Editorial

EQUIPMENT COMPETENCY—WE MIGHT HAVE A PROBLEM

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In the 1992 Fall issue of the *APSF Newsletter,* a report by the APSF Committee on Education and Training addressed the question: Equipment competency—Do we have a problem? An earlier experiment conducted by the Food and Drug Administration had revealed that many anesthesiologists know less about their anesthesia machines than might be expected [1]. There are several possible reasons why clinicians might not know as much about their equipment as expected. For example, a clinician might have missed an "in-service" exercise about a new piece of equipment or instrument or, after attending an in-service, might not have used the equipment for many months. Then, confronted with the equipment during an emergency in the middle of the night, a clinician might not have been able to use it to its full advantage. Or, the clinician might not have received adequate instruction in the first place, either from the manufacturer's representative or from the institution's biomechanical technicians. Alternatively, the instruction manual supplied with the equipment might long since have been lost or misplaced, a particular problem for instruments whose designs do not invite intuitive operation. We assume that many of these factors operate at one time or the other with most clinicians and with many instruments. What to do about the problem?

The committee developed several recommendations; two are most relevant. First, we need to identify which features of a particular piece of equipment are not properly appreciated by clinicians who use the equipment. Second, we need to determine how much of the problem can be ameliorated by redesigning the human interface of the equipment, and how much of the problem must be laid at the doorstep of inadequate education, be this self-education or instruction by someone else. Toward this end, the committee offered a few simple steps, to wit: "To assess the magnitude of the problem, the manufacturers of anesthesia machines and ventilators or of certain monitors might prepare a simple questionnaire covering basic features of the equipment. Anesthesia providers might then test themselves (anonymously) to see whether or not they have an adequate grasp of key features of the equipment." The committee went on to suggest that the results from such a study might guide the manufacturers as well as the clinical educators.

In response to these suggestions, we decided to perform a pilot study with a ten-question quiz on the Nellcor N-200 Pulse Oximeter. A team of clinical specialists and engineers at the manufacturer's headquarters prepared 10 questions based on what the team considered were the most important attributes of the oximeter's

performance that clinical users should be aware of for patient safety.

The questionnaire, without editing on our part, was distributed without forewarning to the participants of a routine clinical conference of a large residency training program where many Nellcor pulse oximeters were in daily use. We informed the 55 anesthesiologists (15 faculty and 40 residents) who were present about the issues that had led to the preparation of the quiz and asked them to answer the questions as best they could, and not to sign the questionnaire.

The industry team that had prepared the questions almost decided against using them because the questions appeared too basic. The mixed quality of the answers, however, suggests otherwise (Table). While relatively few were overtly incorrect, many answers were only partially correct. Some of the incorrect answers were of more potential clinical consequence than others, while still others suggested a failure to read (or recall) the manual; the correct answers were well covered in the manual.

We must stress that we are reporting here the results of a pilot study, primarily to stimulate others to prepare similar questionnaires and collect additional information, and secondarily to discuss some of the lessons learned from this early effort. Regarding lessons learned, several questions might be raised.

Were the questions unambiguous and *relevant* to the clinical use of the equipment? The clinical reader might examine the questions not only for the answers, but also for whether a clinician should be expected to know the answers.

Did the questions actually address the *most important* information needed for proper use of the equipment? Were there essential questions that were omitted? The manufacturer of the equipment judged that these 10 questions were the most important questions to ask clinicians. We invite the reader to comment. If clinicians disagree with the manufacturer's assessment, in-

Questions, Multiple Choice Answers, and Correct Answer(s) (Indicated by Solid Square) about a Pulse Oximeter and Number of Subjects That Gave Each Answer

1. The oximeter has adjustable alarms for
   - ☐ A. High pulse rate
1 ☐ B. Low pulse rate
1 ☐ C. High oxygen saturation
1 ☐ D. Low oxygen saturation
52 ■ E. All of the above

2. When an alarm limit is violated
4 ☐ A. An audible alarm is activated
   ☐ B. A flashing display alerts the clinician
51 ■ C. Both A and B

3. The pulse beep tone
1 ☐ A. Is an indication that the oximeter has recognized a pulse
1 ☐ B. Has a **pitch** proportional to the current saturation reading
   ☐ C. Has **volume** proportional to the current saturation reading
53 ■ D. A and B
   ☐ E. A and C

