the responses from such centres have been equally favourable.

Of the two scoring systems used, the simpler 1-3 scale was more popular, but the 1-5 scale may permit more discrimination when dealing with situations demanding clinical judgments, and there is no absolute correct answer.

In conclusion, computer-assisted self-assessment combines the function of continuing postgraduate education and quality assurance. It would appear to be able to differentiate between varying levels of knowledge. It was acceptable to most of the anaesthetists who took part, and information may be obtained and analysed readily. It may offer a possible solution to the requirements for a method of quality assurance in anaesthesia and in other specialties. The quality of the assessment programs is of major importance in determining this aspect of quality

assurance, and the mechanism for achieving acceptable standards of programs would be a matter for debate within the specialties concerned.

This work is supported by Department of Health and Social Security Grant No J/R125/1930CS(A)4. We are grateful to the dean and Board of Faculty of Anaesthetists of the Royal College of Surgeons of England for additional financial assistance and the opportunity to participate at the meeting of faculty tutors. We also thank all those who participated in the trials and Miss E H Polley and Miss D E McCorkindale for their secretarial help.

Requests for reprints should be addressed to Dr C Schmulian.

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(Accepted 1 December 1981)

Lesson of the Week

Bladder calcification after umbilical catheterisation

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We report on an infant with calcification of the bladder associated with the administration of sodium bicarbonate and calcium chloride through a misplaced umbilical catheter.

Case report

An infant boy sustained profound intrapartum asphyxia during a complicated vaginal delivery at term. He had persistent bradycardia despite intubation, ventilation, and cardiac massage, so an umbilical catheter was introduced without difficulty into the apparent lumen of the umbilical vein. Although blood

Infusion of sodium carbonate and calcium chloride through an umbilical catheter may cause calcification of the bladder

could not be withdrawn from the catheter, sodium bicarbonate (2.5 ml of a 1 mmol/ml solution), calcium chloride (1 ml of a 1 mmol/ml solution), and adrenaline (0.5 ml of a 1 : 1000 solution) were injected through the catheter as a life-saving measure. The heart rate gradually increased, and after 23 minutes he was extubated and the umbilical catheter removed. Apart from transient cerebral irritability, there were no obvious neurological sequelae when he was discharged on the 12th day.

He was readmitted at 25 days of age with a two-day history of vomiting and reluctance to feed. The results of physical examination were normal, but the plasma and urinary electrolyte concentrations showed that he was losing salt. Shortly after admission urine began to drain from his umbilicus and the urethral output was reduced to a dribble. A plain abdominal x-ray examination showed a ring of calcification corresponding

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