THE SLAM EMERGENCY FLOWCHART: A NEW GUIDE FOR ADVANCED AIRWAY PRACTITIONERS

To the editor:

In the December 2004 issue of the AANA Journal, Rich et al1 provide a useful guide for emergency and difficult airway management. The authors define the hypoxemia threshold as an SpO2 of 90% and state, “pulse oximeters have an inherent accuracy of ± 2%.” They encourage “rescuers to maintain an SpO2 of 92% based on calibration and volunteer nomograms.”2 The accuracy of pulse oximeters is referenced as “± 2% over the range of 85% to 100%.” This ± 2% seems to be the rationale for Mason’s PU-92 concept.

Which pulse oximeter and what sensors were used in the development of these guidelines? I raise this question since pulse oximeters from different manufacturers have different accuracy specifications. Accuracy requirements for pulse oximeters are developed by technical committees in the United States (American Society for Testing and Materials or ASTM) and internationally (International Standards Organization or ISO). ISO 9919 states, “The SpO2 accuracy of pulse oximeter equipment shall be a root-mean-square difference of less than or equal to 4.0% SpO2 over the range of 70%-100% SpO2.”3 A root-mean-square (RMS) difference of 4% means that approximately two thirds of observations of SpO2 among the population will fall within ± 4% of the SaO2, with the remaining one third outside this range.4 In the one third outside the range, half of these will be above and half below the range (ie, about one sixth greater than +4% and one sixth less than −4% of the SaO2).

For a system specified with RMS accuracy of ± 2%, 1 SD, 68% of the observations will fall within ± 2%; 95% within ± 4%; and 99.7% within ± 6%, following approximately the behavior of a normal distribution (written communication with Paul Mannheimer, PhD, Technical Fellow/Principal Scientist, Nellcor/Tyco Healthcare). It is important to recognize that ± 2% does not refer to the maximum error of the SpO2 value, but rather the value that encompasses 68% of the population (written communication with Paul Mannheimer, PhD). Manufacturers publish this information in the specifications and accompanying documents since ASTM standards for pulse oximeters require disclosure. “The accuracy and the range of hemoglobin saturation with oxygen over which the accuracy of the pulse oximeter is claimed shall be disclosed.”†

While some pulse oximeters have an accuracy of ± 2% over the range of 85% to 100%, care should be taken in assuming that all have that degree of accuracy. If the pulse oximeter used for the SLAM Emergency Flowchart has an accuracy of ± 2% over the range of 85% to 100%, striving for an SpO2 of 92% is meaningful for the 84% of the population that indeed has an SaO2 of 90% or greater. However, achieving an SpO2 of 92% may not correct hypoxemia in the remaining 16% of the population with true arterial saturations below 90%. A set point of 94% would ensure, in this example, that all but 5% of the population is maintained above 90% SaO2.

In a pulse oximeter with accuracy specifications of ± 3% or ± 4%, would Mason’s PU-92 concept change to PU-93 and PU-94 respectively? In a less accurate pulse oximeter, the PU-92 concept would fail to identify patients needing intervention to approximate an SaO2 of 90%. It is important that all operators of pulse oximeters understand the limitations of the monitors used to diagnose and treat hypoxemia. Explanation of and compensation for these accuracy limitations could strengthen the SLAM Emergency Flowchart and provide a greater margin of safety for patients.

REFERENCES


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Response:

We thank Carolyn Holland, CRNA, MSN, for her detailed analysis on the accuracy of pulse oximeters. This is a very erudite report, and we welcome her contributions to the discussion on the PU-92 concept. She is absolutely correct in emphasizing that all operators of pulse oximeters should understand the limitations of these monitors. However, she is mistaken in suggesting that we define the hypoxemia threshold as “an SpO2 of 90%,” since we were careful to state that this threshold is reached when the SaO2 (rather than SpO2) falls to 90%. She continues by saying that we encourage rescuers to maintain an SpO2 of 92%, when we actually recommended that the SpO2 be maintained at a level > 92%. These subtle yet critical elements concerning PU-92 and the need to maintain an SpO2 > 92% during airway management are reinforced in a revised version of the flowchart.2,3
Dr Mason selected an oximetry reading of 92%, and this was included in the SLAM Emergency Airway Flowchart, as we considered that this would capture the majority of patients who were in danger of significant hypoxemia requiring an immediate change in therapeutic approach. We accept that there may be some patients whose hypoxemia is missed by setting the SpO₂ threshold at 92%, but algorithms cannot, by their very nature, be all-encompassing and need to be interpreted, applied, and modified according to individual patient assessment and good clinical judgment.

It also is important to appreciate that the SpO₂ reading is only 1 element of the PU-92 concept, and its significance is that it challenges the commonly held belief that hypoxemia is not a problem until oximetry readings fall to 90%. Professor Holland’s letter has helped to clarify the science underpinning the PU-92 concept, and we thank her for this.

REFERENCES