2025, Volume 2, Nr. 4 pp 57-72

FINGER VERSUS FOREHEAD PULSE OXIMETRY IN LITERATURE: A NARRATIVE REVIEW

Rita Citarella [1]*, Carmine Sammartino [2], Aniello Lanzuise [3], Marco Abagnale [4]

[1] Department of Surgery and Anesthesia, "Umberto I" Hospital of Nocera Inferiore", 84014, Salerno, Italy.

[2] Department of Kidney Transplantation, "San Giovanni di Dio e Ruggi d'Aragona" Hospital, 84131, Salerno, Italy.

[3] Corporate Health Management, "Ospedale dei Colli",80131, Napoli, Italy.

[4] Department of Critical Care, M. Scarlato Hospital, 84018, Scafati, Salerno, Italy.

* *Corresponding author:* Rita Citarella, Department of Surgery and Anesthesia at Umberto I Hospital of Nocera Inferiore, 84014 Salerno, Italy. E-mail: rita.citarella.91@gmail.com

Review article

DOI: 10.32549/OPI-NSC-120

Submitted: 12 April 2025

Revised: 15 May 2025

Accepted: 16 May 2025

Published online: 20 May 2025

ABSTRACT

Introduction: Pulse oximetry is a technology for monitoring oxygen saturation (SpO2) in various clinical settings. However, measurement of SpO2 value can have different accuracy depending on some factors such as the sensor placement (on the finger or on the head). This narrative review was conducted to synthetize the better evidence to compare finger and forehead pulse oximetry in patients requiring Sp02 monitoring, in order to identify which method was the most effective for nursing practice.

Objective: to describe the potential effectiveness of pulse oximetry saturation measurement using finger sensors versus forehead sensors, focusing exclusively on their reliability in various clinical conditions. This analysis aims to identify the most accurate method for SpO2 monitoring in nursing practice, particularly when addressing challenges related to peripheral perfusion and motion artifacts.

Materials and Methods: A narrative review was conducted through the PubMed and CINAHL databases, the selected articles had to answer the following research questions: "Which sensor placement, finger or forehead, is most effective for measuring oxygen saturation (SpO2) in patients with compromised peripheral perfusion?"; and "Between finger pulse oximetry and forehead pulse oximetry, which is considered the gold standard for accurate SpO2 measurement? "

Results: Four studies were selected. The selected studies show that forehead sensors provide more reliable and accurate measurements, especially under adverse conditions, due to their resistance to peripheral vasoconstriction and motion artifacts. Finger sensors, while widely used, exhibit limitations in physiologically stressful situations.

Conclusions: The finger pulse oximetry remains the standard in most scenarios, but forehead sensors may provide more reliable readings in critically ill patients with compromised peripheral perfusion.

Keywords: oxygen saturation, pulse oximetry, finger sensor, forehead sensor, digit sensor, narrative review.

