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**FAILURE RATES OF TRANSMISSION AND REFLECTANCE PULSE  
OXIMETRY FOR VARIOUS SENSOR SITES**

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The pulse oximeter is now a minimum standard of monitoring in the operating room. Pulse oximeters fail to measure an SpO<sub>2</sub> value whenever their signal to noise ratio falls below preset limits. Such failures are common during hypotension, hypothermia, or extremes of systemic vascular resistance. A recent study reported an overall operating room failure rate of 1.24% using a finger sensor oximeter [1]. Patients of higher ASA physical status and veterans hospital patients exhibited higher failure rates. We report the first study in which pulse oximeter failure rates in surgical patients are determined as functions of sensor type and site. We compare transmission and reflectance pulse oximeter sensors located on the finger, earlobe, nose, and forehead.

Twenty-four patients undergoing surgery under general or regional anesthesia participated in this study. Sixteen of these were ASA physical status I or II. Pulse oximeters and sites compared included Nellcor N-200 finger and nasal sensors, Novamatrix model 500 finger and earlobe sensors, Ohmeda 3700 earlobe sensor, Marquette finger sensor, and Ciba-Corning model 310 reflectance pulse oximeter finger and forehead sensors. Data were recorded from each instrument at 5-minute intervals throughout surgery. A pulse oximeter failure for a single data point was defined as any of the following: no SpO<sub>2</sub> value displayed, "low perfusion" or other error message, pulse rate more than 10% different from electrocardiographic rate during sinus rhythm, or SpO<sub>2</sub> value differing by more than 8% from the average of all other SpO<sub>2</sub> values. For each patient and each pulse oximeter, the number of pulse oximeter failures as a percentage of the total number of readings was recorded. The significances of differences in failure rates were calculated by Student's *t*-test.

The Table shows the mean and between-patient standard deviation values of the failure rate for each of the eight pulse oximeter-sensor combinations. There were no significant differences in failure rates between general and regional anesthesia. The failure rates of the Nellcor and Novamatrix finger sensors (1.34% and 1.36%, respectively) are consistent with previous results [1]. The Ohmeda earlobe sensor (5.8% failure) had a much lower failure rate than the Novamatrix earlobe (52%). Finally, the Ciba-Corning reflectance pulse oximeter had failure rates of 27% on the finger and 59% on the forehead.

Failure rates of commercially available pulse oximeters vary greatly between manufacturer and sensor location. These preliminary results suggest that finger sensors (Nellcor, Novamatrix) yield the lowest failure rates in the average surgical setting, and these failure rates are on the order of 1% to 2%. Earlobe sensors are more variable and, in some cases, unacceptable (i.e., a 52% failure rate). The reflectance pulse oximeter appears to need further improvement in signal to noise ratio before it is adopted as a routine operating room monitor, particularly for the forehead location.

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**REFERENCE**

1. Overand PT, Freund PR, et al. Failure rate of pulse oximetry in clinical practice. *Anesth Analg* 1990;70:S289