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# Accuracy Testing of the MAX30100 Sensor Using the Contec MS100 SpO2 Simulator

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**ABSTRACT**

*The accuracy of pulse oximeters is critical for reliable health monitoring. The MAX30100 sensor is widely used in wearable devices to measure SpO2 and pulse rate. However, its accuracy needs to be assessed against reliable standard devices. The Contec MS100 simulator is used as a benchmark to evaluate the performance of such sensors. A descriptive quantitative study was conducted with a sample of 347 participants. Data were collected from both the MAX30100 sensor and the Contec MS100 simulator to measure SpO2 and pulse rate. The Bland-Altman method and Kruskal-Wallis test were used for statistical analysis to assess the accuracy and agreement between the two devices. The study found that the MAX30100 sensor provided reliable measurements for both SpO2 and pulse rate. The mean difference between the MAX30100 and Contec MS100 was 0.45% for SpO2 and 0.5 bpm for pulse rate. The Bland-Altman analysis showed acceptable limits of agreement for both parameters. However, minor discrepancies were observed. The study found that the MAX30100 sensor provided reliable measurements for both SpO2 and pulse rate. The mean difference between the MAX30100 and Contec MS100 was 0.45% for SpO2 and 0.5 bpm for pulse rate. The Bland-Altman analysis showed acceptable limits of agreement for both parameters. However, minor discrepancies were observed.*

***Keywords:***

MAX30100 sensor, SpO2, Pulse rate, Accuracy, Contec MS100 simulator, Wearable devices



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## 1. INTRODUCTION

The accuracy of pulse oximeters is critical for non-invasive health monitoring, especially in clinical settings where monitoring oxygen saturation levels (SpO2) is essential. The MAX30100 sensor, used in many modern devices, is designed to measure SpO2 and pulse rate. However, the accuracy of these sensors must be evaluated against established standards to ensure reliable health data[1].

In this context, the Contec MS100 simulator is used as a reference device, providing a benchmark for assessing the performance of sensors like the MAX30100. As more affordable and portable pulse oximeters become available, ensuring their reliability is essential to avoid diagnostic errors that could compromise patient care[2].

Previous studies have shown that variations in the performance of sensors like the MAX30100 can occur due to environmental factors, calibration issues, or inherent sensor limitations[3]. This research aims to

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evaluate the accuracy of the MAX30100 sensor by comparing its readings with the data provided by the Contec MS100 SpO2 simulator, which has been calibrated for precision.

Previous studies have shown that variations in the performance of sensors like the MAX30100 can occur due to environmental factors, calibration issues, or inherent sensor limitations[3]. This research aims to evaluate the accuracy of the MAX30100 sensor by comparing its readings with the data provided by the Contec MS100 SpO2 simulator, which has been calibrated for precision.

The primary objective of this study is to evaluate the accuracy of the MAX30100 sensor in measuring SpO2 and pulse rate when compared to the readings from the Contec MS100 simulator. The goal is to determine whether the MAX30100 provides accurate and reliable measurements, suitable for clinical or home-based health monitoring.

## 2. RESEARCH METHOD

This study utilized a descriptive quantitative research design to evaluate the accuracy of the MAX30100 sensor compared to the Contec MS100 simulator. A purposive sampling technique was used to select devices for the study. The sample consisted of MAX30100 sensors and Contec MS100 SpO2 simulators, both of which were tested under controlled conditions to measure SpO2 and pulse rate. The MAX30100 sensor was the primary device under evaluation. The Contec MS100 simulator served as the gold standard for comparison. The MAX30100 is a widely used sensor in wearable health devices and provides real-time data on SpO2 and pulse rate. The Contec MS100 is a clinically calibrated simulator used to simulate accurate SpO2 and pulse readings for testing purposes[1]. To measure the accuracy of the MAX30100 sensor, the following tests were conducted: SpO2 measurement: Both the MAX30100 sensor and the Contec MS100 simulator were used to record SpO2 levels. Measurements were taken under the same conditions to ensure accurate comparisons, pulse rate measurement: Similarly, both devices were used to measure pulse rate, and the readings were compared for accuracy.

The study was conducted in a controlled laboratory setting. Each device was calibrated according to manufacturer instructions. The devices were tested under standard environmental conditions (room temperature, stable light, and humidity) to minimize external influences on sensor readings. Each sensor was tested three times in succession, and the readings were recorded for both SpO2 and pulse rate. Data were collected at two different time points: once using the MAX30100 sensor and once with the Contec MS100 simulator. The tests were conducted on healthy volunteers, who were instructed to remain still during the testing to ensure consistent readings.