INTRODUCTION

Pulse oximetry is often described as the fifth vital sign [1]; it represents a rapid, non-invasive method to measure peripheral capillary oxygen saturation (SpO2) in the blood by directing light of specific wavelengths through tissue, typically at the fingernail bed. The “SpO2” value provided by the pulse oximeter reflects the percentage of oxygenated hemoglobin in the blood. [2]. The “S” stands for saturation, “p” indicates that it is measured peripherally (rather than from arterial blood) and “O2” represents the oxygen. Deoxygenated and oxygenated hemoglobin absorb light differently, at wavelengths of 660 nm and 940 nm, respectively. The light absorption data is analyzed by a proprietary algorithm within the pulse oximeter to produce a saturation value [3]. This non-invasive technique, revolutionized patient monitoring by allowing continuous and immediate assessment of oxygenation status, which was previously possible only through invasive methods such as arterial blood gas analysis [4]. Fingernail and forehead are the most common application sites [5]. In this review, we focused our attention on the two most common application sites, finger and foreahead, in order to assess which of these two methods is better in terms of sensibility (also in patients under impaired clinical conditions). The decision to focus exclusively on finger and forehead sites for oxygen saturation monitoring was driven by their proven reliability in both routine and critically adverse conditions, as supported by existing evidence. These locations were selected based on their widespread use in clinical practice and their relevance to nursing competencies, ensuring standardized and effective monitoring for patients. Existing studies highlight that both finger and forehead sensors outperform other alternative sites such as the earlobe or chest. While earlobe pulse oximetry is sometimes used, it has not consistently demonstrated superior reliability compared to the finger or forehead in diverse clinical scenarios, limiting its integration into evidence-based nursing protocols. [6] Pulse oximeter probes typically consist of two light emitters and a detector, which either receives light transmitted through the tissue or detects light reflected from a site like the forehead [7]. These probes are available in disposable adhesive or reusable clip designs, catering to different clinical needs. At sea level, normal oxygen saturation ranges from 96% to 100%, while individuals living at higher altitudes may have slightly lower saturation levels due to reduced atmospheric oxygen [8]. Pulse oximeters are calibrated for saturation levels between 70% and 100%, with an accuracy of 2% to 4% [9]. It is important to note that various factors can influence pulse oximeter readings. For instance, colder temperatures may reduce accuracy; so, maintaining a temperature near 33°C (91.4°F) is recommended for reliable measurements. External factors (such as black or blue nail polish and artificial nails) can also interfere with readings. [10] If these obstructions cause inaccuracies, repositioning the sensor sideways on the finger bed has shown some success, though this placement falls outside the sensor's calibration parameters. However, measurement of SpO2 value can have different accuracy depending on some factors such as the sensor placement (on the finger or on the head). [11] Monitoring oxygen saturation requires precision, and nursing professionals are extensively trained to apply and interpret results from sensors placed on the finger and forehead [12]. These sites allow for continuous assessment while ensuring patient comfort and minimizing interference during routine care activities. The inclusion of additional sites could lead to inconsistencies in application and monitoring outcomes, complicating care delivery without providing significant advantages [13]. By focusing on finger and forehead sites, the review aligns with clinical guidelines and promotes uniformity in practice, facilitating clearer communication and collaboration among healthcare teams.

PURPOSE

The purpose of this narrative review was to describe the potential effectiveness of pulse oximetry saturation measurement using finger sensors versus forehead sensors, focusing exclusively on their reliability in various clinical conditions. This analysis aims to identify the most accurate method for SpO2 monitoring in nursing practice, particularly when addressing challenges related to peripheral perfusion and motion artifacts.

MATERIALS AND METHODS

A comprehensive bibliographic search was conducted on PubMed (via MEDLINE), CINAHL (via EBSCO), in April 2024

Search strategy and keywords used

A narrative review of the literature [14] was conducted following the methodology reported in the 'Scale for the Assessment of Narrative Review Articles' (SANRA) [15]. The following research question was formulated:

1. Which sensor, on the finger or forehead, is more reliable and accurate for measuring oxygen saturation (SpO2) in patients with compromised peripheral perfusion?";

To conduct the literature search, a research question was previously outlined using the P.I.C.O. framework, which stands for population, intervention, comparison and outcomes (Table 1).

POPULATION	PATIENTS REQUIRING SPO2 SATURATION MONITORING
INTERVENTION	FINGER PULSE OXIMETRY
COMPARISON	SENSORS FOREHEAD PULSE OXIMETRY
OUTCOME	ACCURACY AND RELIABILITY OF SpO2 READINGS

Table 1. *The PICO methodology assessment*

The search strategy included combinations and synonyms of free text and MESH (medical subject headings) terms, using the Boolean operators "AND" and "OR" to interconnect the following keywords: oxygen saturation, pulse oximetry, finger sensor, forehead sensor, digit sensor, SpO2 accuracy, low peripheral perfusion conditions. To identify additional studies, we also examined the reference lists of retrieved articles.

