

Clinical impact of the oximeters' inaccuracy (bias and errors) – secondary analysis of the OXYGAP study

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Introduction: Pulse oximetry is daily used worldwide to measure SpO₂ in order to monitor and titrate oxygen support. We previously showed that four among the most frequently used oximeters have significant bias (systematic errors from -3% to +1%) and inaccuracy (random error) in comparison with the gold standard SaO₂. The main objective of this study was to highlight the impact of the oximeters' variability on monitoring and clinical decisions in acutely ill patients.

Methodology: We prospectively included 210 stable ICU patients with an arterial catheter in place. For all included patients, we compared SpO₂ values for each of the four evaluated oximeters (Nonin, Nellcor, Massimo and Philips) and concomitant PaO₂ and SaO₂ values from the arterial blood gases. When the patients met the criteria for hypoxemia (SaO₂ < 90% or PaO₂ < 60 mmHg), we evaluated which oximeter could detect hypoxemia (SpO₂ < 90%). For each measurement, we evaluated for each oximeter when the oxygen support should be maintained even, increased or decreased to maintain a SpO₂ value between 92 and 96%.

Results: Mean age of the patients was 66.3 year, 73% were men, skin pigmentation was light (Fitzpatrick 1 or 2 in 96.2% of the patients). The SpO₂-SaO₂ bias went from -3.1% (Nonin), to +0.9% (Philips) (P<0.001). With Nellcor and Masimo, bias were -0.3 (P<0.03) and -0.2% (P=0.17) respectively. Nonin oximeter underestimated arterial oxygenation in 91% of the cases but detected 100% of hypoxemia defined by PaO₂<60 mmHg. Philips overestimated oxygenation in 55% of the cases but detected 11% of episodes of hypoxemia. Based on the oximeter used, the management of oxygen support to maintain the patients within a SpO₂ target of 92-96% differed a lot. To keep the patients within this SpO₂ target, in the cohort of 210 patients, it would be required to increase oxygen in 60.6% vs. 19.1% vs. 18.7% vs. 10.4% and to decrease oxygen in 1.0% vs. 6.2% vs. 9.1% vs. 20.9% of the cases (p<0.0001) when using Nonin, Nellcor, Masimo or Philips oximeter respectively (see Figure).

Conclusion: The variability of SpO₂ measurements between oximeters has a significant impact for the monitoring and management of oxygen support. The bias of each oximeters should be known by clinicians and SpO₂ targets should be adapted to the oximeter brand used by clinicians.

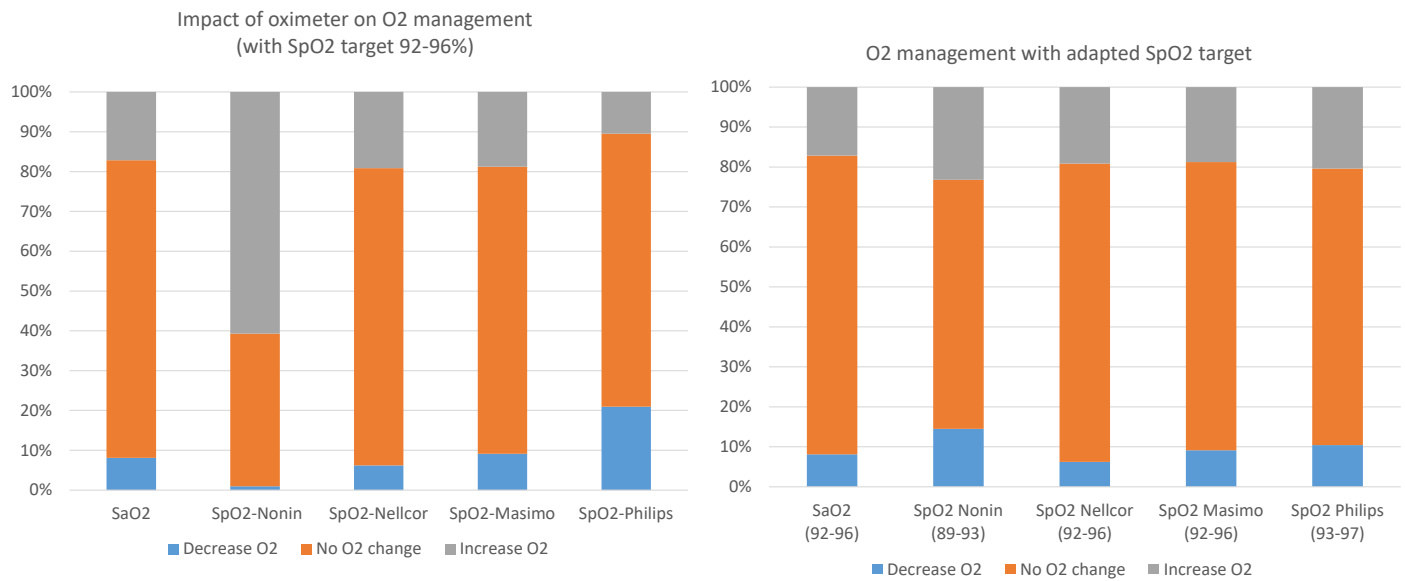


Figure: impact of oximeter on oxygen management to maintain a SpO₂ target between 92 and 96% (left panel) and impact with adapted SpO₂ target to the oximeter (right panel). If the SpO₂ target is not adapted to the oximeter, the management of oxygen support may vary a lot within the same cohort of patients (left panel).