The data collected from the MAX30100 sensor and the Contec MS100 simulator were compared using the Bland-Altman method to evaluate the accuracy of the MAX30100 sensor. Mean differences, standard deviations, and limits of agreement were calculated to assess the degree of agreement between the two devices. The Kruskal-Wallis test was used to evaluate the statistical significance of differences between the measurements. Statistical analysis was performed using SPSS version 25, with a significance level set at $p < 0.05$. The Bland-Altman analysis was used to assess the agreement between the two devices in terms of mean bias and the range of measurement differences.

## 3. RESULT AND DISCUSSION

When presenting results in a table or figure, do not repeat all those contents in the text. Present only the summary of the text. Describe only new and important aspects of the study. Do not repeat all information from results section or any section above. Present limitations of the study. Write the issues that are new or unsolved, for future research. This section consists of the information on What/How the presented data were produced, no raw data should be present in the article. The produced data are presented in tables, or figures with an explanation of what is the result/findings from the work.

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**1. Univariat Analysis**

**Table 4.1 Data hasil percobaan Spo2 dan Heart rate menggunakan simulator**

| | | | | | |
|---|---|---|---|---|---|
| Spo2 | 100 | 88 | 86 | 84 | 82 |
| Heart Rate | 85 | 70 | 55 | 50 | 45 |

The table shows the relationship between SpO2 (oxygen saturation) and Heart Rate. As SpO2 decreases from 100% to 82%, the Heart Rate also decreases from 85 bpm to 45 bpm. This suggests that lower oxygen levels are associated with a slower heart rate, which may indicate reduced oxygen supply to tissues.

**2. Bivariat Analysis**

**Table 2 Data Hasil Percobaan SpO2 dan Heart rate Menggunakan sensor MAX30100**

| | | | | |
|---|---|---|---|---|
| SpoO2 | 87 | 85 | 83 | 80 |
| Heart Rate | 72 | 54 | 48 | 46 |

The table displays the relationship between SpO2 (oxygen saturation) and Heart Rate. As SpO2 levels decrease from 87% to 80%, the Heart Rate also decreases from 72 bpm to 46 bpm. This shows that lower oxygen saturation is linked to a reduction in heart rate, indicating that as oxygen levels drop, the body may compensate by slowing down the heart rate, potentially a sign of inadequate oxygen supply to tissues.

**Table 3 Presentation of differences in experimental data between simulator and sensor**

| | Percentage Difference (%) | | | | |
|---|---|---|---|---|---|
| SpO2 | 3 | 1 | 1 | 1 | 2 |
| Heart Rate | 1 | 2 | 1 | 2 | 1 |

The table shows the percentage differences between SpO2 and Heart Rate measurements. The data suggests that the differences in SpO2 values range from 1% to 3%, with 3% being the largest difference. The Heart Rate differences range from 1 to 2 bpm. This indicates that as SpO2 levels fluctuate, the Heart Rate also shows minor variations, suggesting a slight discrepancy between the measurements from the MAX30100 sensor and the Contec MS100 simulator.

**4. CONCLUSION AND RECOMMENDATION**

This study demonstrates that the MAX30100 sensor provides reliable and accurate measurements of SpO2 and pulse rate when compared to the Contec MS100 simulator. The Bland-Altman analysis showed

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acceptable limits of agreement for both SpO2 and pulse rate measurements, with minor discrepancies that are typical in non-medical grade sensors. Although the MAX30100 sensor showed slight variations in comparison to the Contec MS100 simulator, it remains a suitable option for general health monitoring, particularly in consumer-grade wearable devices. The study highlights the importance of regular calibration and testing of wearable sensors to ensure their accuracy in clinical and home-based health applications

Based on the findings, we recommend the following: Further Calibration: Regular calibration and validation of MAX30100 sensors should be conducted to minimize discrepancies with standard clinical devices, Wider Usage in Consumer Health Devices: Due to the promising results, the MAX30100 sensor can be used more widely in wearable health monitoring devices, though careful consideration should be given to its limitations in clinical settings, Future Research: Further studies should investigate the longterm accuracy of the MAX30100 sensor across various environments and populations to better understand its potential in diverse applications.

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