Inclusion and Exclusion criteria

Studies that responded to the hypotheses of bibliographic research were considered. Primary studies, systematic reviews and guidelines were included. The inclusion criteria used for the selection of articles were: 1) human population including both males and females, 2) studies in English language, 3) available abstract and 4) publications of the last 10 years. Articles of national and international scientific literature whose title and content contained at least one of the keywords or a link to them are included. All those quotes for which it was not possible to find the written "full text" version were excluded. The results obtained were analyzed by C.R and A.M. independently, by title and abstract, to identify relevant articles. The selected studies were found in full text format, read critically and the relevant ones were included in the review.

RESULTS

The bibliographic search revealed 72 references, of which 22 in CINAHL Complete and 50 in PubMed. Two references were excluded at the beginning because they were double. After a selection by reading the title and abstract, 54 articles were excluded,. The main reasons for exclusion included: lack of relevance to the research questions (for example studies not comparing finger vs forehead sensor), use of pediatric or animal populations, absence of full text, publication date older than 10 years, and articles not written in English. The articles initially included were 16 full text articles. The results were analyzed by C.R. and A.M. independently and read critically; of the 16 remaining papers 4 were included, respectively: 3 articles in PubMed and 1 article in CINAHL Complete. After full-text reading, 12 articles were excluded for the following reasons: 6 did not meet the inclusion criteria regarding a direct comparison between finger and forehead sensors or did not report clinically relevant data on SpO_2 accuracy or reliability;3 used outdated technologies not aligned with current clinical standards; 2 lacked the quantitative data necessary for outcome analysis; and 1 was a narrative review without original research data.

Selected studies

The following table reports the included studies, describing their features: year of publication, name of authors, aim, methodology, study sample, their results and outcome measures (Table 2); 4 articles were identified, published between 2015 and 2025, with different methodology as follows: one prospective study and three observational studies.

YEAR	AUTHORS	AIM	STUDY DESIGN	SAMPLE	RESULTS	OUTCOME MEASURES
2018 [16]	Seifi S. et al.	To Determine which placement of pulse oximetry sensors (finger, forehead, ear or toe) provides the most accurate measurements vs ABG to in intensive care unit patients.	Prospective observational study	50 pts admitted to the intensive care unit following coronary artery bypass surgery.	FoSpo02 was the ↑. Finger and toe sensors showed > variability, especially in case of low peripheral perfusion conditions.	Accuracy vs ABG, variability
2020 [17]	Kelly KL et al.	To compare performance of pulse oximetry sensors on the finger and forehead during MXT in patients with heart failure.	Observational study.	40 pts	FoSpo02 ↑ during intense exercise.	Reliable, signal stability, response time
2022 [18]	Robertson L et al.	To assess the accuracy, reliability and signal quality of pulse oximetry sensor placed on the forehead and finger during the 6-MWT, using CBG as the clinical reference.	Observational study.	80 pts with pulmonary vascular disease.	FoSp02 is ↑ to the FiSp02. However, both sensors showed < accuracy in patients with significant desaturation (< 80% SpO2).	Signal quality, reliable, accuracy vs CBG , sensor riability
2024 [19]	Lynggaard A. et al	To evaluate the reliability of SpO2 measurements from sensors placed on the finger, forehead, and ear during the 6-MWT in patients with systemic sclerosis.	Observational study.	82 pts	FoSp02 is ↑ to the FiSp02. FoSp02 showed < accuracy in patients with vascular complications	Signal quality, accuracy, reliable

Table Legend: pts= patients, FiSp02= finger sensor, FoSpo02= forehead sensor, ABG= arterial blood gas, > = major, < = minor, CBG= capillary blood gas, ↑= more reliable, 6-MWT=6- Minute Walking Test, MXT= maximal exercise testing

Table 2. *Analysis of selected studies*

The first study, conducted in Iran [16], compared four sensor placements using arterial blood gas as a reference. The results showed that the forehead sensor had the highest accuracy, particularly in patients with low peripheral perfusion, while finger ant toe sensors showed greater variability. The second study, conducted in the United Kingdom [17], assessed signal stability and response during maximal exercise in heart failure patients. It found that the forehead sensor provided more reliable readings, whereas the finger sensor tended to underestimate Sp02. The third study, from the Usa [18], involved patients with pulmonary vascular disease undergoing the 6- minute walk test. The study evaluated signal quality, accuracy vs capillary blood gas, and sensor reliability during desaturation episodes. The forehead sensor showed better signal consistency, although with a slight overestimation of Sp02, values below 80%. The fourth study, form Denmark [19], examined patients with systematic sclerosis. It compared sensor placements in terms of error rate, signal dropouts, and inter -device agreement, showing the forehead sensor, outperformed the finger sensor, especially in patients with vascular complications.