4. The PULSE SEARCH indicator
9 ☐ A. Lights up whenever the monitor is on and measuring a patient's saturation
8 ☐ B. Indicates that a patient's pulse is too faint to provide reliable readings
   ☐ C. Lights up when the sensor is removed from a patient
38 ■ D. B and C

5. The default low-saturation alarm limit for adults is
2 ☐ A. 95%
26 ☐ B. 90%
2 ☐ C. 88%
21 ■ D. 85%
   ☐ E. 82%
4 ☐ F. 80%

6. The oximeter can compensate for significant amounts of carboxyhemoglobin in the patient's blood (e.g., in smoke inhalation patients).
5 ☐ A. True
50 ■ B. False

7. The adult/neonate switch on the back of the monitor*
10 ☐ A. Changes internal monitoring parameters to adult or fetal hemoglobin
19 ■ B. Changes default alarm limits only
5 ☐ C. Changes hemoglobin parameters and default alarm limits
20 ☐ D. None of the above

8. The different operating modes*
20 ☐ A. Change the averaging times used in calculating oxygen saturation
1 ☐ B. May be useful under different levels of patient activity
32 ■ C. Both A and B

9. The alarm limits can be changed by
2 ☐ A. Repeatedly pressing the appropriate alarm button, until the desired alarm limit value is displayed
   ☐ B. Disconnecting an adult sensor and connecting a neonatal sensor to the monitor
53 ■ C. Touching the appropriate alarm button and rotating the knob until the desired alarm limit value is displayed
   ☐ D. None of the above

10. The pulse amplitude bar
3 ☐ A. Provides a qualitative indication of pulse strength
23 ☐ B. Is a qualitative indicator of signal quality
27 ■ C. Both of the above
2 ☐ D. None of the above

*Because some subjects did not answer questions 7 and 8, the total number of responses does not equal 55.

dustry needs to know where to place more or less emphasis. Such information could powerfully affect the design of the machine–human interface of the equipment. It could also strongly influence the quality of the manuals that accompany each unit.

Do users need to know by heart information that could be easily obtained from the instrument—for example, alarm limits? Perhaps users need not know if they are in the habit of determining the default alarm values before every case, or if they are setting alarm limits as appropriate for every case. Users who set the alarm limits regularly might not know default values. We are under the impression, however, that many clinicians do not set alarms and do not check default values.

Is it meaningful to request a clinician not in daily contact with a monitor to answer correctly any question regarding that monitor? If, unexpectedly, the clinician might be confronted with the instrument during an emergency, we submit that the patient would have the right to assume that the clinician had the expertise to operate the instrument with confidence. And here we come to the issue of relevance. Do the questions address essentials of great clinical importance? If yes, the user should know the answers, or the instrument should readily make them available so that even the occasional user would be able to operate the system safely, if not to its full potential.

What difference does it make if clinicians cannot answer all the posed questions about a pulse oximeter and yet use the instrument to derive some—apparently useful—clinical information? We cannot answer that question and do not know how to obtain an answer.

Does the number of (partially or wholly) incorrect answers ultimately indicate an educational failure of clinicians either by the institution or by the manufacturer's representatives? Or is there simply a failure of the clinicians to learn or remember what they have previously learned? Once again, the relevancy of the questions to clinical practice (and particularly those elements that may have a bearing on patient safety) must be examined.

We have no evidence or reason to believe that knowing the correct answer affected anesthetic morbidity and mortality. Not knowing all the answers to the questions related to this instrument, therefore, appears to be of little clinical consequence. Should we, therefore, abandon attempts to improve the understanding of how our instruments operate? We think not. In general, we assume that experts master the tools of their trade. If they don't, we suggest that the design of the tools (and their accompanying manuals), as well as the education of the clinical user, should be examined, particularly where misuse of the tools might compromise patient safety.

In summary, we are presenting a challenge to the partnership of clinical medicine and industry. We are inviting other manufacturers to prepare similar questionnaires covering what they think are the most important features of their instruments. Questionnaires should be brief (no more than 10 to 12 questions). We believe that these efforts can help manufacturers in the design of their equipment and can assist clinicians in using the equipment to the best advantage of the patient.

REFERENCE

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