

# Pulse Oximeter Accuracy

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- Messages sorted by: [ date ] [ thread ] [ subject ] [ author ]
- Next message: [MKauff2556@aol.com](mailto:MKauff2556@aol.com): "PM frequency"
- Previous message: Hilary Bridel: "Biomed-Jobs-NSW"

For years it has been standard practice at our hospital to combine Nellcor N-25 paediatric finger probes or DS-100A reusable adult finger probes with Nonin 8500 pulse oximeters. While considered safe because of a lack of negative experiences to the contrary, no data exists to support the practice. Anecdotal information suggests that SpO2 measurements using this combination may differ by as much as 2% when compared to the Nellcor probe used with a Nellcor pulse oximeter. Is this "inaccuracy" relevant or is it inconsequential given the errors inherent in the technique?

In reviewing the literature, we came across the following paper dealing with pulse oximetry. Sections of the paper which we consider important to the present discussion have been reproduced below. Please refer to the Canadian Medical Association Journal 1996; 146: 703-712 Noninvasive blood gas monitoring: a review for use in the adult critical care unit.

The entire paper can be found at the following CMA website:

<http://www.cma.ca/journals/cmaj/vol-146/0703e.htm>

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Noninvasive blood gas monitoring: a review for use in the adult critical care unit

Technology Subcommittee of the Working Group on Critical Care, Ontario Ministry of Health

Canadian Medical Association Journal 1996; 146: 703-712

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## Abstract:

**Objective:** To evaluate the accuracy, reliability, clinical effectiveness and economic impact of bedside pulse oximetry and capnometry as used routinely in the adult critical care environment.

**Data sources:** The key words "oximetry," "carbon dioxide/analysis" and "evaluation studies" were used to search MEDLINE for all relevant articles published from January 1985 to January 1991.

**Study selection:** Articles were included for review if they were original research studies designed to clinically evaluate pulse oximetry or capnometry, or both, were published in English and described a critically

<http://www.nor.com.au/lists/BmElist/0599.html>

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ill adult population. Eleven articles met these criteria; seven evaluated pulse oximetry, three evaluated capnometry and one evaluated both. Data extraction: The data were evaluated by means of five validity criteria: study setting and subjects, diagnostic accuracy, reliability, clinical effectiveness and economic impact.

Results: No study satisfied all our criteria. Most of the studies were designed to evaluate diagnostic accuracy only, and clinically relevant information was lacking. The accuracy of pulse oximetry was clinically acceptable in five of the eight studies. However, in two of them physiologic extremes, skin pigmentation and an arterial saturation of less than 90% resulted in unacceptable error. The diagnostic accuracy of capnometry was unacceptable.

Conclusions: Pulse oximetry may expedite accurate and continuous monitoring of oxygenation at the bedside of the critically ill adult patient.

Nevertheless, there are clinical limitations, and caution is needed before oximeters are accepted for routine use. The routine bedside use of capnometry should be discouraged.

### Summary

Pulse oximetry is widely used in clinical situations in which rapid, continuous monitoring of arterial saturation is important. Its ease of use, portability and noninvasiveness are other attractive features. It is clear why the use of the pulse oximeter has extended into the critical care environment. However, a thorough evaluation of its ability not only to provide accurate information but also to improve patient care and disease outcome is required before widespread dissemination is recommended. Such studies are seriously lacking. If pulse oximetry is to become routine at the bedside of critically ill patients whose oxygen levels are precarious, then proper clinical trials will be necessary to document the advantages over the present monitoring approach (intermittent ABG determinations).

The studies reviewed confirm the manufacturers' specifications that the precision of pulse oximeters is within  $\pm 2\%$  to  $\pm 3\%$  when the  $\text{SaO}_2$  is 90% or more; the precision is thus  $\pm 4\%$  to  $\pm 6\%$  if a 95% confidence interval ( $\pm 2$  SD) is desired. For example, if the  $\text{SpO}_2$  is 94%, then the true  $\text{SaO}_2$  may be as low as 88% or as high as 100% for 95% of the measurements. This translates into a wide range of  $\text{PaO}_2$  values. Adequate arterial oxygenation will result if a target  $\text{SpO}_2$  of 92% or more is achieved in white patients and 95% or more in black patients[19].

Pulse oximetry may fail to record accurately the true  $\text{SaO}_2$  during severe or rapidly produced desaturation and during physiologic extremes (e.g., hypotension, hypothermia, unstable hemodynamic factors and agitation). More information is required concerning the prevalence of signal failure with the regular use of pulse oximetry and the effect this has on nursing and medical care (e.g., Does frequent signal failure lead to greater demands on nurses to reposition the probe and to frequent, annoying alarms?).

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Paying particular attention to the second paragraph, does this mean that the "intrinsic" error of pulse oximetry overshadows the introduced "accuracy error" of the Nellcor/Nonin combination, making any error due to the combination irrelevant and therefore the combination acceptable?

Being unsure of how to interpret this information, we would appreciate some advice on this issue. Our thanks in advance.

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