Study description

According to Seifi's study [16] comparing the different methods the forehead sensor was most accurate than the finger. Attention must be focused on low peripheral perfusion conditions; in effect, in these cases, finger and toe sensors showed higher variability, providing results that didn't reflect the real life. This study [16], being prospective in design, provides a relevant contribution to the literature; probably, however, a larger sample could yield more robust results. For reason, other authors, such as Kelly Kl et al. [17], decided to assess the impact of the use of forehead sensor in some particular condition such as intense exercise; in this case, according to their results, the forehead sensor showed higher reliability. Furthermore, as shown by Robertson's study [18], compared to finger sensor, the forehead sensor showed more reliable signal quality. The limit of this last study is its observational nature, although the sample is to be noted enrolling 80 patients. The problem arises in patients with vascular complications: in these cases, compared to forehead sensor, the finger sensor showed poor accuracy [19].

DISCUSSION

The purpose of this narrative review was to describe the potential effectiveness of pulse oximetry saturation measurement using finger sensors versus forehead sensors, focusing exclusively on their reliability in various clinical conditions. This analysis aims to identify the most accurate method for SpO2 monitoring in nursing practice, particularly when addressing challenges related to peripheral perfusion and motion artifacts. Pulse oximetry is a critical tool in clinical practice; however, the accuracy of measurements can vary depending on some factors such as the sensor's placement, the patient's condition and motion of perfusion. The four studies analyzed provide a comprehensive overview of the differences between finger and forehead pulse oximeters in various clinical contexts, highlighting the strengths and limitations of each device. Below is a detailed comparison supported by the findings of these studies. The observational study by Seifi et al. [16], involving 67 post-coronary bypass patients, demonstrated that forehead sensors have superior accuracy compared to finger sensors, particularly in conditions of poor peripheral perfusion. Similarly, the validation study by Elkjær et al. [19], conducted on 82 patients with systemic sclerosis (SSc), found that forehead and earlobe sensors outperformed finger sensors. Forehead sensors, benefiting from better central perfusion, provided more reliable measurements in these settings. The clinical trial by Kelly et al. [17], involving 29 patients with heart failure and coronary artery disease, highlighted the superior reliability of forehead sensors during maximal exercise. Finger sensors underestimated SpO2 during peak exertion due to reduced peripheral perfusion. The clinical study by Robertson et al. [18], conducted on 80 patients with pulmonary vascular or interstitial lung diseases during the six-minute walk test (6MWT), also found forehead sensors more reliable, particularly during episodes of exercise-induced desaturation. However, the forehead sensor exhibited a slight bias compared to capillary blood gas (CBG) measurements, especially during deep desaturation. This reinforces the need for caution when interpreting extreme SpO2 values. All four studies highlight the limitations of finger pulse oximeters in conditions of poor peripheral perfusion, whether caused by critical illness, exercise or vascular disease. While finger sensors remain adequate for routine monitoring in stable patients, they underperform in situations requiring high accuracy. The forehead sensor consistently emerged as the most reliable alternative, particularly in: critically ill patients (Seifi et al. [16]), people undergoing physical exertion (Kelly et al. [17], Robertson et al. [18]) and patients with vascular conditions like systemic sclerosis (Elkjær et al. [19]). The studies involved different groups of patients and different clinical environments. These differences reflect the variety of clinical contexts and patient populations, providing a comprehensive perspective on the use of pulse oximeters in different conditions. However, despite these variations, the studies consistently agree that forehead sensors offer greater reliability than finger sensors in critical or dynamic conditions. Finally, the four studies address the research question as follows:

Research Question 1: Which sensor, on the finger or forehead, is more reliable and accurate for measuring oxygen saturation (SpO2) in patients with compromised peripheral perfusion?": All four studies indicate that the forehead sensor placement is more reliability in patients with compromised peripheral perfusion. This is due to the fact that peripheral sites, such as the fingers, often show reduced perfusion in critically ill patients, leading to inaccurate or delayed readings. In contrast, the forehead maintains a more stable blood flow under such conditions, allowing for more accurate and reliable SPO2 measurements. Therefore, the studies consistently support the use of forehead sensors in scenarios involving low peripheral perfusion while finger pulse oximetry is widely used in routine clinical settings. Forehead sensors demonstrate faster response times and more consistent readings, minimizing the likelihood of underestimation or signal loss. As a result, in critical care contexts or when peripheral perfusion is impaired, forehead pulse oximetry is regarded as the more reliability method and may be considered the preferred standard for SpO2 monitoring.

Before drawing final conclusions, it is necessary to consider the methodological limitations of the included studies. It is also important to highlight that the included studies present some methodological limitations. Small sample sizes, variability in study design (mostly observational), and inconsistent use of reference standards (not all studies included comparison with arterial blood gas analysis) may affect the reliability of the findings. Moreover, the diversity of patient populations reduces the generalizability of the results across broader clinical settings

Implications for clinical practice

The review suggests that forehead pulse oximeters are more reliable than finger pulse oximeters in clinical scenarios involving poor peripheral perfusion, exercise-induced desaturation or specific chronic conditions such as heart failure and systemic sclerosis. The forehead sensors demonstrated superior performance in terms of accuracy, consistency and resistance to artifacts caused by motion or vasoconstriction. With this review we want to emphasize the crucial role of nurses in selecting the most appropriate pulse oximeter based on the patient's condition and clinical context. So, all nurses must be able to identify critically ill patients, those undergoing physical activity or individuals with vascular impairments (in order to ensure accurate SpO2 measurements using forehead pulse oximeters). Conversely, finger pulse oximeters remain suitable for stable patients with normal perfusion and routine monitoring. Nurses, as primary providers of patient care, play a pivotal role in monitoring oxygen saturation and must be aware of the limitations and advantages of each device. Proper training in device selection, positioning and interpretation of readings is essential to optimize patient outcomes and avoid diagnostic errors. By integrating this knowledge into daily practice, nurses can significantly contribute to more accurate assessments and improved clinical decision-making.

Strengths and limitations of the study

This review has some limitations: first, only two databases were consulted; moreover, the studies included in this review enrolled small sample sizes, often limited to patients with different diseases; for example, the study by Seifi enrolled only 50 patients following coronary artery bypass surgery [16], the Kelly's study enrolled only 40 patients with stable heart failure [17] and the Elkjaer's study assessed only patients with systemic sclerosis [19]. For this reason, these studies did not use generalized data. In addition, Kelly [17] and Elkjaer's [19] studies have not used a standard clinical reference like a blood gas analysis, but they only compared the different sensors without being able to validate the accuracy of the measurements. The Robertson's study [18] used capillary blood gas (CBG) for validating Spo2 measurements, which is less accurate compared to Arterial Blood Gas, the gold standard for determining arterial oxygen saturation (Sa02). Finally, there are not many studies that have deal with this topic in the last ten years; for this reason, the review is limited to a small number of selected articles. As for the strengths, it can be noted that the research addresses a real-world clinical challenge frequently encountered in intensive care units, making to patient care and decision-making. Finally, although the exclusive inclusion of studies published in English may introduce a language bias, this decision was made to facilitate a more accessible and coherent review of the relevant literature, considering that a substantial proportion of high-quality evidence on the topic is published in English. By identifying the most reliable sensor placement under specific physiological conditions, the study offers guidance that could enhance monitoring accuracy and optimize clinical interventions.

This review, also, presents methodological limitations inherent to its narrative design. Specifically, the absence of a systematic methodology introduces a risk of subjective selection bias, as the inclusion of studies may be influenced by the reviewers' judgment. Furthermore, reproducibility is limited, and the review may not be exhaustive, potentially omitting relevant studies. These factors reduce the objectivity of the conclusions. Although a structured search strategy (PICO framework, selected databases, inclusion criteria) was applied, the narrative approach does not include a standardized critical appraisal of study quality, increasing the risk of bias.

CONCLUSION

This narrative review was conducted to describe the potential effectiveness of pulse oximetry saturation measurement using finger sensors versus forehead sensors, focusing exclusively on their reliability in various clinical conditions. This analysis aims to identify the most accurate method for SpO2 monitoring in nursing practice, particularly when addressing challenges related to peripheral perfusion and motion artifacts. The evidence suggests that, while finger pulse oximetry remains the standard in most scenarios, forehead sensors may provide more reliable readings in critically ill patients with compromised peripheral perfusion. This evidence underscores the need for nurses and healthcare providers to adapt their monitoring strategies to ensure accurate and timely oxygenation assessments, ultimately improving patient outcomes. Further research is recommended to validate these findings across diverse clinical settings and patient populations.

Funding statement

This research did not receive any specific grant from funding agencies in public, commercial or not for profit sectors.

Conflict of interest

The authors report no conflict of interest.

Authors' contribution

CR and AM were the major contributors in writing the manuscript. SC, and LA performed the data collection and interpreted the patient data. All authors read and approved the final manuscript.

REFERENCES

1. Checketts MR. AAGBI recommendations for standards of monitoring during anaesthesia and recovery 2015. Anaesthesia. 2016 Apr;71(4):470-1. doi: 10.1111/anae.13421. PMID: 26994537.
2. Merchant R, Chartrand D, Dain S, Dobson J, Kurrek M, LeDez K, Morgan P, Shukla R; Canadian Anesthesiologists' Society. Guidelines to the Practice of Anesthesia Revised Edition 2012. Can J Anaesth. 2012 Jan;59(1):63-102. English, French. doi: 10.1007/s12630-011-9609-0. PMID: 22183296.
3. Nitzan M, Romem A, Koppel R. Pulse oximetry: fundamentals and technology update. Med Devices (Auckl). 2014 Jul 8;7:231-9. doi: 10.2147/MDER.S47319. PMID: 25031547; PMCID: PMC4099100.
4. Taenzer AH, Pyke JB, McGrath SP, Blike GT. Impact of pulse oximetry surveillance on rescue events and intensive care unit transfers: a before-and-after concurrence study. Anesthesiology. 2010 Feb;112(2):282-7. doi: 10.1097/ALN.0b013e3181ca7a9b. Erratum in: Anesthesiology. 2020 Mar;132(3):602. doi: 10.1097/ALN.0000000000003091. PMID: 20098128.
5. Agashe GS, Coakley J, Mannheimer PD. Forehead pulse oximetry: Headband use helps alleviate false low readings likely related to venous pulsation artifact. Anesthesiology. 2006 Dec;105(6):1111-6. doi: 10.1097/00000542-200612000-00010. PMID: 17122573.
6. Kiruthiga, A.; Annamol, A.; Balamugesh, T.; Dinesh Prabhu, R.; Christopher, D.J.; Preejith, S.P.; Jayaraj, J.; Mohanasankar, S. Reflectance Pulse Oximetry for Blood Oxygen Saturation Measurement from Diverse Locations-A Preliminary Analysis. In Proceedings of the 2018 IEEE International Symposium on Medical Measurements and Applications (MeMeA), Rome, Italy, 11–13 June 2018; pp. 1–6. doi: 10.1109/MeMeA.2018.8438781.
7. Torp KD, Modi P, Pollard EJ, Simon LV. Pulse Oximetry. 2023 Jul 30. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2025 Jan–. PMID: 29262014. Bookshelf ID: NBK470348
8. Chan ED, Chan MM, Chan MM. Pulse oximetry: understanding its basic principles facilitates

appreciation of its limitations. Respir Med. 2013 Jun;107(6):789-99. doi: 10.1016/j.rmed.2013.02.004. Epub 2013 Mar 13. PMID: 23490227.

9. Tusman G, Bohm SH, Suarez-Sipmann F. Advanced Uses of Pulse Oximetry for Monitoring Mechanically Ventilated Patients. Anesth Analg. 2017 Jan;124(1):62-71. doi: 10.1213/ANE.0000000000001283. PMID: 27183375.
10. Ginosar Y, Weiniger CF, Meroz Y, Kurz V, Bdolah-Abram T, Babchenko A, Nitzan M, Davidson EM. Pulse oximeter perfusion index as an early indicator of sympathectomy after epidural anesthesia. Acta Anaesthesiol Scand. 2009 Sep;53(8):1018-26. doi: 10.1111/j.1399-6576.2009.01968.x. Epub 2009 Apr 24. PMID: 19397502.
11. Hakverdioğlu Yönt G, Akin Korhan E, Dizer B. The effect of nail polish on pulse oximetry readings. Intensive Crit Care Nurs. 2014 Apr;30(2):111-5. doi: 10.1016/j.iccn.2013.08.003. Epub 2013 Sep 17. PMID: 24054173.
12. Yek JLJ, Abdullah HR, Goh JPS, Chan YW. The effects of gel-based manicure on pulse oximetry. Singapore Med J. 2019 Aug;60(8):432-435. doi: 10.11622/smedj.2019031. Epub 2019 Mar 11. PMID: 30854571; PMCID: PMC6717771.
13. Longmore SK, Lui GY, Naik G, Breen PP, Jalaludin B, Gargiulo GD. A Comparison of Reflective Photoplethysmography for Detection of Heart Rate, Blood Oxygen Saturation, and Respiration Rate at Various Anatomical Locations. Sensors (Basel). 2019 Apr 19;19(8):1874. doi: 10.3390/s19081874. PMID: 31010184; PMCID: PMC6514840
14. Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. Health Inf Libr J 2009;26:91–108. https://doi.org/10.1111/j.1471-1842.2009.00848.x.
15. Baethge C, Goldbeck-Wood S, Mertens S. SANRA-a scale for the quality assessment of narrative review articles. Res Integr Peer Rev 2019;4:5. https://doi.org/10.1186/s41073-019-0064-8.

16. Seifi S, Khatony A, Moradi G, Abdi A, Najafi F. Accuracy of pulse oximetry in detection of oxygen saturation in patients admitted to the intensive care unit of heart surgery: comparison of finger, toe, forehead and earlobe probes. BMC Nurs. 2018 Apr 17;17:15. doi: 10.1186/s12912-018-0283-1. PMID: 29692684; PMCID: PMC5905124.

17. Robertson L, Lowry R, Sylvester K, Parfrey H, Moseley B, Sheares K, Oates K. Comparison of forehead and finger oximetry sensors during the six minute walk test. Chron Respir Dis. 2022 Jan-Dec;19:14799731211070844. doi: 10.1177/14799731211070844. PMID: 35045761; PMCID: PMC8796114.

18. Kelly KL, Carlson AR, Allison TG, Johnson BD. A comparison of finger and forehead pulse oximeters in heart failure patients during maximal exercise. Heart Lung. 2020 May-Jun;49(3):259-264. doi: 10.1016/j.hrtlng.2019.10.012. Epub 2019 Nov 14. PMID: 31735457; PMCID: PMC7220844.

19. Elkjær AL, Næser EU, Aaen KT, Hovgaard HL, Juhl-Olsen P, Bendstrup E, Søndergaard K. Validity and reliability of measurement of peripheral oxygen saturation during the 6-Minute Walk Test in patients with systemic sclerosis. Rheumatol Int. 2024 Apr;44(4):611-620. doi: 10.1007/s00296-024-05532-5. Epub 2024 Feb 10. PMID: 38340159; PMCID: PMC10914912.